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VARGA,S.A. Operating Reactors Branch 1

SUBJECT: Responds to concerns re spurious operation of high-low pressure interface valves due to fire,per 850327 meeting & 840808 SER re alternate safe shutdown capability.Replacement pages for util 840206 submittal encl,for inclusion in SER.

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SERIAL: NLS-85-140

JUN 18 1985

Director of Nuclear Reactor Regulation
Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
United States Nuclear Regulatory Commission
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
APPENDIX R - ALTERNATE SHUTDOWN CAPABILITY
OPEN ITEM RESOLUTION AND ADDITIONAL CLARIFICATION

Dear Mr. Varga:

On March 27, 1985, Carolina Power & Light Company (CP&L) met with NRC staff personnel to discuss resolution of the open item from the H. B. Robinson Steam Electric Plant Unit No. 2 (HBR2) Alternate Safe Shutdown Capability Safety Evaluation Report (SER) issued on August 8, 1984. This open item concerned spurious operation of the high-low pressure interface valves due to a postulated fire. Attachment 1 to this letter presents the resolution of this open item based upon the discussions held at the meeting. CP&L, therefore, considers this item to be closed and requests that the SER be revised accordingly.

Attachment 2 to this letter provides a list of clarifications concerning the HBR2 Alternate Shutdown Capability. These clarifications are reflected in replacement pages to our February 6, 1984 submittal included as Attachment 3. Vertical change bars in the right hand margin indicate where these replacement pages have been affected. These changes are the result of refinements to the shutdown method and changes in plant procedures and do not affect the conclusions reached in the August 8, 1984 SER. CP&L requests that these changes be included in the revised SER.

Should you have any questions concerning the information in this letter, please contact Mr. Patrick P. Carier at (919) 836-8165.

Yours very truly,

A. B. Cutter - Vice President
Nuclear Engineering & Licensing

PPC/pgp (1403PPC)

Attachments

cc: Dr. J. Nelson Grace (NRC-RII)
Mr. G. Requa (NRC)
Mr. H. Krug (NRC Resident Inspector - RNP)

A006
1/1

ATTACHMENT 1

RESOLUTION OF HIGH-LOW PRESSURE

INTERFACE SPURIOUS OPERATION

The August 8, 1984 Safety Evaluation Report (SER) on alternative shutdown documented the issue of spurious operation of high-low pressure interface valves as an unresolved open item. The Staff was concerned with CP&L's methodology used to prevent or terminate the spurious operation of the following valves: 1) letdown system isolation valves, 2) Residual Heat Removal (RHR) suction valves, 3) reactor head vent solenoid valves, 4) pressurizer vent solenoid valves, 5) the pressurizer power-operated relief valves (PORVs). Specifically, the NRC was concerned that the actions being taken were not adequate to mitigate the spurious operation of the high-low pressure interface valves.

CP&L committed to resolve this issue to the satisfaction of the Staff during a July 5, 1984 telephone conversation. Based on this commitment, CP&L undertook a re-analysis of each high-low pressure boundary. The analysis identified the minimum combination of electrical circuit faults that would be required to breach a high-low pressure boundary. The analysis considered the pre-fire and/or post-fire actions being proposed by CP&L to prevent or mitigate the spurious operation of the redundant boundary components. The results of the analysis were presented to the NRC Staff at a March 27, 1985 meeting. The analysis showed that it would take a minimum of three cable to cable hot shorts to spuriously align a flow path for the following high-low pressure interfaces: 1) letdown system, 2) RHR system, 3) reactor vessel head vent, 4) pressurizer head vent. Based on the extremely low probability of three cable to cable hot shorts occurring simultaneously, the Staff agreed that the pre-fire and/or post-fire circuit de-energizations being proposed would be sufficient to prevent or mitigate a breach of the high-low pressure interfaces for the four systems discussed above.

The analysis identified cables where a combination of two external hot shorts could cause spurious operation. These cables were associated with the pressurizer PORVs. There is an extremely low likelihood that two external hot shorts could occur independent of other circuit faults causing a spurious operation. To further reduce the probability of spurious operation, post-fire operator actions will deenergize the majority of the DC power sources. This will provide reasonable assurance that external DC sources of power will not be available to energize the pressurizer PORVs should the cable insulation degrade as a result of a fire. Therefore, spurious operation of the valves is effectively prevented or mitigated since the PORVs must be energized to open.

Based on the discussions in our meeting of March 27, 1985 and the information provided herein, CP&L considers the open item in the August 8, 1984 SER to be resolved.

ATTACHMENT 2

SUMMARY OF CLARIFICATIONS

TO FEBRUARY 6, 1984 SUBMITTAL

Revisions to the February 6, 1984 submittal on Alternate Shutdown Capability have been made in the following areas:

1. References to specific HBR2 operating procedures have been deleted, since individual procedures have been replaced by the Emergency Operating Procedure Network.

2. The natural circulation cooldown scenario has been changed to reflect revised natural circulation cooldown procedural requirements.

3. RHR post-fire actions have been changed to reflect repair to both RHR flow control valves, and repair to RHR heat exchanger inlet temperature only.

4. A statement has been added to Section 1 to allow operator responsibility t be governed by plant procedures.

5. Service Water Pump D has been added to the list of components controlled from the Dedicated Shutdown local panels.

6. Control of charging flow has been changed to manually control the charging flow rate.

7. Isolation/depressurization of instrument air has been deleted as a means of terminating spurious operations. Such operations will be terminated by de-energizing the affected components.

8. A description of Alternate Train B shutdown methodology has been added. This alternate shutdown method utilizes Control Room actions and a reduced set of normal safe shutdown components.

ATTACHMENT 3

REPLACEMENT PAGES TO

FEBRUARY 6, 1984 SUBMITTAL

- o Indication and control for associated instruments, monitors, and valves required for safe shutdown and protection against spurious actuation

In lieu of these modifications, post-fire procedures will be developed to assure the timely availability of the equipment necessary to achieve safe shutdown. Outlines of these procedures are presented in this submittal and identified as substitutes for previously proposed equipment modifications.

1.3 Methodology

The methodology employed herein is based on a task analysis of the operations and repairs which need to be accomplished by on-site personnel in order to achieve safe shutdown. The definitions, assumptions, and requirements described in Appendix B are used to assure that the manpower and time is available to perform the required procedural steps necessary to fulfill the requisite safety functions. Safe shutdown timelines have been developed to ensure that the procedural steps identified herein are achievable within the required time frame using available staffing. Only in such cases can a post-fire procedure be used as substitute for a previously proposed modification.

The basic shutdown process for a fire in one of the critical areas of the plant (see Section 3.3) is detailed in Sections 2 and 3. Fires in these areas would require the use of distributed control locations, manual operations, and dedicated shutdown equipment. Safe shutdown for these areas uses designated alternate train A equipment. The operation's response to fires in those areas which contain the dedicated shutdown equipment will be to use alternate train B equipment. This consists of

achieving safe shutdown from the Control Room using a subset of the normal shutdown equipment. The achievement of safe shutdown from the Control Room is designated alternate train B because of the reduced amount of equipment credited with achieving safe shutdown versus the equipment used for a normal reactor plant shutdown and cooldown. Because of the increased complexity and constraints of achieving safe shutdown independent of the Control Room, the alternate train A methodology is presented in this report.

Assuming an unmitigated fire in any plant area, a basic fire scenario was developed for the purpose of determining initial manpower loading and the timing of the fire-induced plant transient.

For the remainder of this submittal, the tasks assigned to specific operators are only meant to show that it is possible to achieve hot shutdown with available operators. As the plant specific procedures are developed, tasks may be reassigned among the available operators as more efficient ways to utilize them become apparent. The plant approved procedures will govern the final assignment of tasks to the operators. This scenario is outlined below:

It is postulated that within the first minute of fire initiation the plant fire detection system will activate the area alarms and give indication in the Control Room. On receiving the alarm, the operators will dispatch the fire brigade to investigate and will sound the appropriate plant general alarm. With the assumption of a severe fire in any single fire area, the operators will shut down the reactor and secure steam flow to the turbines. The appropriate actions prescribed in the HBR-2 Emergency Operating Procedures will be followed.

Once the fire has been extinguished, the three operators assigned to the fire brigade will be available to assist in operation of the safe shutdown systems. The Fire Protection Technical Aid and the Unit One Operator assigned to the Fire Brigade cannot be used for post-fire operation of safe shutdown equipment. They will be used for post-fire surveillance activities. There will be a hold period during which the operators can assess the damage caused by the fire, as it is assumed the fire fighting effort will be completed approximately one hour after initiation of the fire. Based on the operators' assessment, various systems may be checked for operability and re-energized to support reactor plant cooldown. Even though some

REFERENCES

SECTION 1

(1) "Safe Shutdown Capability Assessment and Proposed Modifications, 10 CFR 50, Appendix R - Section III.G and III.L, H.B. Robinson Unit No. 2," Carolina Power and Light Company, Raleigh, NC, March 1982.

immediately following a fire during which hot standby is achieved in 50 minutes. Three operators are needed to energize and control hot shutdown equipment from the dedicated shutdown stations. Figure 2-2 shows the overall period beginning with initiation of the fire to completion of cold shutdown in less than the required 72 hours. The number of operators is increased to ten to direct post-fire repairs following achievement of hot standby. Table 2-2 lists the manpower requirements by operator station and task during the transition from normal operation to cold shutdown. A detailed description of the operation of dedicated/alternative shutdown systems is included in Section 3.

2.1 Actions Required to Achieve Hot Shutdown

It is postulated that within the first minute of fire initiation the plant fire detection system will activate the area alarms and give indication in the Control Room. On receiving the alarm, the operators will dispatch the fire brigade to investigate and will sound the appropriate plant general alarm. With the assumption of a severe fire in any of the critical fire areas (listed in Section 3.3), the operators will shut down the reactor and secure steam flow to the turbine. The appropriate actions prescribed in the HBR-2 Emergency Operating Procedures will be followed.

Federal Regulation 10 CFR 50 Appendix R Section III.L.3 requires the alternative shutdown capability to accommodate post-fire conditions where off-site power is not available for 72 hours and where off-site power is available. In order to maintain the conservatism of the manpower/timeline analysis the worst case associated with the unavailability of off-site power for 72 hours is considered. Off-site power is, therefore, assumed lost within the first minute of the fire, and it is further assumed that the fire has precluded use of the station diesel generators to supply power to the emergency buses. This will necessitate the starting of the dedicated shutdown diesel generator.

Operator A

Subsequent to detection of fire and receiving alarm, the shift foreman on hand will station himself in the most central control area available, determine the magnitude of the fire and decide on the appropriate response. Based on the "worst case" fire scenario, this response will require the manning of the dedicated shutdown panels located in the Charging Pump Room and on the Turbine Deck. In addition to manning these stations, the operators will be sent to different plant areas to perform specific actions.

Operator A will be in charge of coordinating the safe shutdown activities. As a contingency against potential spurious operations, Operator A may relieve Operator C at the Turbine Deck Panel in order to have Operator C reestablish service water flow.

Operator B

Prior to DS power lineup to MCC-5, Operator B will isolate the outlet of the RWST. This will prevent potential spurious operations from depleting the RWST inventory.

After the DS bus is energized, Operator B will proceed to the switching panel in the Auxiliary Building to transfer the control for the following components to the Turbine Deck panel:

Auxiliary Building Switching Panel Alignment

	Component	Function
(1)	Steam-Driven Auxiliary Feedwater Pump Valve V1-8A	Supply steam to steam-driven auxiliary feed-water pump turbine
(2)	Steam-Driven Auxiliary Feedwater Pump Valve V2-14A	Supply feedwater to steam generator A

The same operator will then transfer the power for service water pump D to the DS bus, transfer power for MCC-5 from bus E1 to the DS bus, and transfer power for service water pump D discharge valve V6-12D from MCC-6 to MCC-5. As a result of these operator actions the following components can now be controlled from the dedicated shutdown panel.

Components Which Can Now Be Controlled
From The Dedicated Shutdown Panels

Component	Function
(1) Charging pump A	Supplies reactor coolant makeup and reactor coolant pump seal water.
(2) Component cooling pump A	Supplies cooling to reactor components.
(3) Service water pump D	Supplies cooling water to CCW heat exchangers
(4) Service water valve V6-12D	Service water header isolation valve
(5) Auxiliary feedwater pump valves V1-8A and V2-14A	Supply feedwater to SG-A

In the event of a fire at MCC-5, valves V1-8A and V2-14A will be manually operated by Operator C. Valve V6-12D will be operated manually by Operator C if required. Following the above activities, Operator B will proceed to the Charging Pump Room. Taking local control of component cooling water pump A, the operator will reinstate component cooling flow. This action is required to minimize the potential for damage to reactor coolant pump seals. Service water flow and charging water flow will also be initiated from the Charging Pump Room control panel.

Operator C

Operator C proceeds to the DS diesel generator control panel in the 4kV Switchgear Room and starts the DS diesel. The

When the necessary repairs have been completed, cooldown of the reactor plant can begin. A maximum number of ten operators will be needed to achieve cold shutdown. (Operator manpower loading requirements are shown on the bottom of Figure 2-2.) The activities will be directed through a senior operator stationed in the most central control area available. In the event of a fire in the Control Room, the senior operator will be stationed at the 4kV Switchgear Room or the Turbine Deck panel. Communications via intercom and radio will be established in order to coordinate functions during the cooldown.

If the second Charging Pump Room operator listed in Table 2-2 (one of the operators released from fire brigade) is not available to control the reactor coolant make-up rate, then the operator assigned to the Charging Pump Room control panel would perform this function. Cooldown and charging functions must be coordinated to maintain a constant pressurizer level and to maintain primary pressure within the plant operational curves. Cooldown will be initiated using steam generator A PORV. Natural circulation and the cooldown rate will be monitored by loop A T_{cold} and T_{hot} temperature indication at the Charging Pump Room control panel to ensure the required cooldown rates are not exceeded.

A manual valve lineup will align steam generators B and C to the steam-driven auxiliary feedwater pump turbine via valves V1-8B and V1-8C, when required. Feedwater to steam generator A will be controlled from the Turbine Deck control panel. Feedwater to

steam generators B and C will be controlled by manual operation of valves V2-14B and V2-14C. Steam generators B and C should be alternately steamed at routine intervals as necessary to minimize temperature differences in the primary while maintaining their respective temperatures slightly above that of steam generator A. The sequence of cooldown is presented in detail in Section 3.

During the cooldown, the necessary repair procedures and system lineups to support RHR system operation will be performed. This will allow entry into RHR cooldown once the specified plant conditions are satisfied. When the RHR system temperature requirement is satisfied, the RHR system will be placed in operation. Steam will continue to be drawn off the steam generators to cool down that portion of the primary coolant system not receiving RHR cooling flow. Cooldown will continue until reactor coolant temperature is below 200°F. Steam generator levels will be raised as high as possible prior to primary temperature being reduced below the point which provides adequate steam pressure to the steam-driven auxiliary feed water pump. This action will ensure adequate water inventory to complete steam generator cooldown prior to losing the capability of running the steam-driven auxiliary feed pump.

2.3 Safe Shutdown Timelines

The foregoing safe shutdown scenario was used to develop the post-fire timelines. One of the very first actions to be taken is to initiate feed water supply to the steam generators in sufficient time to avoid steam generator dryout. The immediate post-fire actions are detailed in Figure 2-1. This figure covers the critical period from the start of the fire to the achievement of a hot standby condition. Figure 2-2 illustrates the overall sequence of required operator actions leading to successful achievement of cold shutdown. The number of operators required is also provided. The details supporting the development of the timeline construction are listed in the corresponding "Figure Notes" shown on pages 2-18 through 2-20.

2.4 Associated Circuits

Generic Letter 81-12 and its subsequent clarification require the licensee to address the issue of associated circuits of concern. The associated circuits are divided into the general categories of common power supply, spurious actuation and common enclosure.

In the previous submittal[3], associated circuits were identified and resolved to meet the requirements. The new approach to alternate shutdown at H.B. Robinson resulted in deletion of a majority of the previously proposed modifications. Previously identified associated circuits of concern have been

TABLE 2-2
OPERATOR MANPOWER LOADING AVAILABLE FOR POST-FIRE OPERATIONS FROM START OF FIRE

Operator Stations		From / To	0 min / 10 min	10 min / 32 min	32 min / 1 hr	1 hr / 2 hr	2 hr / 6 hr	6 hr / 8 hr	8 hr / 11 hr	11 hr / 27 hr	27 hr / 34 hr	34 hr / 47 hr	47 hr / 67 hr
			Number of Operators Required — Time from Start of Fire										
Major Control Stations	Control Room (or Central Control Location if Control Room Evacuated)		1	1		1	1	1	2	2	2	2	2
	Charging Pump Room Control Panel			1	1	1	1	1	1	1	1	1	1
	Turbine Deck Control Panel				1	1	1	1	1	1	1	1	1
Intermediate Local Control Stations	Spurious Events	DC Control Circuits - Batt. Room		Control Room Oper.									
		Service Water V6-12D- Intake Structure			1								
		RWST Drain Path	1										
		Post-Fire Roving Surveillance				1	1	1					
	Equipment Control	D.S. Diesel Control Panel-4 kV Switchgear Room	1										
		Steam-Driven Auxiliary Feedwater Pump-Turbine Building		1			1	1	1	1	1	1	
		Charging Pump A-Charging Pump Room							1	1	1	1	1
		RHR Control - Outside RHR Room										2	2

TABLE 2-2
OPERATOR MANPOWER LOADING AVAILABLE FOR POST-FIRE OPERATIONS FROM START OF FIRE
(continued)

		Number of Operators Required Time from Start of Fire										
Operator Stations	From / To	0 min 10 min	10 min 32 min	32 min 1 hr	1 hr 2 hr	2 hr 6 hr	6 hr 8 hr	8 hr 11 hr	11 hr 27 hr	27 hr 34 hr	34 hr 47 hr	47 hr 67 hr
Post-Fire Repairs	Repairs Required for Cooldown (Turb. Bld.)						2					
	Repairs Required for Depressurization (DS Bus, Cable Vault, Containment							3				
	Repairs Required for RHR Cooldown (RHR Pit)								3			
Roving Operators	Assess Fire Damage - Plant Wide				2*	2*						
	Assist in Operation, Control and Repairs - Plant Wide					1	1	1	1	4	2	3
Total Operators Required		3	3	3	6	8	8	10	10	10	10	10

* Post-fire damage assessment will be performed by the Fire Protection Technical Aid and Operator from Unit One when released from the Fire Brigade.

CP&L

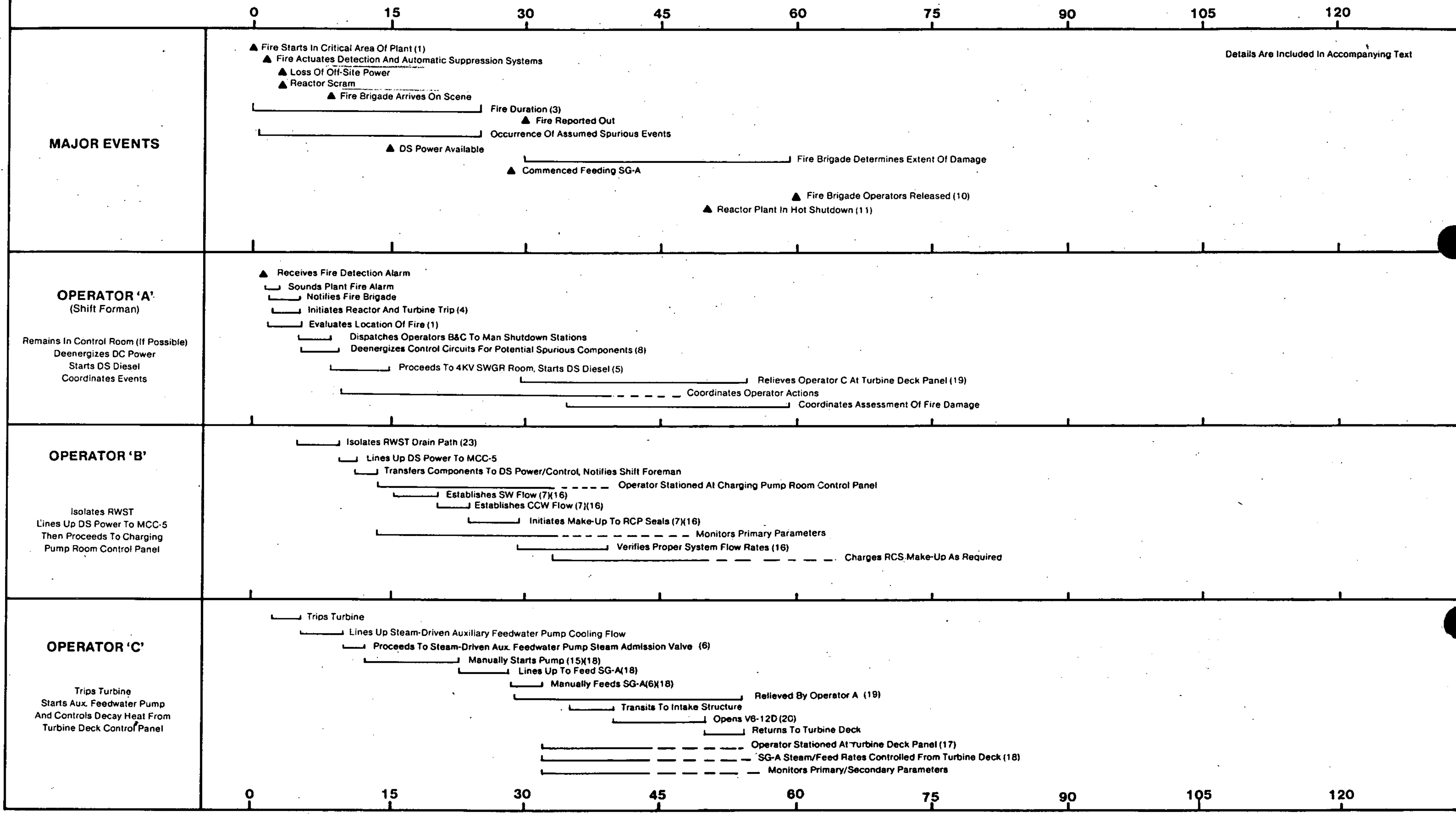
APRIL 1985

CAROLINA POWER AND LIGHT COMPANY

H. B. Robinson Steam And Electric Plant - Unit No. 2

Figure 2-1. Post-Fire Operator Actions Required to Achieve Safe Hot Shutdown

(Time In Minutes)



84-0125/P038

FIGURE NOTES
POST-FIRE PROCEDURE TIMELINE DETAILS

1. Details of fire location and duration are in accordance with Sections 1 and 3.

2. Operators in the Control Room receive fire alarm. Fire brigade is notified and plant fire alarm sounded.

3. The expected fire duration is 25 minutes.

4. Due to the severity of a fire in any of the fire zones listed in Section 3.3, it is expected the operators would manually trip the reactor and the turbine. The appropriate actions of the Emergency Operating Procedures would be carried out.

5. Because of the loss of all on-site and off-site power, it is imperative that the DS diesel be started immediately.

6. Feedwater flow should be initiated within approximately 30 minutes to avoid steam generator dryout. This is a conservative estimate based on NUREG 0611[4] which calculates an SG dryout time from a steam generator low level trip.

7. CVCS and CCW flow should be re-initiated as soon as possible to prevent damage to reactor coolant pump seals, and to provide cooling flow to components. Service water flow will be verified by service water discharge pressure on suction side of service water booster pumps in Auxiliary Building Hallway.

8. Isolation of spurious events will be handled in two phases. The first phase will be to stop those spurious events which have occurred and are deleterious to achieving safe hot shutdown. The second phase will be to perform those operations which are required to remove spurious operations which are allowable for a limited period of time. For a detailed explanation of the operations intended to prevent spurious operations, see Section 3.

9. When the fire has been extinguished and sufficient operators are available, those circuits which have not been damaged by the fire will be checked for proper operation and re-energized.

10. When the fire brigade is released from its fire fighting responsibility, three additional operators become available to assist in operating the dedicated shutdown system.

11. The reactor plant is in safe hot shutdown condition when the plant achieves and maintains the following:

    o The reactor is subcritical;

    o The reactor coolant inventory is such that pressurizer level is within the indicating range;

    o The reactor heat removal function is capable of removing the decay heat being generated;and

    o The process monitoring functions are capable of providing direct readings of the process variables necessary to perform and control the above functions.

12. The cooldown scenario details are in accordance with Section 3.1(7).

13. RHR repair and operation procedures are detailed in Section 3.

14. Fill steam generators to the top of the indicating range. This should be accomplished prior to reducing the temperature below that which corresponds to an adequate steam pressure to operate the steam-driven auxiliary feedwater pump.

15. Align auxiliary feed pump oil cooler flow to pump discharge until service water flow is available.

16. If service water or component cooling water flow cannot be verified, then secure the charging and CCW pumps until adequate cooling flows can be established.

17. Steam generator A feedwater flow will be controlled by local manual operation of V2-14A until DS power is available. At this time, control may be transferred to the Turbine Deck control panel.

18. If MCC-5 is not damaged by the fire, then the steam-driven auxiliary feed water pump would be started and the steam generator feed control will be performed from the Turbine Deck Panel once MCC-5 is energized from the DS bus.

REFERENCES

SECTION 2

(1) Memorandum to Mr. R.H. Vollmer from Dr. R.J. Mattson, Subject: "Position Statement on Allowable Repairs for Alternative Shutdown and on the Appendix R Requirement for Time Required to Achieve Cold Shutdown," dated July 2, 1982.

(2) Technical Specifications and Bases for H.B. Robinson Unit No. 2, Carolina Power & Light Company, Darlington County, S.C., Docket No. 50-261, October 1978.

(3) "Safe Shutdown Capability Assessment and Proposed Modifications, 10 CFR 50, Appendix R, Section III.G and III.L, H.B. Robinson Unit No. 2," Carolina Power and Light Company, Raleigh, NC, March 1982.

(4) Nuclear Regulatory Commission, "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents in Westinghouse-Designed Operating Plants," NUREG-0611, January 1980.

- Transfer charging pump control to local control.
- Manually shut valve LCV-115C and open valve 358 manually to align RWST to charging pump A suction.
- Manually shut the reactor coolant pump seal injection isolation valves CVC-297A, B and C to prevent thermal shock to the reactor coolant pump seals.
- Manually shut valves 202A and 202B and open 309A to provide a charging flow path to the Reactor Coolant System.
- Start charging pump A. Slowly open reactor coolant pump seal injection isolation valves to reestablish seal cooling.
- Manually control charging flow as necessary to maintain adequate pressurizer level.

(2) Operation of Component Cooling Water System

To supply component cooling water to the required components, the following activities must take place:

- Ensure DS bus is energized to supply power to component cooling pump A.
- Transfer control of component cooling pump A to local control at the charging pump control panel.
- Start the component cooling pump if not already running.
- Verify flow to components.

(3) Operation of Service Water System

To supply service water cooling to required components, the following activities are required:

- Ensure DS bus is energized to provide power to service water pump D.
- Transfer control for V6-12D to the dedicated shutdown panel in the Charging Pump Room, and transfer power from MCC-6 to MCC-5.
- Transfer the power supply for service water pump D from bus E2 to the DS bus. This will also transfer control to the Charging Pump Room control panel.
- Start service water pump D and check open V6-12D.

(4) Operation of Main Steam and Auxiliary Feedwater Systems

To remove decay heat from the reactor coolant system via steam generator A, the following activities will be performed:

- o Ensure DS bus is energized.
- o Transfer control of V1-8A and V2-14A to local control on the Turbine Deck.
- o Transfer control of steam generator PORVs to local control on the Turbine Deck.
- o If instrument air to the steam generator PORVs has been disabled, automatic operation of the safety valves would be sufficient to remove the decay heat during hot standby until the long term nitrogen supply can be connected for cooldown.
- o Supply cooling water to the steam-driven auxiliary feedwater pump oil cooler from the discharge of the pump.
- o Open V1-8A to supply steam to the steam-driven auxiliary feed pump.
- o Throttle open V2-14A to supply feedwater to steam generator A, using valve controls and steam generator level indications on the Turbine Deck Panel.

  Note: If instrument air is lost to the pump discharge pressure controller, control flow by manually throttling the feedwater discharge valve (V2-14A).
- o Steam-driven auxiliary feed pump suction is normally aligned to the condensate storage tank (CST). If CST inventory is exhausted, manually open AFW-24 and SW-118 to align service water to the pump suction.
- o During hot standby the system pressure is controlled by steam generator A PORV or automatic operation of safety valves in the absence of instrument air.

(5) Operation of Residual Heat Removal System

In order to line up and place the RHR system in operation, the following activities must take place:

- o Initiate repairs to damaged components as necessary to regain system operation:
  - Install temporary RHR pump motor power cables.
  - Provide a temporary self contained ventilating unit for cooling the RHR pit area.
  - Install mechanical D/P gauge across FE-605 flow transmitter. Place the gauge outside radiation area.
  - Install the portable temperature monitor leads to monitor reactor coolant temperature at the inlet to the RHR heat exchanger.
  - Connect the nitrogen supply with regulator to provide remote operation of RHR flow control valves HCV-758 and FCV-605.
- o Manually shut valves 862A and 862B.
- o Slowly open valves 750 and 751 manually to pressurize the RHR system.
- o Manually shut valve 764 and open valve 605 and then start RHR pump to warm up system.
- o Verify adequate RHR system temperature.
- o Manually open valves 744A and 744B.
- o Throttle open valve HCV-758. Control flow rate and cooldown rate by repositioning flow control valves HCV-758 and FCV-605 using remote nitrogen pressurization supply.

(6) Operations to Control Spurious Events

Spurious operations caused by fire-induced associated circuit damage must be prevented. Any components or cabling exposed to a fire are susceptible to damage in that fire area. This damage, in the form of hot shorts, shorts to ground, or spurious control signals, could cause unwanted and unexpected operation of components. These spurious

- Prevent the spurious operation of the letdown flow high/low pressure boundary valves.

The specific valves affected are listed in Table 3-1a. The post-fire safe shutdown system has been designed to remain operable without instrument air. This has been taken as a conservative approach. If instrument air is lost throughout the plant, then the system responses listed in Table 3-1b will occur. The last column of Table 3-1b includes operator actions which may be taken to overcome the loss of system function.

- De-energize Major Buses

  With the loss of off-site power occurring during the post-fire scenario, all 4kV and 480V buses will be de-energized. Depending on the location of the fire, it is possible that the emergency diesel generators will be disabled. Even if the site emergency diesels can be started, these should be secured along with the E1 and E2 buses once the dedicated shutdown diesel has been started. This action is recommended to mitigate the occurrence of a severe fire in one of the locations listed in Section 3.3. A fire in one of these areas will affect most of the reactor plant's power and control circuits. By securing all emergency 480V power to the E1 and E2 buses, the spurious operation of electrical switchgear and the electrical hazards of fighting the fire will be minimized.

- Prevent Spurious Operation of RHR Valves

  To prevent the inadvertent draining of the refueling water storage tank (RWST) through spurious operation of the containment sump valves 860A and 861A or 860B and 861B, the drain path will be isolated by post-fire operator action. Analysis has confirmed that because of the large water inventory in the RWST and the relatively low-leakage hydraulic head, the spurious opening of these motor-operated valves, for a limited period of time, will not present a problem to reactor

plant cooldown. One of the RHR system inlet valves, RHR-750 or RHR-751 will be prevented from spurious operation by electrical disconnection from its power supply prior to power operation. This will be ensured by a station breaker tagout. Spurious operation of the reactor vessel and pressurizer vessel vents V-567 through V-570 will be prevented from spurious operation in a similar manner (see discussion in Appendix A).

- o Prevent Spurious Operation of Pressurizer PORVs

  Pressurizer PORV 125V dc circuits will be de-energized early in the fire scenario. The PORVs are not required during hot shutdown, so these may be de-energized to prevent spurious operation. Once the fire is extinguished, the PORVs will be re-energized and checked for proper operation. If the control cables were damaged by the fire, the necessary repairs will be instituted if operation of pressurizer PORVs is needed to expedite the cooldown.

(7) Operation of Systems to Cooldown the Reactor Plant:

This procedure outline has been developed from the H.B. Robinson Plant operating procedures for temperature and pressure control using natural circulation. The following sequence of events will be required to cooldown the reactor plant to the cold shutdown condition:

- o Line up to charge makeup water to the reactor coolant system to compensate for contraction during cooldown.
- o Commence cooldown by releasing steam from steam generator A using the PORV. Verify natural circulation by check of (T_{hot} -T_{cold}) temperature differential. Do not exceed the cooldown rate limits.
- o Alternately release steam from steam generators B and C to equalize reactor coolant system temperatures, while maintaining their temperature slightly above steam generator A. Use steam generator pressure to compare temperatures between the respective loops.

- Maintain reactor coolant system pressure greater than 1900 psi by charging to the reactor coolant system. Establish 150^{o}F subcooling between loop-A T_{hot} and pressurizer temperature (based on system pressure). Duration: 6 to 8 hours.

- Block out safety injection signals prior to decreasing primary system pressure below 1,900 psi.

- Allow pressure to decrease from 1900 psi to 1000 psi by natural heat loss from the pressurizer, while cooling down to 350^{o}F. Maintain 190^{o}F subcooling between loop A T_{hot} and pressurizer temperature. Duration: 3 to 4 hours.

- When a T_{hot} temperature of 350^{o}F is reached in loop A, commence an eleven-hour hold period. This is to allow the reactor vessel upper head region to cool down below the associated saturation temperature. Pressure should be controlled such that it does not decrease below 1000 psi until completion of the eleven-hour hold period. Continue to remove the decay heat generated during this period to maintain temperature near 350^{o}F. Duration: 11 hours.

- Decrease system pressure from 1000 psi to 375 psi. Align and warm up RHR system.

- Continue cooldown with RHR system as described previously. (See Section 3.1, item 5.)

3.2 Post-Fire Repair and Equipment Summary

When post-fire repair is utilized to ensure equipment operability for achieving cold shutdown, 10 CFR 50 Appendix R requires that "material for such repairs shall be readily available and procedures shall be in effect to implement such repairs.[1]" Several of the previously proposed modifications listed in Table 3-2 are being replaced by post-fire repair procedures. In order to comply with the requirements of Appendix R, the following procedures, materials, and system interface connections will be prepared:

(1) The "spare" breaker cubicle on the DS bus will be modified to provide a post-fire power supply for the RHR pump motor. The unit in the cubicle will be changed to one of 500 amps capacity. Necessary procedures to detail the post-fire repair for fire damage to RHR pump motor cabling will be developed. This will require pre-fire preparation of a temporary cable made up with proper terminations and stored on-site.

(2) Procedures and materials will be developed to utilize the existing RHR flow transmitter (FT-605) instrument piping to allow the post-fire connection of a mechanical differential pressure gauge. The gauge will be connected to the instrument piping in the event of fire damage to the electrical cables for the normal instrument. Interconnecting tubing will allow for placement of the differential pressure gauge outside the RHR system radiation area.

(3) Post-fire repair procedures and materials will be developed to utilize the existing instrument air piping to RHR flow control valves HCV-758 and FCV-605 for the post-fire connection of a nitrogen tank. This nitrogen supply will be provided with a pressure regulator to control opening and closing of the valves, to allow RHR system warm-up, and to control RHR flow during reactor cooldown below 350^{o}F. This post-fire installation will be used in the event that instrument air or valve control power is not available. The repair equipment will be designed to allow control of HCV-758 and FCV-605 from outside the RHR system radiation area.

(4) Procedures and portable instrumentation necessary to measure the temperature of reactor coolant flowing through the RHR system will be prepared. A portable temperature monitoring device, cables, and temperature sensors will be utilized in a post-fire repair situation to monitor RHR inlet temperatures, and RCS cooldown rate. The equipment will be designed to allow monitoring of temperature from outside the RHR system radiation area.

(5) The steam generator PORV backup supply to instrument air will consist of a long-term supply which will have a capacity large enough to operate the PORVs for cooldown. Automatic operation of the steam generator safety valves is adequate for the decay heat removal during hot standby. A post-fire repair will be used to connect the long-term supply. This will consist of a high pressure hose with suitable connections to connect the PORVs to the station nitrogen system to provide the necessary capacity to ensure PORV operation throughout the reactor plant cooldown.

(6) The post-fire procedure and materials necessary to provide power and control for pressurizer PORVs will be developed. This will be used to provide post-fire PORV operation, if required during cooldown, to reduce primary system pressure. The system will take advantage of the currently installed nitrogen back-up

TABLE 3-1a

Effects of Deenergizing DC Power to

Air-Operated Components Inside Containment

System	Component	Failed Position	Effect
CVCS Letdown	460A	closed	Secures letdown flow
	460B	closed	Secures letdown flow
	200A	closed	Secures letdown flow
	200B	closed	Secures letdown flow
	200C	closed	Secures letdown flow
CVCS Charging	310A	open	Aligns charging loop A
	310B	open	Aligns charging loop B
	311	shut	Secures aux. spray flow

TABLE 3-1b

System Response to Total, Station-wide Loss of Instrument Air

System	Function	Effect of Loss of Instrument Air	Comments
CVCS	Letdown	Secures system flow	Not required during post-fire hot shutdown or cooldown
CVCS	Charging pump discharge	Aligns charging path to loops A and B	Required lineup for hot shutdown and cooldown. Manually position valves to control flow
CVCS	Charging pump	Fails to full speed	Manually control charging flow rate
CVCS	Charging pump suction	Secures normal flow path	Manually align pump suction to RWST
CVCS	Auxiliary Spray	Secures spray flow	Not needed for post-fire hot shutdown or cooldown
RHR	Flow control	Loss of flow control	Post-fire repair will regain flow control
Steam-Driven Auxiliary Feedwater Pump	Supplies feedwater to steam generator	Flow control will fail	Manually throttle pump steam supply and feed-water discharge valve
Pressurizer PORV	Primary system over-pressure control	Loss of automatic and manual operation	PORVs have installed backup nitrogen supply. This supply is normally isolated during plant operation and will have to be manually aligned.

TABLE 3-3b

ADDITIONAL APPENDIX R MODIFICATIONS REQUIRED BY REVISED APPROACH

* Modification of the spare breaker cubicle on the dedicated shutdown 480V bus for RHR pump cable post-fire repair.
* Install suitable system connections to facilitate the post-fire installation of:
  - Mechanical differential pressure gauge to monitor the differential pressure across FE 605 and provide indication of RHR system flow.
  - Temporary nitrogen supply to the instrument air piping for RHR-FCV-605 and HCV-758 to control opening and closing of the air-operated valves for RHR flow control.
  - Temporary hose connection from the station nitrogen system to the steam generator PORVs to provide the motive force for valve operation during reactor plant cooldown.

NOTE: These modifications may be extensive. However, this will not be known until detailed design is completed.

REFERENCES

SECTION 3

(1) 10 CFR 50, Appendix R.

Purpose:

Required For __X__ Hot Standby ____ Cold Shutdown

The purpose of the temperature monitor was to provide indication of flow through the relief valve 203. Flow through the letdown relief valve could be caused by either improper operation of the letdown system inlet valves or fire-induced spurious operation of these valves.

Discussion:

The use of the letdown system during cooldown has been eliminated by substituting the use of pressurizer ambient heat losses in place of the auxiliary spray function in order to decrease primary system pressure, and the use of the RWST for boration. The letdown isolation valves (460A and 460B) will be closed early in the fire scenario by deenergizing dc power. This will secure letdown flow and prevent any over-pressurization of the letdown system inlet piping, thereby precluding relief valve 203 from lifting. Indication of this operation is not required since spurious actuation will be prevented.