UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

February 28, 1992

NRC INFORMATION NOTICE 92-18: POTENTIAL FOR LOSS OF REMOTE SHUTDOWN CAPABILITY DURING A CONTROL ROOM FIRE

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to conditions found at several reactors that could result in the loss of capability to maintain the reactor in a safe shutdown condition in the unlikely event that a control room fire forced reactor operators to evacuate the control room. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On July 26, 1991, the Washington Public Power Supply System, the licensee for Unit 2 at the Washington Nuclear Plant (WNP-2), discovered an unanalyzed condition regarding fire protection and the safe shutdown capability for the plant. The licensee found that a fire in the control room could cause hot shorts, i.e. short circuits between control wiring and power sources, for certain motor-operated valves (MOVs) needed to shut the reactor down and to maintain it in a safe shutdown condition. If a fire in the control room forces reactor operators to leave the control room, these MOVs can be operated from the remote/alternate shutdown panel. However, hot shorts, combined with the absence of thermal overload protection, could cause valve damage before the operator shifted control of the valves to the remote/alternate shutdown panel.

Thermal overload protection is absent for some valves at WNP-2. This configuration exists to ensure that the thermal overload protection does not prevent MOVs from performing their safety-related functions during an accident. As a result, the thermal overload protection is configured to be either continuously bypassed or bypassed only during an accident. Regulatory Guide (RG) 1.106, Revision 1, "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," provides guidance in this area.

Figure 1 of Attachment 1 shows the control circuitry for MOVs in a conceptual manner, and the figure includes the relay coils which operate the contactors

in the power circuitry for the motors. Figure 2 provides an example of the manner in which the motor of an MOV that is closed can be energized and damaged by a hot short if its overload protection is bypassed. The hot short bypasses the push button that is normally used to close the MOV and thus provides power to the relay coil, which closes those contactors that provide power to drive the motor in the closed direction. Power will not be disconnected from the motor although it is stalled, because the same hot short bypasses the torque switch. With the motor stalled, current and torque are abnormally high, possibly causing the motor windings to fail and possibly causing mechanical damage to the valve. This mechanical damage may be sufficient to prevent reactor operators from manually operating the valve. A similar problem can occur for MOVs that are open (see Figure 3). Shorts to other sources of power can also cause failure of MOVs.

The licensee for WNP-2 determined that up to 15 MOVs in the residual heat removal system might be adversely affected in this scenario. After identifying the problem while the reactor was shut down, the licensee notified the NRC Operations Center and took corrective action. After conducting an initial analysis and before restarting the reactor, the licensee rewired the control circuitry for the MOVs so that the torque and limit switches in the valve operators are now located electrically between the control room, the remote or alternate shutdown panel, and the motor control center. Figure 4 is a diagram of the concept. Figures 5 and 6 show how hot shorts can still cause the modified control circuitry to open or close the MOVs. However, now the torque and limit switches are not bypassed by the hot short, and the MOVs are protected from damage.

On November 20, 1991, the Pennsylvania Power and Light Company, licensee for the Susquehanna Steam Electric Station, learned of the problem at WNP-2, determined that a similar condition existed for both units at the Susquehanna Steam Electric Station, and notified the NRC Operations Center. Later, the licensee stated that 37 MOVs which would be required to place the plant in a safe shutdown condition could possibly be damaged by hot shorts occurring during a fire in the control room. One of the MOVs is a reactor recirculation suction valve, 15 are in the reactor core isolation cooling system, 16 are in the residual heat removal system, and 5 are in the service water system.

On December 10, 1991, Northern States Power Company also found a similar condition at the Monticello Nuclear Generating Plant.

Discussion

In RG 1.106, Revision 1, the staff stated that if thermal overload protection devices are bypassed, it is important to ensure that the bypassing does not result in jeopardizing the completion of the safety function or in degrading other safety systems because of any sustained abnormal circuit currents that may be present.

When thermal overload protection devices are bypassed and valve operators are wired as shown in Figure 1, hot shorts can result in sustained abnormal circuit currents. Even if thermal overload protection devices are not bypassed, hot shorts can cause loss of power to MOVs by tripping the thermal overload protection devices because of the demand of the motors for excessive current. In this case, hot shorts impair the licensee's capability to efficiently shut its plant down and maintain it in a safe shutdown condition. Rewiring the control circuitry for the valve operators to put them between the control room, the remote or alternate shutdown panel, and the motor control centers prevents bypassing of the torque and limit switches by hot shorts in the control room.

Related Generic Communications

The staff addressed hot shorts in Generic Letter 86-10, "Implementation of Fire Protection Requirements," Enclosure 2, Section 5.3.1.

This information notice requires no specific action or written response. If you have any question about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contacts: James E. Knight, NRR
(301) 504-3264

Roger W. Woodruff, NRR
(301) 504-1152

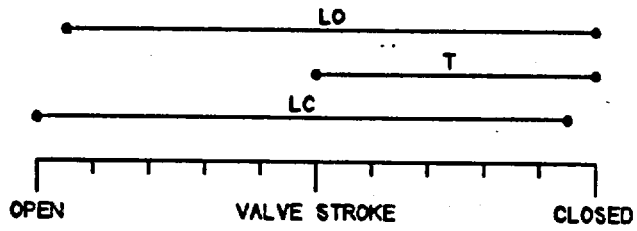
Attachments:
1. Figure 1, "Conceptual Control Circuitry for MOVs"
   Figure 2, "Postulated Short Occurring While an MOV is Closed"
   Figure 3, "Postulated Short Occurring While an MOV is Open"
   Figure 4, "Conceptual Modification of Control Circuitry for MOVs"
   Figure 5, "Postulated Short Occurring While an MOV with Modified Control Circuitry is Closed"
   Figure 6, "Postulated Short Occurring While an MOV with Modified Control Circuitry is Open"
2. List of Recently Issued NRC Information Notices

Computer Printout: see jacket

LEGEND

CR	CONTROL ROOM
RSP	REMOTE SHUTDOWN PANEL
MCC	MOTOR CONTROL CENTER
VO	VALVE OPERATOR
MC	RELAY COIL - CLOSE VALVE
MO	RELAY COIL - OPEN VALVE
C	PUSH BUTTON - CLOSE VALVE
O	PUSH BUTTON - OPEN VALVE
LC	LIMIT SWITCH - CLOSE VALVE
LO	LIMIT SWITCH - OPEN VALVE
T	TORQUE SWITCH
G	GREEN LAMP
R	RED LAMP

CONTACT ACTUATION POINTS *



* THE LINES INDICATE THAT THE SWITCH CONTACTS ARE CLOSED. THE POINTS INDICATE THE VALVE POSITIONS WHERE THE SWITCH CONTACTS OPEN AND CLOSE. FOR THE TORQUE SWITCH, THE CONTACTS ARE ACTUATED BY THE POSITION OF THE VALVE DISK AT MID STROKE AND BY THE PRESET TORQUE AT THE END OF THE CLOSING STROKE.

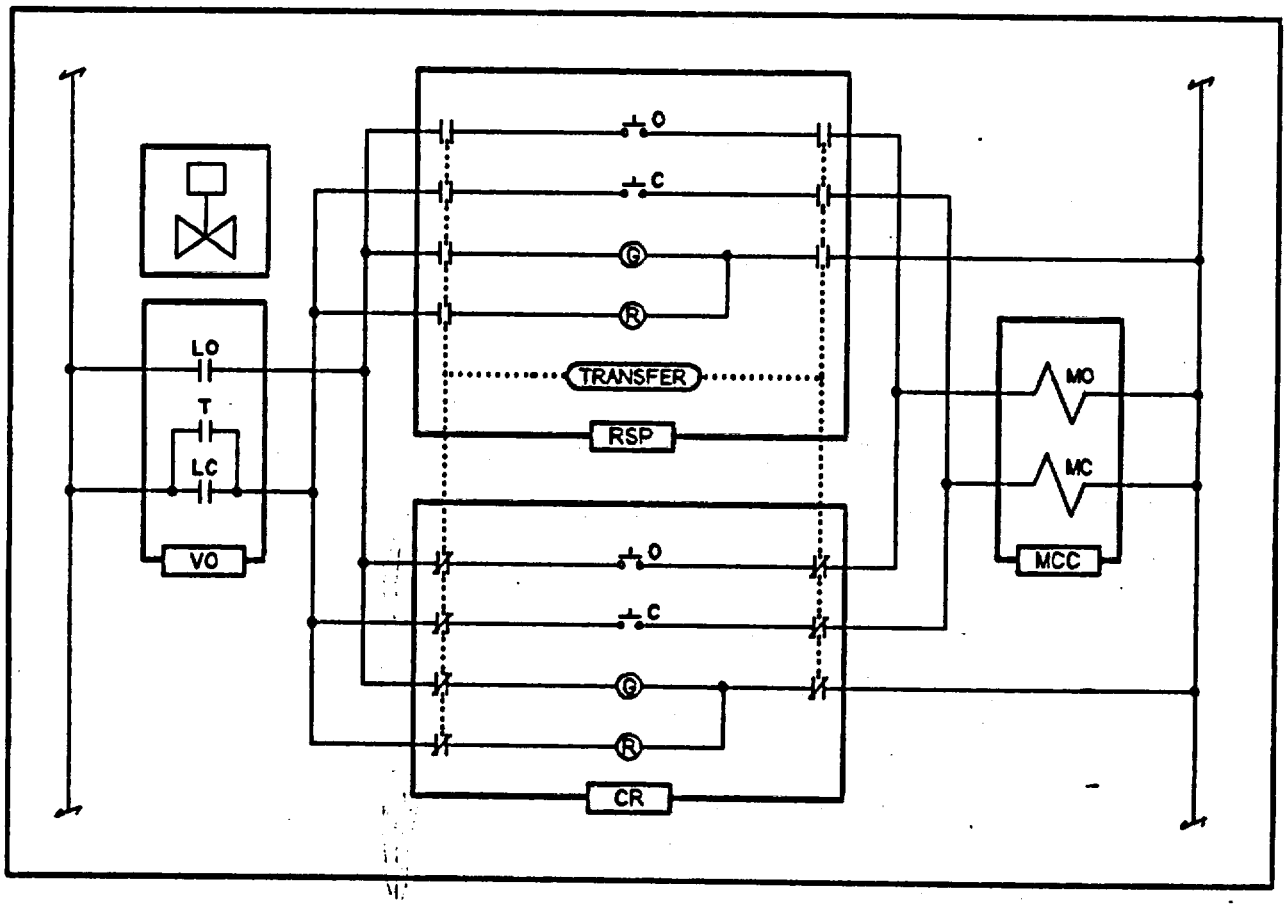


FIGURE 1. CONCEPTUAL CONTROL CIRCUITRY FOR MOVs

LEGEND

CR	CONTROL ROOM
RSP	REMOTE SHUTDOWN PANEL
MCC	MOTOR CONTROL CENTER
VO	VALVE OPERATOR
MC	RELAY COIL - CLOSE VALVE
MO	RELAY COIL - OPEN VALVE
C	PUSH BUTTON - CLOSE VALVE
O	PUSH BUTTON - OPEN VALVE
LC	LIMIT SWITCH - CLOSE VALVE
LO	LIMIT SWITCH - OPEN VALVE
T	TORQUE SWITCH
G	GREEN LAMP
R	RED LAMP
S	HOT SHORT

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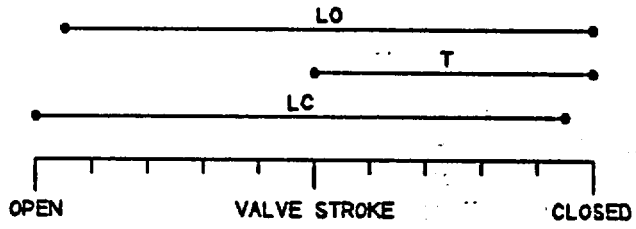

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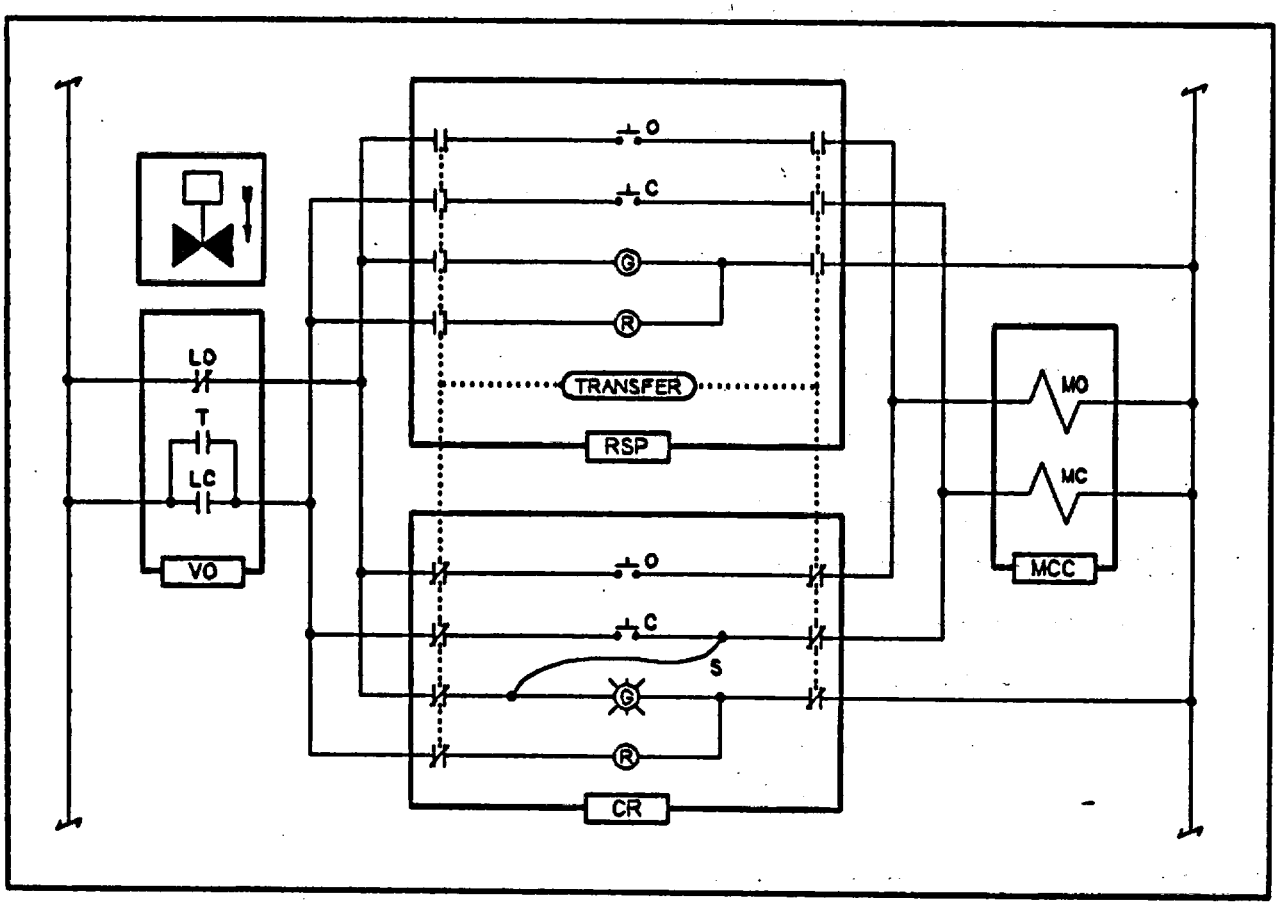

FIGURE 2. POSTULATED SHORT OCCURRING WHILE AN MOV IS CLOSED

LEGEND

CR	CONTROL ROOM
RSP	REMOTE SHUTDOWN PANEL
MCC	MOTOR CONTROL CENTER
VO	VALVE OPERATOR
MC	RELAY COIL - CLOSE VALVE
MO	RELAY COIL - OPEN VALVE
C	PUSH BUTTON - CLOSE VALVE
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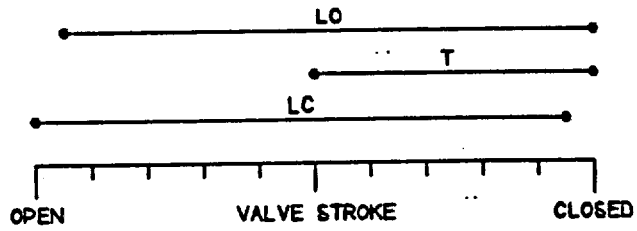

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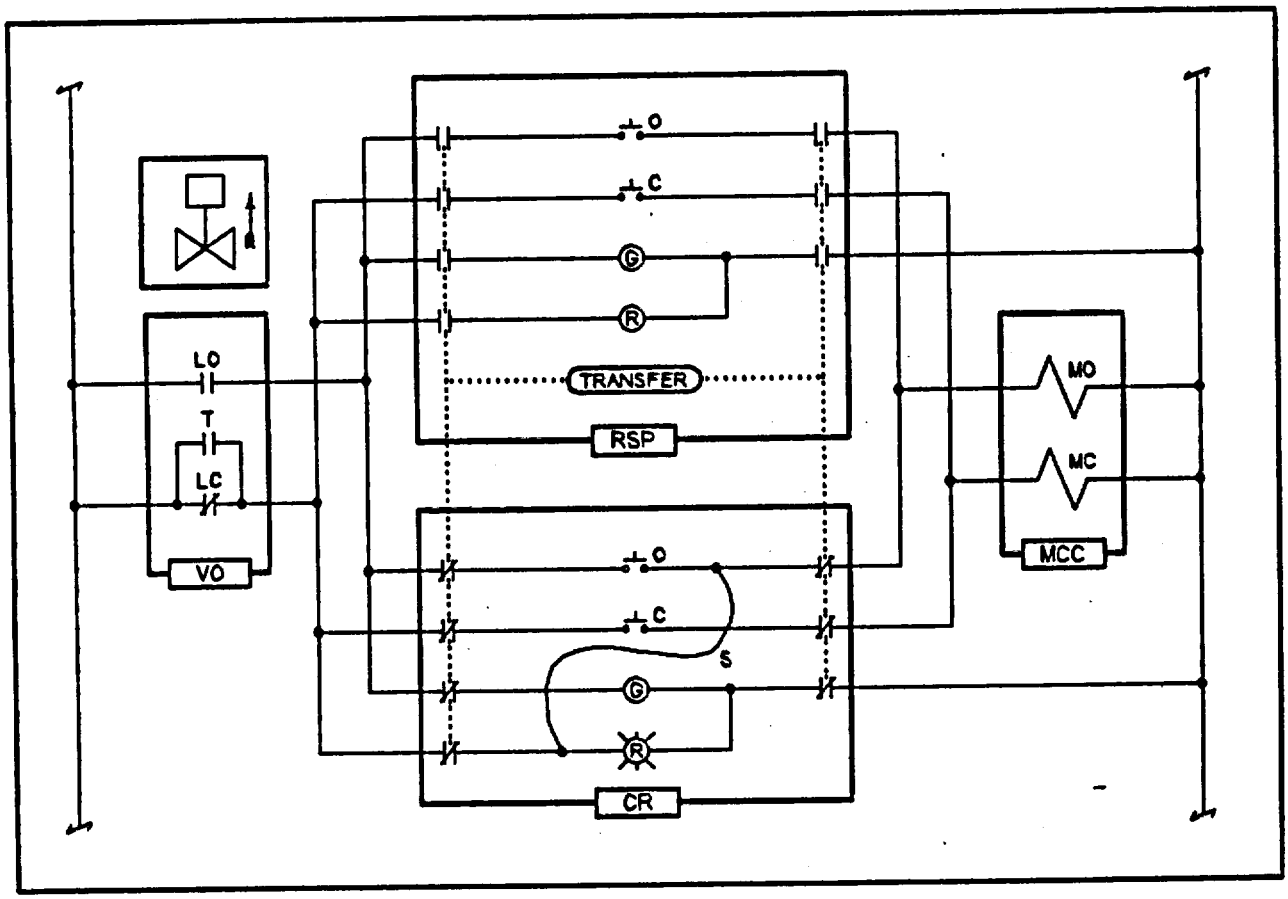

FIGURE 3. POSTULATED SHORT OCCURRING WHILE AN MOV IS OPEN

LEGEND

CR	CONTROL ROOM
RSP	REMOTE SHUTDOWN PANEL
MCC	MOTOR CONTROL CENTER
VO	VALVE OPERATOR
MC	RELAY COIL - CLOSE VALVE
MO	RELAY COIL - OPEN VALVE
C	PUSH BUTTON - CLOSE VALVE
O	PUSH BUTTON - OPEN VALVE
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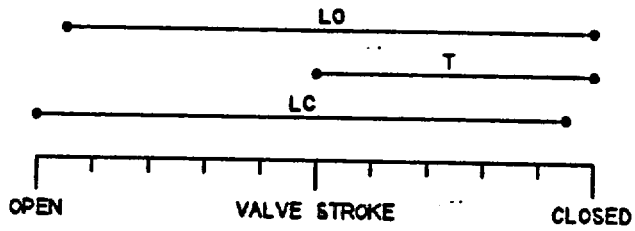

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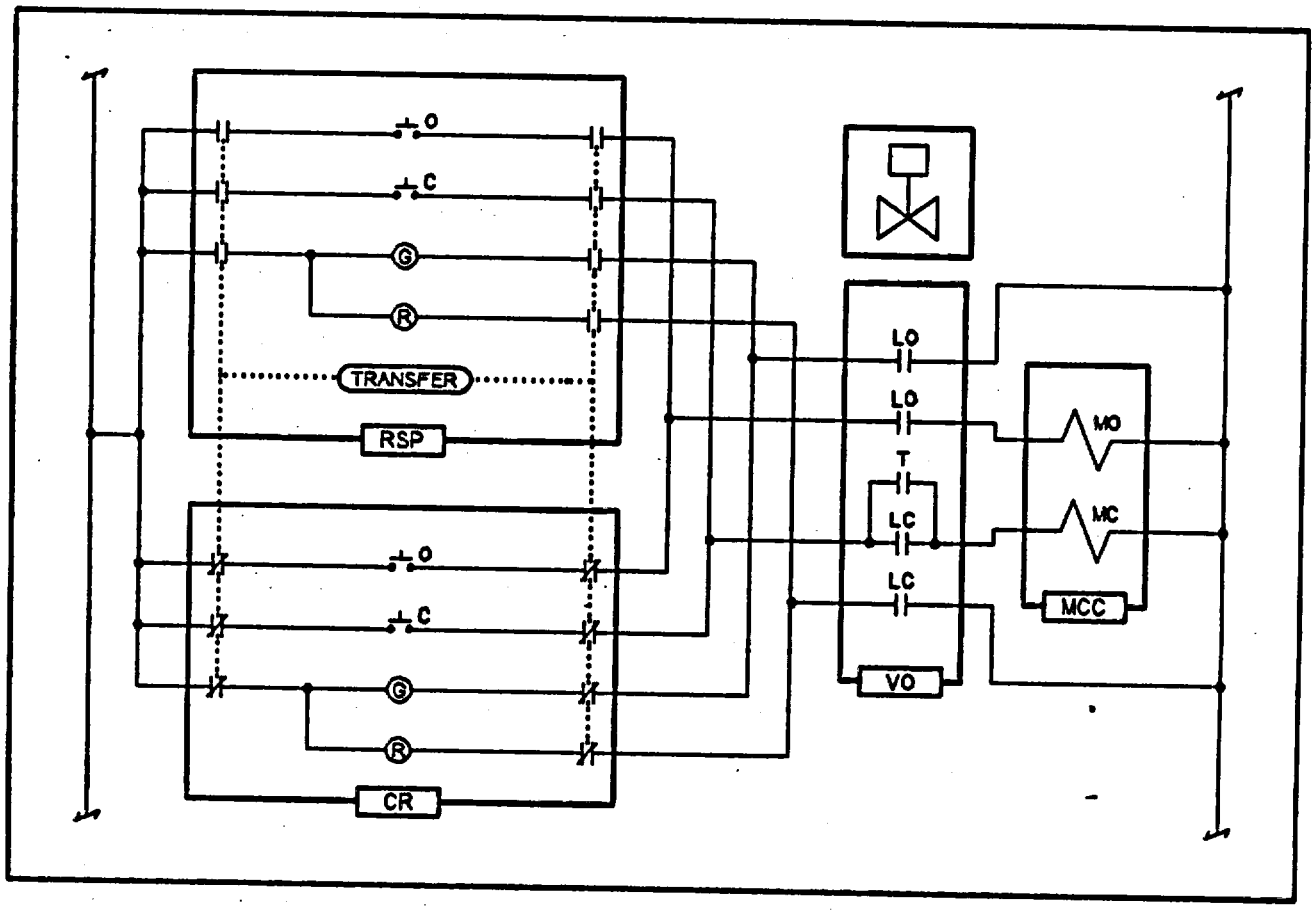

FIGURE 4. CONCEPTUAL MODIFICATION OF CONTROL CIRCUITRY FOR MOVs

LEGEND

CR	CONTROL ROOM
RSP	REMOTE SHUTDOWN PANEL
MCC	MOTOR CONTROL CENTER
VO	VALVE OPERATOR
MC	RELAY COIL - CLOSE VALVE
MO	RELAY COIL - OPEN VALVE
C	PUSH BUTTON - CLOSE VALVE
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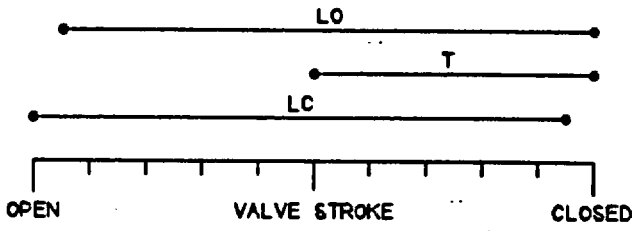

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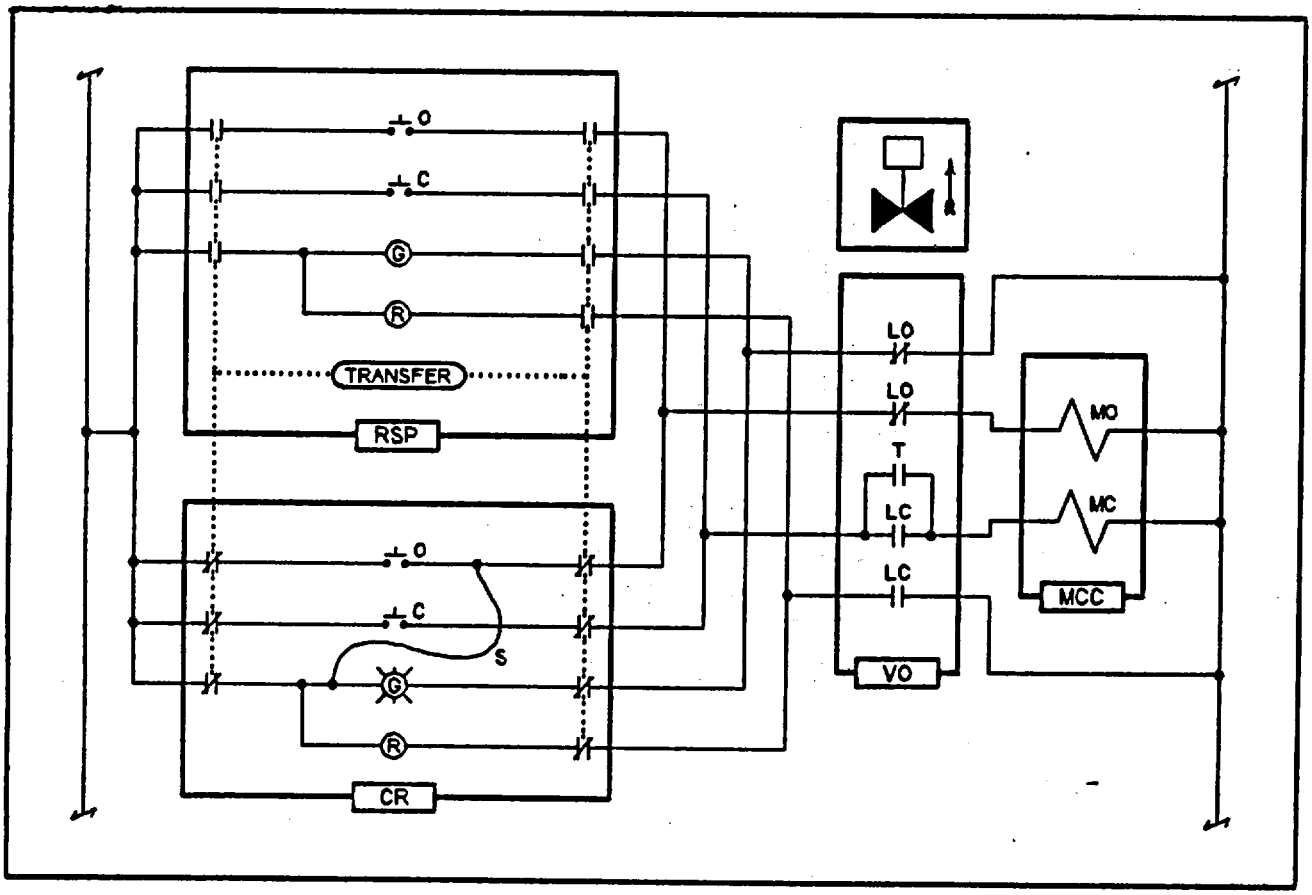

FIGURE 5. POSTULATED SHORT OCCURRING WHILE AN MOV WITH MODIFIED CONTROL CIRCUITRY IS CLOSED

LEGEND

CR	CONTROL ROOM
RSP	REMOTE SHUTDOWN PANEL
MCC	MOTOR CONTROL CENTER
VO	VALVE OPERATOR
MC	RELAY COIL - CLOSE VALVE
MO	RELAY COIL - OPEN VALVE
C	PUSH BUTTON - CLOSE VALVE
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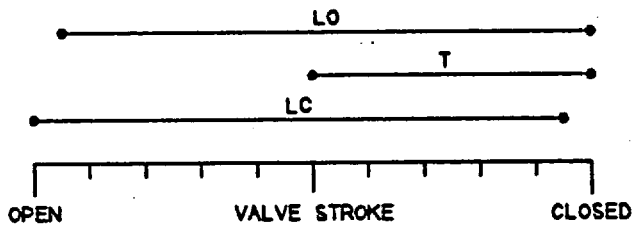

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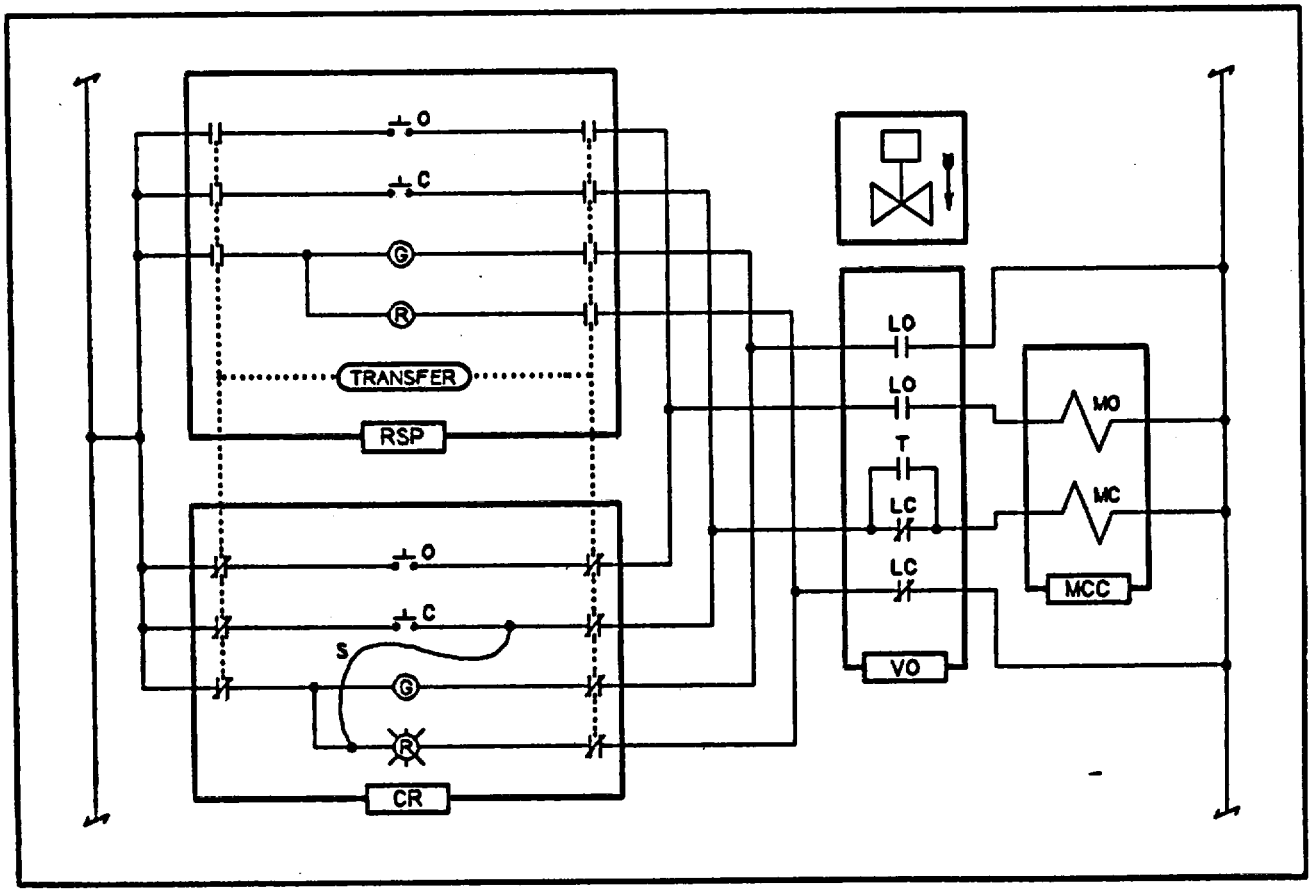

FIGURE 6. POSTULATED SHORT OCCURRING WHILE AN MOV WITH MODIFIED CONTROL CIRCUITRY IS OPEN

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-17	NRC Inspections of Programs being Developed at Nuclear Power Plants in Response to Generic Letter 89-10	02/26/92	All holders of OLs or CPs for nuclear power reactors.
92-16	Loss of Flow from the Residual Heat Removal Pump during Refueling Cavity Draindown	02/25/92	All holders of OLs or CPs for nuclear power reactors.
92-15	Failure of Primary System Compression Fitting	02/24/92	All holders of OLs or CPs for nuclear power reactors.
92-14	Uranium Oxide Fires at Fuel Cycle Facilities	02/21/92	All fuel cycle and uranium fuel research and development licensees.
92-02, Supp. 1	Relap5/Mod3 Computer Code Error Associated with the Conservation of Energy Equation	02/18/92	All holders of OLs or CPs for nuclear power reactors.
92-13	Inadequate Control Over Vehicular Traffic at Nuclear Power Plant Sites	02/18/92	All holders of OLs or CPs for nuclear power reactors.
92-12	Effects of Cable Leakage Currents on Instrument Settings and Indications	02/10/92	All holders of OLs or CPs for nuclear power reactors.
92-11	Soil and Water Contamination at Fuel Cycle Facilities	02/05/92	All uranium fuel fabrication and conversion facilities.

OL = Operating License
CP = Construction Permit