

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

October 4, 1993

NRC INFORMATION NOTICE 93-78: INOPERABLE SAFETY SYSTEMS AT A NON-POWER REACTOR

Addressees

All holders of operating licenses or construction permits for test and research reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a problem which resulted in inoperable safety systems at a non-power reactor. 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 April 28, 1993, after a number of spurious scrams had occurred, the licensee for the University of Virginia Research Reactor shut down the reactor and began troubleshooting activities to determine the cause of the problem. The reactor had been experiencing spurious scrams for some time and the licensee had concluded that the scrams were not caused by electrical transients or line noise. The licensee suspected the reactor scram logic to be the cause of the scrams. The reactor scram logic consists of two trains that cause power to different magnets to be cut off on receipt of a scram signal. This in turn releases control rods and shuts down the reactor. While investigating the problem, the senior reactor operator (SRO) interchanged components of the scram logic system between the two trains. Among these components were solid-state relays and mixer-drivers (M/Ds) which act as a 28-channel "OR" gate in the scram logic. After consulting the facility safety analysis report and visually inspecting the exterior of the components, the SRO assumed that the interchanged components were identical. However, the M/Ds had been internally modified in the 1970s to tie unused inputs together and were no longer identical.

After the M/Ds had been exchanged and no spurious scram signals were received for 30 minutes, the reactor administrator and the SRO started the reactor. Neither the reactor administrator nor the SRO recognized that the troubleshooting activities were actually a maintenance or modification function and that testing to verify the operability of the reactor scram system was required before the reactor was restarted.

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After operating for approximately 5½ hours, the reactor was shut down by driving the rods into the core. With three of the four control rods seated, licensee personnel then introduced a scram signal into the reactor electronics using the intermediate range channel switch. However, the electronics did not generate a scram signal as expected. The licensee investigated and found that the M/Ds were not internally identical as described above. Further investigation showed that the following scram signals were inoperable: the two power level scrams, intermediate range period scram, primary coolant low flow scram, loss of power to the primary pump scram, intermediate channel range switch scram, and key switch scram. The licensee returned the M/Ds to their original positions and tested the reactor to ensure that the reactor electronics had not been damaged.

To prevent a recurrence of this problem, the licensee made the following changes: (1) revised the facility standard operating procedures (SOPs) to clearly define maintenance and troubleshooting activities, (2) added a checklist to the SOPs to specifically control maintenance activities, and (3) added a checklist to the SOPs to verify the operability of the reactor safety systems after an unplanned reactor scram. Other changes were also made to the SOPs to ensure management control over maintenance.

The licensee checked the reactor electronics against the schematics and found that changes had been made to console modules that were not reflected in the schematics. The licensee found two instances where externally identical components were internally different and therefore not interchangeable. After completing this check, the licensee labeled the modules that had been modified to clearly indicate that they were unique and not interchangeable.

#### Discussion

The circumstances described above demonstrate the importance of recognizing and controlling maintenance and modification actions. Clearly defining maintenance activities in facility procedures and providing training to personnel can be effective methods for controlling such activities. Also important to reactor safety is updating schematics of reactor electronics to reflect modifications to safety systems. Performing testing of the affected safety systems after activities of the type described above may prevent the occurrence of similar events.

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Brian K. Grimes, Director  
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Office of Nuclear Reactor Regulation

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(301) 504-1127

C. Bassett, RII  
(404) 331-5570

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problem was corrected by returning the M/Ds to their original position. The reactor was tested to ensure that the reactor electronics had not been damaged.

The UVRR staff has instituted a number of corrective actions to prevent a recurrence of this problem. Facility standard operating procedures (SOPs) have been revised to clearly define maintenance and troubleshooting, a new checklist to control maintenance has been developed and added to the SOPs, a new checklist to be followed after an unplanned reactor scram to verify operability of the reactor safety systems has been added to the SOPs, and other changes have been made to the SOPs to increase management control over maintenance. The reactor electronics have been checked against schematics, and the schematics have been updated when necessary. The licensee found that various changes had been made to console modules that were not reflected in the schematics. The reactor console was checked for other externally identical components that were internally different and not interchangeable. Two instances of this type were identified. Modules in the console were clearly labeled to indicate if any modifications were made and if they were unique and not interchangeable. A sign was added to the reactor console reminding operators that modules in the console were not interchangeable.

Discussion

This problem emphasizes the importance of recognizing and controlling maintenance functions at NPRs. What constitutes maintenance should be clearly defined in the facility procedures and understood by the staff. The operability of safety systems should be verified every time maintenance is performed on a system.

Also important is having clear, up-to-date schematics of reactor electronics and procedures that ensure that they will be consulted during maintenance.

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pump scram, intermediate channel range switch scram and key switch scram were found to be inoperable. This problem was corrected by returning the M/Ds to their original position. The reactor was tested to ensure that no damage occurred to the reactor electronics.

The UVRR staff has instituted a number of corrective actions to prevent reoccurrence of this problem. Facility Standard Operating Procedures (SOPs) have been revised to clearly define maintenance and troubleshooting, a new checklist to control maintenance has been developed and added to the SOPs, a new checklist to be followed after an unplanned reactor scram to verify operability of the reactor safety systems has been added to the SOPs, and other changes have been made to the SOPs to increase management control over maintenance. The reactor electronics have been checked against schematics and schematics updated when necessary. The licensee found that various changes had been made to console modules that were not reflected in the schematics. The reactor console was reviewed for other externally identical components that were internally different and not interchangeable. Two instances of this type were identified. Modules in the console were clearly labeled to indicate if any modifications were made and if they were unique and not interchangeable. A sign was added to the reactor console reminding operators that modules in the console were not interchangeable.

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Information Notice No.	Subject	Date of Issuance	Issued to
93-77	Human Errors that Result in Inadvertent Transfers of Special Nuclear Material at Fuel Cycle Facilities	10/04/93	All nuclear fuel cycle licensees.
93-76	Inadequate Control of Paint and Cleaners for Safety-Related Equipment	09/21/93	All holders of OLs or CPs for nuclear power reactors.
93-75	Spurious Tripping of Low-Voltage Power Circuit Breakers with GE RMS-9 Digital Trip Units	09/17/93	All holders of OLs or CPs for nuclear power reactors.
93-74	High Temperatures Reduce Limitorque AC Motor Operator Torque	09/16/93	All holders of OLs or CPs for nuclear power reactors.
93-73	Criminal Prosecution of Nuclear Suppliers for Wrongdoing	09/15/93	All NRC licensees.
93-72	Observations from Recent Shutdown Risk and Outage Management Pilot Team Inspections	09/14/93	All holders of OLs or CPs for nuclear power reactors.
93-71	Fire at Chernobyl Unit 2	09/13/93	All holders of OLs or CPs for nuclear power reactors.
93-70	Degradation of Boraflex Neutron Absorber Coupons	09/10/93	All holders of OLs or CPs for nuclear power reactors.
93-69	Radiography Events at Operating Power Reactors	09/02/93	All holders of OLs or CPs for nuclear power reactors and all radiography licensees.

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