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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

April 20, 1998

NRC INFORMATION NOTICE 98-14: UNDOCUMENTED CHANGES TO NON-POWER REACTOR SAFETY SYSTEM WIRING

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 inform addressees of undocumented modifications that have occurred in the scram system wiring of two research reactors. In the first case, the modification in conjunction with a switch failure resulted in the reactor being operated for a short time without any technical specification (TS) required scrams. In the second case, because of a modification, a switch failure could have resulted in a TS required scram being disabled. It is expected that recipients will review the information for applicability to their facilities and consider action, 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

Oregon State University

On the morning of February 17, 1998, the TRIGA non-power reactor at Oregon State University (OSU) had completed a routine 14-minute run at 15 watts of power to perform core excess reactivity measurements. An attempt was made to manually scram the reactor at the end of the run using the scram button. When the manual scram button did not work, the operator's next step was to turn off power to the scram circuit using the reactor's three-position key switch. This switch has OFF, OPERATE, and RESET positions with a spring return between the RESET and OPERATE positions. As the operator touched the switch, the switch moved from a position between OPERATE and RESET to the OPERATE position. The operator then tried the manual scram button again and this time it worked.

The licensee determined that a buildup of dirt prevented the three-position switch from returning to the OPERATE position. When the switch is in the RESET position, the scram bus is disabled. This switch dates to 1967 when the original console was installed. The switch operated properly during preoperational testing before startup.

Upon further investigation, the licensee discovered that the wiring of the scram circuit was different from the wiring shown in the Instrument Maintenance Manual provided by the reactor vendor. Figure 1 shows part of the circuitry as designed. If the key switch is in the OPERATE

position, ac power is supplied from terminal block one, terminal number four (TB1-4) through TB1-9, to TB2-3, the A3 and A1 contacts of the three-position switch, and then the console power switch. This allows transformer four (T4) to power the rod magnets. When the key is turned to RESET, this circuit is opened and the magnet current is cut off. This prevents rod withdrawal if the rods are down, or causes the rods to drop if they are up. This design feature prevents a single failure of the three-position switch from disabling the scram circuits. In the RESET position, power is supplied to the scram reset relays (K19, K20, and K24), which reset the scram relays (only one scram relay, K12, is shown). If the key switch sticks in the RESET position, the scram relay will continued to be energized by the reset relay even if a scram signal occurs. This is not a problem because the power would already be cut off to the magnets.

Figure 2 shows the wiring as found in the OSU console. The wiring that was between TB1-9 and TB2-3 in the "as designed" circuit was between TB1-9 and TB10-10 in the OSU console. As a result, there is power to the magnets when the switch is in the RESET or OPERATE position.

The licensee concluded that the location of the jumper was probably modified during initial installation of the reactor console in 1967. This modification was probably done to provide power to the "B deck" on the three-position switch to power REACTOR ON lights.

The licensee took a number of corrective actions. The three-position switch was removed, cleaned, relubricated, and reinstalled in the console. The reactor console wiring was restored to its as-designed condition. The wiring in the scram circuitry and in other non-scram-related circuits was checked physically and electronically to demonstrate that the wiring in the console is as designed. The reactor startup procedure was rewritten to test that the magnet power is cut off when the three-position switch is placed in the RESET position. The reactor console was subject to routine startup checks and the semiannual console check procedure. The reactor vendor was contacted to obtain checkout procedures to confirm that all suggested surveillances are done before reactor operation.

Texas A&M University

OSU quickly placed information about the failure to scram on the Organization of Test, Research and Training Reactors (TRTR) list server. As a result, the staff at the Texas A&M University Nuclear Science Center checked the logic diagrams for its TRIGA research reactor and determined that its reactor could not fail to scram. The Texas A&M console differs from the one at OSU in that there is no master reset equivalence to the three-position switch. Three of the scrams have push-button spring-returned switches that clear the locked-in alarm on the console and allow the scram relay coil to be reenergized if the signal is clear.

The licensee also tested the circuit and determined that each of the three scrams associated with these switches could be defeated by holding its switch down in the RESET position (this simulated a switch failure). In this case, the failure of a single switch could prevent an individual scram signal but would have not disabled all scrams. The licensee then checked the wiring diagrams for the console and discovered that the wiring of the console matched the wiring diagrams. The RESET switches were wired in parallel with the normally closed scram contacts. This wiring maintained power to the magnets through one parallel path if the switch was

depressed, even if a scram contact opened in the other parallel path. The switches should have been wired in series. The licensee cannot determine when the console was wired this way, but notes that the console underwent a major upgrade in 1968. The logic diagram, drawn in 1976, which differs from the wiring diagram and the as-wired console, appears to have been based on system knowledge of how it should be configured rather than on the actual configuration.

To correct this situation, the licensee changed the wiring to put the RESET switch in series with the protective action contacts, physically verified console wiring for scram circuits, identified various failure modes, and tested the console for proper operation.

Discussion

The circumstances described above demonstrate the importance of controlling modifications, ensuring that all of the consequences of a modification are carefully considered, and ensuring that design features in the scram circuitry perform as designed. Careful reviews of modifications through the safety review process can be an effective method to help to ensure that unintended deleterious effects from modifications do not occur. The identification of safety system design features could lead to surveillances or tests that could prevent the occurrence of similar problems. The staff noted that many licensees contacted the NRC to discuss the results of testing performed on consoles because of the information placed on the TRTR listed server by OSU.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below.

Jack Roe, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contact: Alexander Adams, Jr., NRR
301-415-1127
E-mail: axa@nrc.gov

Attachments:
1. Figure 1, "Reactor Operate Circuit, As-Designed"
2. Figure 2, "Reactor Operate Circuit - As Found"
3. List of Recently Issued NRC Information Notices — FILED in Jacket

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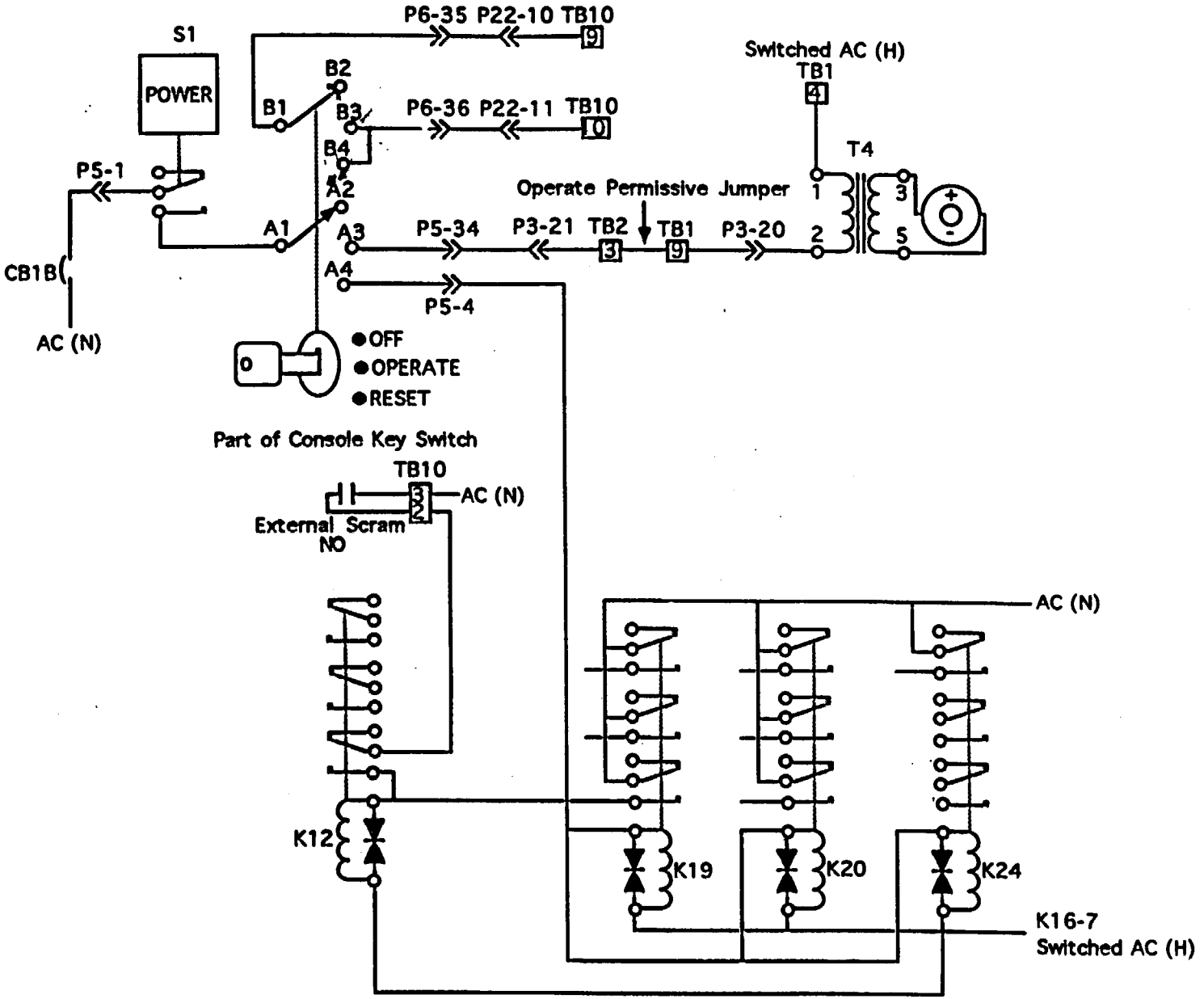

Figure 1. Reactor Operate Circuit, As-designed

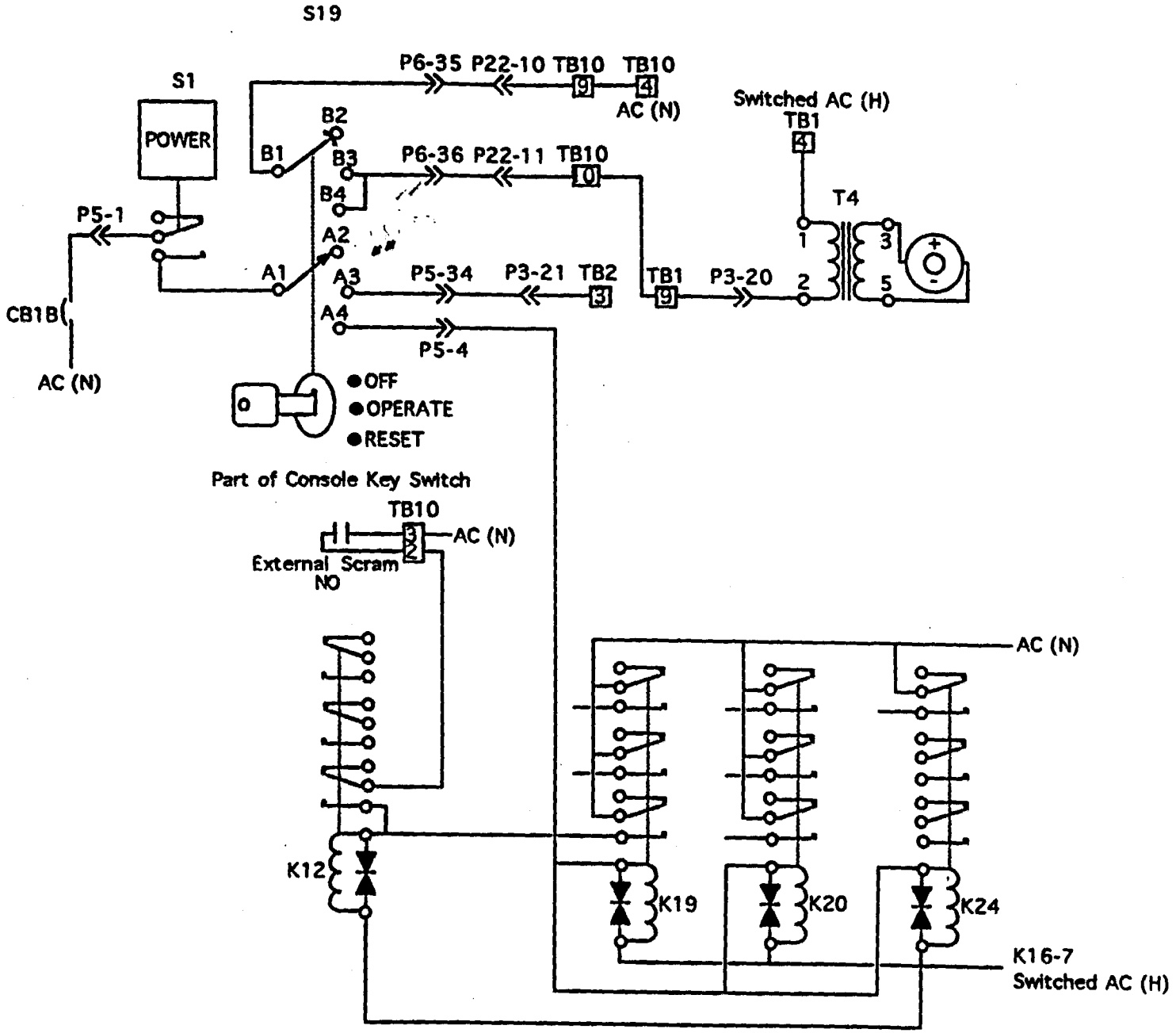

Figure 2. Reactor Operate Circuit - As Found

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
98-13	Post-Refueling Outage Reactor Pressure Vessel Leak Testing Before Core Criticality	4/20/98	All holders of operating licenses for nuclear power reactors except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
98-12	Licensees' Responsibilities Regarding Reporting and Follow-up Requirements for Nuclear-Powered Pacemakers	4/3/98	All U.S. Nuclear Regulatory Commission nuclear pacemaker licensees
98-11	Cracking of Reactor Vessel Internal Baffle Former Bolts in Foreign Plants	3/25/98	All holders of operating licensing for pressurized-water reactors (PWRs) except those who have ceased operation and have certified that fuel has been permanently removed from the reactor vessel.
95-52, Supp.1	Fire Endurance Test Results for Electrical Raceway Fire Barrier Systems Constructed From 3M Company Interam Fire Barrier Materials	3/17/98	All holders of operating licenses for nuclear power reactors except those who have permanently ceased operation and have certified that fuel has been permanently removed from the reactor vessel.
98-10	Probable Misadministrations Occurring During Intravascular Brachytherapy With The Novoste Beta-Cath System	3/9/98	All Medical Licensees
98-09	Collapse Of An Isocam II Dual-Headed Nuclear Medicine Gamma Camera	3/5/98	All Medical Licensees

OL = Operating License
CP = Construction Permit

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orig /s/'d by D. B. Matthews
FOR
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