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February 1, 2019

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

REFERENCE: Docket No. 50-186
University of Missouri-Columbia Research Reactor
Renewed Facility Operating License No. R-103

SUBJECT: Written communication as required by University of Missouri Research Reactor Technical Specification 6.6.c(3) regarding a deviation from Technical Specification 3.2.a

The attached document provides the University of Missouri-Columbia Research Reactor (MURR) Licensee Event Report (LER) for an event that occurred on January 27, 2019, that resulted in a deviation from MURR Technical Specification 3.2.a.

If you have any questions regarding this report, please contact Bruce A. Meffert, the facility Reactor Manager, at (573) 882-5118.

Sincerely,

J. David Robertson, PhD
Reactor Facility Director

JDR:jlm

Enclosure

xc: Reactor Advisory Committee
Reactor Safety Subcommittee
Dr. Mark McIntosh, Vice Chancellor for Research, Graduate Studies and Economic Development
Mr. Geoffrey Wertz, U.S. Nuclear Regulatory Commission
Mr. William Schuster, U.S. Nuclear Regulatory Commission

IE22
NRR

Licensee Event Report No. 19-02 – January 27, 2019
University of Missouri Research Reactor

Introduction

On January 27, 2019, with the reactor operating at 10 MW in the automatic control mode, the Lead Senior Reactor Operator (LSRO) was conducting surveillance Technical Specification (TS) 4.2.a, which states, "*All control blades, including the regulating blade, shall be verified operable within a shift.*" While conducting the surveillance TS, all blades were initially verified operable. However, when banking the control blades to their final position after all blades were satisfactorily tested a few moments earlier, shim control blade 'A' would not move in the inward direction. The LSRO then immediately shut down the reactor by initiating a manual scram by placing master control switch 1S1 to the "TEST" position. Not being able to shim control blade 'A' in the inward direction resulted in a deviation from TS 3.2.a, which states, "*All control blades, including the regulating blade, shall be operable during reactor operation.*" Additionally, TS 1.15 states, "*Operable means a component or system is capable of performing its intended function.*"

Description of the Rod Control System

As described in Section 7.5, Rod Control System, of the MURR Safety Analysis Report (SAR), the reactivity of the reactor is controlled by five (5) neutron absorbing control blades. Each control blade is attached to a control rod drive mechanism (CRDM) by means of a support and guide extension (offset mechanism). Four (4) of the control blades, referred to as the shim blades, are used for coarse adjustments to the neutron density of the reactor core. The fifth control blade is a regulating blade. The low reactivity worth of this blade allows for very fine adjustments in the neutron density in order to maintain the reactor at the desired power level. The nominal speed of the shim control blades is one (1) inch per minute in the outward direction and two (2) inches per minute in the inward direction. Nominal speed of the regulating blade is 40 inches per minute in both the inward and outward directions. The four (4) shim control blades are actuated by electromechanical CRDMs that position, hold, and scram each shim blade. Each CRDM consists of a 0.02-HP, 115-volt, one-amp, single-phase, 60-cycle motor connected to a lead screw assembly through a reduction gearbox.

The reactor is operated from the reactor control console in either of two (2) control modes: manual or automatic. Manual control is used for reactor startup, changes in power level, and steady-state operation for short periods of time. Automatic control is selected only after a minimum power level has been attained and is used for long-term steady-state operation.

Control blade movements, interlocks and bypasses, and control modes are managed by the rod control system. The rod control system is a relay and switch logic system used to prohibit accidental or incorrect operation which could result in an unsafe condition. A three-position ("OFF-TEST-ON") keylock master control switch and a two-position ("OFF-ON") magnet current switch located on the reactor control console controls power to the rod control system. The master control switch and the magnet current switch, designated as 1S1 and 1S14 respectively, must both be in the "ON" position to provide current to the shim control blade electromagnets.

The shim and regulating blades are withdrawn or inserted manually by three-position ("IN-NORMAL-OUT") switches located on the reactor control console. The switches are spring-return to the mid-position ("NORMAL") when released. A five-position ("A-B-C-D-GANG") selector switch enables the reactor operator to select the shim blades individually or as a group. The shim blade selector switch is designated 1S3 and the withdrawal-insertion switches for the shim and regulating blades are designated 1S4 and 1S5, respectively. Two (2) push button switches located on the reactor control console allow the regulating blade to be "jogged" inward and outward for fine adjustment of reactor power level in the manual control mode. Note: Switch 1S4 is designated as the "Control Rod Operate" switch, which is identified as Item No. 35 on Table 7-2, "Reactor Control Console Control Equipment," of the MURR SAR.

Also part of the rod control system is the rod run-in system which initiates the automatic insertion of the control blades at a controlled rate should a monitored parameter exceed a predetermined value.

Detailed Event Description

On January 27, 2019, at 19:13 CST, with the reactor operating at 10 MW in the automatic control mode, the LSRO was conducting surveillance TS 4.2.a, which states, "*All control blades, including the regulating blade, shall be verified operable within a shift.*" Note: The MURR control room operates with 12-hour shifts; 06:30 to 18:30 then 18:30 to 06:30. During the shiftly verification of control blade operability, all control blades were initially verified operable. However, when banking the shim control blades to their final position after all control blades were satisfactorily tested a few moments earlier, shim control blade 'A' would not move in the inward direction. The LSRO then immediately shut down the reactor by initiating a manual scram by placing master control switch 1S1 to the "TEST" position. The LSRO then completed all immediate and subsequent actions of reactor emergency procedure REP-2, "Reactor Scram," and verified all shim control blades were fully inserted.

Not being able to shim control blade 'A' in the inward direction resulted in a deviation from TS 3.2.a, which states, "*All control blades, including the regulating blade, shall be operable during reactor operation.*" Additionally, TS 1.15 states, "*Operable means a component or system is capable of performing its intended function.*" Furthermore, TS 1.1, Abnormal Occurrence, states, "*An abnormal occurrence is any of the following which occurs during reactor operation:... b. Operation in violation of Limiting Conditions for Operations established in Section 3.0.*"

After the reactor was shut down, troubleshooting efforts revealed that control rod operate switch 1S4 had failed – contact '1,' which supplies common supply power for inward motion for all four (4) shim control blades, was not making a good connection when switch 1S4 was in the "IN" position. As switch 1S4 was cycled towards the "IN" position, contact '1' moveable contact pad would move in a sideways direction such that when the moveable contact pad pressed against the stationary contact pad, the two (2) pads were not aligned with each other making less than optimal electrical contact. A replacement 1S4 switch was removed from inventory, and its contacts were inspected for proper movement and contact prior to installing it into the rod control system. Switch 1S4 was replaced and retested satisfactorily, which included verifying inward and outward movement of all four (4) shim control blades. Authorization was received from the Reactor Facility Director, as required by TS 6.6.c(4), to restart the reactor and resume 10 MW operation.

Safety Analysis

The basis for TS 3.2.a is to ensure that the normal method of reactivity control is used during reactor operation (Ref. Section 4.5 of the SAR). When operating the reactor at 10 MW in the automatic control mode, the shim control blades are routinely shimmed in the outward direction as a result of poison buildup (especially within the first 40 to 50 hours after a reactor startup) and fuel depletion. Additionally, surveillance TS 4.2.a is conducted to assure that the control blades are operable within a shift should routine outward shimming not be required during that shift.

While the ability to manually insert the shim control blades may have been unavailable for a few seconds after completion of surveillance TS 4.2.a, at no time was the ability to scram the reactor, through automatic initiation or manually by the control room operator, affected by this failure. Control rod operate switch 1S4 is not a part of the reactor safety system. This failure would not have prevented the rod run-in system from functioning normally.

Corrective Actions

When it was discovered that shim control blade 'A' would not move in the inward direction, the LSRO immediately shut down the reactor by initiating a manual scram by placing master control switch 1S1 to the "TEST" position and completing all immediate and subsequent actions of reactor emergency procedure REP-2, "Reactor Scram," to ensure the reactor was in a safe shutdown condition. All four (4) shim control blades were verified to be fully inserted.

Troubleshooting efforts identified that control rod operate switch 1S4 had failed – contact '1,' which supplies common supply power for inward motion for all four (4) shim control blades, did not make a good connection when the switch was in the "IN" position. A replacement 1S4 switch was removed from inventory and its contacts were inspected for proper movement and contact prior to installing it into the rod control system. Switch 1S4 was replaced and retested satisfactorily, which included verifying inward and outward movement of all four (4) shim control blades.

Switch 1S4 was also replaced on May 30, 2018, after a failure of contact '1' resulted in an abnormal occurrence, which is described in detail in MURR LER No. 18-02, dated June 11, 2018. However, LER No. 18-02 was a result of a worn spring that did not apply enough force to mate the moveable contact pad to the stationary contact pad. LER No. 19-02 control rod operate switch 1S4 contact '1' failure was due to the moveable contact pad not lining up properly with the stationary contact pad even though the contact spring applied sufficient force to mate the contact pads. Therefore, the causes of LER Nos. 18-02 and 19-02 are different even though both resulted from a failure of switch 1S4 contact '1.'

LER No. 19-02 appears to be a result of a manufacturing defect – either a bad switch component or incorrect switch assembly. Therefore, MURR is sending the failed switch back to the manufacturer to investigate a potential cause for the contact failure.

Furthermore, this event has been entered into the MURR Corrective Action Program as CAP No. 19-0013. Any additional improvements or corrective actions that are identified will be documented in that CAP entry.

If there are any questions regarding this LER, please contact me at (573) 882-5118. I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

Bruce A. Meffort
Reactor Manager

ENDORSEMENT:
Reviewed and Approved,

J. David Robertson, PhD
Reactor Facility Director

State of Missouri
County of Boone
Subscribed and sworn to before me this 1 day of February 2019
Jacqueline L Matyas
JACQUELINE L. MATYAS, Notary Public
My Commission Expires: March 26, 2019

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

JACQUELINE L. MATYAS
My Commission Expires
March 26, 2019
Howard County
Commission #15634308