University of Missouri

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June 11, 2018

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 May 30, 2018, 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,

Matt Sanford

Matthew R. Sanford
Interim Reactor Facility Director

MRS: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

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Attachment
U.S. Nuclear Regulatory Commission
June 11, 2018

Licensee Event Report No. 18-02 – May 30, 2018
University of Missouri Research Reactor

Introduction

On May 30, 2018, 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,*" shortly after shift turnover. While conducting the surveillance TS, it was discovered that shim control blades 'A,' 'B,' and 'C' would not shim in the inward direction (outward direction was operable) when Rod Control Operate Switch 1S4 was manipulated (each control blade is shimmed in both the inward and outward direction to satisfy the requirements of the surveillance TS). The LSRO then immediately shut down the reactor by initiating a manual scram. Not being able to shim the control blades 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 start-up, 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 May 30, 2018, at 07:10, 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. While conducting the surveillance TS, it was discovered that shim control blades 'A,' 'B,' and 'C' would not shim in the inward direction (outward direction was operable) when Control Rod Operate Switch 1S4 was manipulated (each control blade is shimmed in both the inward and outward directions to satisfy the requirements of the surveillance TS). The LSRO then immediately shut down the reactor by initiating a manual scram. The LSRO 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 the control blades 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.*" TS 1.15, Operable, 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 and secured, 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, would not close when switch 1S4 was in the "In" position. Switch 1S4 was replaced and retest was conducted satisfactorily, which included

verifying inward and outward movement of all four (4) shim control blades. Authorization was received from the Interim 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.

In review of the Nuclear Data Sheets from May 30, 2018, which requires shim control blade height to be logged hourly, the last time the shim control blades where shimmed in the inward direction was between 01:00 and 02:00, and the last time the shim control blades where shimmed in the outward direction was between 06:00 and 07:00, just prior to the event. While the ability to manually insert the shim control blades may have been unavailable for approximately 6 hours – time between the observed failure and the last time the shim control blades were manually inserted – at no time was the ability to scram the reactor, through automatic initiation or manually by the control room operator, affected by this failure. Switch 1S4 is not a part of the Reactor Safety System. This failure would also not have prevented the Rod Run-In System from functioning normally.

Corrective Actions

When the LSRO discovered that switch 1S4 was inoperable, he immediately initiated a reactor scram and completed all 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 switch 1S4 had failed – contact 1, which supplies common supply power for inward motion for all four (4) shim control blades, would not close when switch 1S4 was in the "In" position. Switch 1S4 was replaced and retest was conducted satisfactorily, which included verifying inward and outward movement of all four (4) shim control blades.

Additionally, this event has been entered into the MURR Corrective Action Program as CAP No. 18-0053. 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. Meffert
Reactor Manager

ENDORSEMENT:
Reviewed and Approved,

Matthew R. Sanford
Interim Reactor Facility Director

State of Missouri
County of Boone
Subscribed and sworn to before me this 11 day of June 2018
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