University of Missouri

Research Reactor Center
1513 Research Park Drive
Columbia, MO 65211
PHONE 573-882-4211
WEB murr.missouri.edu

January 31, 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 3.3.a(1)

The attached document provides the University of Missouri-Columbia Research Reactor (MURR) Licensee Event Report (LER) for an event that occurred on January 21, 2019, that resulted in a deviation from MURR Technical Specification 3.3.a(1).

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

Attachment
U.S. Nuclear Regulatory Commission
January 31, 2019

Licensee Event Report No. 19-01 – January 21, 2019
University of Missouri Research Reactor

Introduction

On January 21, 2019, with all four (4) shim control rods fully inserted into the reactor core, a deviation from Technical Specification (TS) 3.3.a(1) occurred during performance of a reactor pre-startup checklist due to test jumpers being installed while electrical power was available to all four (4) shim control rod drive mechanism (CRDM) electromagnets. For approximately 10 seconds, electrical power was available to the shim CRDM electromagnets while electrical test jumpers, which hold anti-siphon system isolation valves V543A and V543B closed during surveillance testing, were inserted. In effect, the anti-siphon system was considered not operable while the reactor was technically operating even though all four (4) shim control rods were fully inserted and a reactor startup had not commenced. With the reactor in operation at the same time that the anti-siphon system was not operable is a deviation from TS 3.3.a(1) which states, "*The reactor shall not be operated in Mode I or II unless the following components or systems are operable: (1) Anti-siphon system; .....*"

For approximately 10 seconds, the reactor was considered in operation per TS Definition 1.23 while the anti-siphon system was not operable.

Background – Technical Specification Relationship between Anti-Siphon System Operability and Reactor in Operation

A. Technical Specification Definitions

1.17 **Operational Modes** - The reactor may be operated in any of three (3) operating modes, depending upon the configuration of the reactor coolant systems and the protective system set points.

a. **Operational Mode I** - Reactor can be operated at a thermal power level of ten megawatts or less.

b. **Operational Mode II** - Reactor can be operated at a thermal power level of five megawatts or less.

c. **Operational Mode III** - Reactor can be operated at a thermal power level of fifty kilowatts or less.

1.23 **Reactor in Operation** - The reactor shall be considered in operation unless it is either shutdown or secured.

1.26 **Reactor Secured** - The reactor shall be considered secured when:

a. There is insufficient fuel in the reactor core to attain criticality with optimum available conditions of moderation and reflection with all four (4) shim blades (rods) removed,

OR

b. Whenever all of the following conditions are met:

(1) All four shim blades (rods) are fully inserted;

(2) One of the two following conditions exists:

i. The Master Control Switch is in the "OFF" position with the key locked in the key box or in custody of a licensed operator,

OR

ii. The dummy load test connectors are installed on the shim rod drive mechanisms and a licensed operator is present in the reactor control room;

(3) No work is in progress involving the transfer of fuel in or out of the reactor core;

(4) No work is in progress involving the shim blades (rods) or shim rod drive mechanisms with the exception of installing or removing the dummy load test connectors; and

(5) The reactor pressure vessel cover is secured in position and no work is in progress on the reactor core assembly support structure.

1.27 **Reactor Shutdown** - The reactor is shutdown when:

a. It is subcritical by at least 0.0074 Δk/k in the reference core condition with the reactivity worth of all installed experiments included,

AND

b. All four (4) of the shim blades (rods) are fully inserted and power is unavailable to the shim rod drive mechanism electromagnets.

Operational Mode I is defined by the MURR Safety Analysis Report (SAR) as, "At power levels of up to 10 MW with the primary coolant system pressurized and at a flow rate of approximately 3,750 gpm (14,195 lpm), and a pool coolant flow rate of approximately 1,100 gpm (4,164 lpm); used when all heat exchange and pumping capacity is available."

B. Conditions During the Event with Respect to Technical Specification Definitions

1. MURR was not secured per TS Definition 1.26 because condition 1.26.a and either of the two (2) conditions of 1.26.b(2) were not met.
2. MURR was not shut down per TS Definition 1.27 because electrical power was available to the shim CRDM electromagnets; therefore, condition 1.27.b was not met.
3. The primary and pool coolant systems were operating, and instrumentation was configured for Operational Mode I.
4. Given statements 1, 2 and 3 above, MURR was in Operational Mode I per the definitions of TS 1.23 and the SAR.
5. The anti-siphon system was inoperable with the installation of electrical test jumpers, which maintained anti-siphon system isolation valves V543A and V543B closed.

The above statements 4 and 5 combined caused a deviation from TS 3.3.a(1), which states, "*The reactor shall not be operated in Mode I or II unless the following components or systems are operable: (1) Anti-siphon system; .....*"

Description of the Reactor Scram System and the Anti-Siphon System

The reactor scram system consists of the electronic circuitry which can initiate the instantaneous drop of the reactor control blades (reactor scram) by interrupting power to their electromagnets should a monitored parameter exceed a predetermined value. The protection channels and protective responses are sufficient to ensure that no safety limit, limiting safety system settings, or reactor scram system limiting condition for operation will be exceeded.

The reactor scram system consists of two (2) noncoincidence logic units (NCLUs) and two (2) trip actuation amplifiers (TAAs) located in the reactor control room instrument panel. The NCLUs receive input signals from the neutron monitoring and process instruments and provide outputs to control the TAAs. The TAAs are arranged in parallel, each controlling current to two (2) control blade electromagnets. Should an input signal to either NCLU be interrupted, the TAAs will de-energize and interrupt current to the shim CRDM electromagnets. In addition, master control switch 1S1 and magnet current switch 1S14, both located on the reactor control console, are available to secure 115-VAC supply power to the TAAs.

The anti-siphon actuation system functions as a backup system to the various safety instrumentation and equipment (e.g., pressure sensors, pump and valve interlocks, etc.) which ensures that the reactor core does not become uncovered during a loss of coolant accident (LOCA).

The anti-siphon actuation system is automatically actuated upon detection of primary coolant system low pressure. System pressure is monitored by two (2) electronic pressure transmitters (PT 944A and PT 944B) located on the 12-inch primary coolant piping between the reactor pressure vessel and primary coolant isolation valve V507A. Should primary coolant system pressure decrease below a predetermined value, PT 944A and PT 944B will de-energize relays 2K13 and 2K28, respectively, either of which will cause the following actions to occur:

1. Reactor will scram: relay 2K13 will open a contact in the process input string to E4A and relay 2K28 will open a contact in the process string to E3B of the reactor scram system NCLUs;
2. Primary coolant circulation pumps P501A and P501B will stop;
3. Primary coolant isolation valves V507A and V507B will close; and
4. Anti-siphon system isolation valves V543A and V543B will open.

The opening of valves V543A and V543B admit a fixed volume of air to the high point of the reactor outlet piping, or invert loop, instantaneously establishing the pressure in this area at equal to or greater than atmosphere. This prevents a siphon action from being created due to a rupture of the primary coolant piping which could potentially uncover the reactor core.

Detailed Event Description

On January 21, 2019, at approximately 12:35 CST with the reactor shutdown for regularly scheduled maintenance activities, the primary coolant system was being started prior to conducting a normal reactor startup. During this time, electrical test jumpers, which hold anti-siphon system isolation valves V543A and V543B closed, were inserted in accordance with a temporary procedure (standing order) supplementing the normal primary coolant system startup procedure. Immediately after the primary coolant system was started, the Lead Senior Reactor Operator (LSRO) placed magnet current switch 1S14 to the "ON" position and reset the scram TAAs, which supplied electrical power to the shim CRDM electromagnets. The LSRO then promptly realized that he should have waited to reset the scram TAAs until after the electrical test jumpers were removed; therefore, he immediately placed magnet current switch 1S14 to the "OFF" position, which secured electrical power to the electromagnets. In addition, he directed a Reactor Operator to remove the electrical test jumpers holding valves V543A and V543B closed.

For the approximately 10 seconds in which electrical power was available to the shim CRDM electromagnets, the reactor was not shutdown as defined by TS 1.27 nor was it secured as defined by TS 1.26. Therefore, the reactor was in operation as defined by TS 1.23. With the electrical test jumpers installed holding valves V543A and V543B closed, the anti-siphon system was not operable. With the reactor in operation at the same time that the anti-siphon system was not operable is a deviation from TS 3.3.a(1), which states, "*The reactor shall not be operated in Mode I or II unless the following components or systems are operable: (1) Anti-siphon system; .....*"

Though this event happened at approximately 12:35 CST, it was not fully identified as a deviation from TS 3.3.a(1) until approximately 16:25 CST, after a reactor startup was performed to 10 MW operation. Once the TS deviation and abnormal occurrence, as defined by TS 1.1.b, was realized, the Reactor Facility Director was notified at 17:15 CST, and he gave permission to continue reactor operation.

Safety Analysis

The basis for TS 3.3.a(1) is to assure that the reactor core will remain covered during a LOCA. The MURR LOCA analysis is based on a double-ended rupture of 12-inch primary coolant piping with the reactor operating at a steady-state power level of 10 MW and a core at near equilibrium fission product inventory and significant decay heat. On January 21, prior to this event, the reactor was shut down. Therefore, the anti-siphon system not being operable while the reactor was technically operating by TS definition, though at a shutdown power level, was a deviation from the performance specification provided in TS 3.3.a(1) but did not represent an undue safety hazard or concern for the reactor, staff, or general public.

Corrective Actions

When the LSRO realized that he should have waited to reset the scram TAAs until after the electrical test jumpers were removed, he immediately placed magnet current switch 1S14 to the "OFF" position, which secured electrical power to the shim CRDM electromagnets. In addition, he directed a Reactor Operator to remove the electrical test jumpers holding valves V543A and V543B closed. Placing magnet current switch 1S14 to the "OFF" position shut down the reactor satisfying TS 1.27.

Later, after the reactor was operating at 10 MW, a conversation between the Reactor Manager and the LSRO revealed the deviation from TS 3.3.a(1).

The next day, January 22, the Reactor Manager added a step to the temporary procedure (standing order) supplementing the normal primary coolant system startup procedure to ensure that the dummy load test connectors are in place prior to installing the electrical test jumpers, which hold anti-siphon system isolation valves V543A and V543B closed. With the dummy load test connectors installed, electrical power cannot be supplied to the shim CRDM electromagnets; thereby, ensuring the reactor is always in a shutdown condition while the anti-siphon system is not operable.

As a long-term corrective action, form FM-57, "Long Form Startup Checksheet," has also been revised to add a step to ensure 'Jumper Board In Use' annunciation is cleared prior to removing the dummy load test connectors. This action should minimize the potential for the reactor to be in operation with any electrical test jumpers in place.

Additionally, this event has been entered into the MURR Corrective Action Program as CAP No. 19-0010. 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,

J. David Robertson, PhD
Reactor Facility Director

State of Missouri
County of Boone
Subscribed and sworn to before me this
31 day of January, 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