

July 17, 2017

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Mail Station P1-37  
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 3.5.a.3 and its associated note (1)

The attached documents provide the University of Missouri-Columbia Research Reactor (MURR) Licensee Event Report (LER) for an event that occurred on July 4, 2017, that resulted in a deviation from MURR Technical Specification 3.5.a.3 and its associated note (1).

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

Sincerely,



Ralph A. Butler, P.E.  
Director

RAB: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. Johnny Eads, U.S. Nuclear Regulatory Commission

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NRR

**Licensee Event Report No. 17-05 – July 4, 2017**  
**University of Missouri Research Reactor**

**Introduction**

On July 4, 2017, during a normal reactor startup with the reactor subcritical and the four (4) shim control blades withdrawn five (5) inches from their fully inserted positions and banked, reactor operations' personnel noticed that Source Range Nuclear Instrumentation Channel 1 (SRM-1) was providing erratic indication. The reactor startup was aborted by manual scram. All immediate and subsequent actions of reactor emergency procedure REP-2, "Manual Scram," were completed. Failure of SRM-1 resulted in a deviation from Technical Specification (TS) 3.5.a.3 and its associated note (1), which states, "*The reactor shall not be operated unless the following instrument channels are operable:*". In the table that lists the instrument channels of 3.5.a, the third instrument channel listed is the "*Source Range Nuclear Instrument Channel*" with one (1) channel required for Mode 1 (10 MW) operation. Note (1) states that a Source Range Nuclear Instrument Channel is "*Required for reactor startup only.*" It was determined that SRM-1 was not operable during this reactor startup.

**Description of the Source Range Nuclear Instrument Channels**

The Source Range Nuclear Instrument Channels monitor count rate over a six-decade range of reactor power from  $10^{-1}$  to  $10^5$  cps. SRM-1 is the source range monitor on Signal Processor No. 1, and Source Range Nuclear Instrument Channel 2 (SRM-2) is the source range monitor on Signal Processor No. 2. Source range levels and periods are independently displayed on each signal processor by linear bar graphs. Source range level and period from SRM-1 are displayed on analog meters located on the reactor control console. A strip-chart, one-pen recorder mounted on the instrument panel records the source range level from SRM-1.

The discriminated output signals of both source range channels from SRM-1 and SRM-2 are also transmitted to a multiscaler mounted on the instrument panel. The multiscaler is used to monitor the shutdown core, presence of the neutron source, and the proper response to changes in reactivity when the control rods are initially withdrawn during reactor startup.

**Detailed Event Description**

On July 4, 2017, at 01:44, a reactor startup was commenced. At 01:49, the four (4) shim control blades were banked at five (5) inches withdrawn from their fully inserted positions. At ~ 01:52, a 1/M value of 0.56 was calculated. Normal values for 1/M at this step in the startup range between 0.7 and 0.9. Therefore, reactor operators and management started to investigate why the 1/M value was low.

Operators noticed the source range count rate on the console meter, the chart recorder, and the multiscaler was varying back and forth between 110 to 200 cpm over a few minute timeframe. Since the shim control blades were positioned more than nine (9) inches below the estimated critical position and independent source range and intermediate range nuclear instrument channels from Signal Processor No. 2 were showing the reactor well below criticality, the Reactor Manager allowed the shim control blades to remain

at five (5) inches withdrawn to assess SRM-1 indication. It was also noted at this time that the SRM-1 count rate at the beginning of the reactor startup had been ~110 cpm, higher than the historical range of 50 to 90 cpm for SRM-1. At 02:32, the reactor startup was terminated by manual scram. All immediate and subsequent actions of reactor emergency procedure REP-2, "Manual Scram," were completed.

Failure of SRM-1 resulted in a deviation from TS 3.5.a.3 and its associated note (1), which states, "*The reactor shall not be operated unless the following instrument channels are operable:*" In the table that lists the instrument channels of TS 3.5.a, the third instrument channel listed is the "*Source Range Nuclear Instrument Channel*" with one (1) channel required for Mode 1 (10 MW) operation. Note (1) states that a Source Range Nuclear Instrument Channel is "*Required for reactor startup only.*" It was determined that the SRM-1 was not operable during this reactor startup. It could be argued that SRM-2 was working properly; therefore, TS 3.5.a.3 would be satisfied by the installed spare source range nuclear instrument channel. However, since the console meter and the strip chart recorder both are driven by SRM-1, reactor operators routinely observe the startup on these indications which are easier to read than the linear bar graphs on the front of the signal processors.

Subsequent troubleshooting efforts revealed that the erratic indication on SRM-1 was caused by a failed power supply in Signal Processor No.1.

### **Safety Analysis**

During the failure of SRM-1, the reactor was operating at a subcritical power level, and a reactor startup was in progress. After the 1/M value was calculated to be 0.56 from SRM-1 indication, a 1/M value was estimated from SRM-2 indication to be 0.8. In addition, the intermediate range instrument channels from both signal processors indicated a power level well below criticality.

The basis for the Source Range Nuclear Instrument Channel is to provide a neutron monitor that is very sensitive to neutrons and thus provides improved indication of the low neutron flux levels present during a reactor startup (Reference: Section 7.4 of the Safety Analysis Report).

SRM-1 is not part of the reactor safety system as defined by TS 1.24, which states, "*The reactor safety system is that combination of sensing devices, electronic circuits and equipment, signal conditioning equipment, and electro-mechanical devices that serves to either effect a reactor scram, or activates the engineered safety features.*"

### **Corrective Action**

The reactor was shut down by manual scram once SRM-1 was deemed inoperable. After the reactor was shut down and secured, troubleshooting efforts on SRM-1 revealed a failed power supply in Signal Processor No. 1. The failed power supply was replaced. Post-maintenance testing included the performance of compliance procedure CP-35A, "Nuclear Instrumentation Signal Processor No. 1," which tests for proper operation of Signal Processor No. 1 and the Signal Processor No. 1's portion of

compliance procedure CP-9, "Nuclear Instrumentation Scram and Rod Run-In," which tests that the signal processor activates reactor scrams and rod run-ins as designed.

To minimize the potential of commencing a reactor startup in the future with an inoperable Source Range Nuclear Instrument Channel, the preparation section of operating procedure OP-RO-210, "Reactor Startup – Normal," will be revised to have the reactor operator verify SRM-1 count rate is within a normal historical range. The normal range will be provided to reactor operators. If SRM-1 count rate is outside the normal range, the procedure will require the Lead Senior Reactor Operator to determine the cause of the out-of-range condition prior to withdrawing the shim control blades for reactor startup.


Additionally, this event has been entered into the MURR Corrective Action Program as CAP entry No. 17-0090, and any additional improvements or corrective actions will be considered.

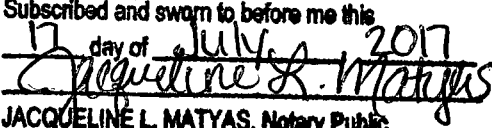
If there are any questions regarding this LER, please contact me at (573) 882-5118. I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

  
Bruce A. Meffert  
Reactor Manager

ENDORSEMENT:  
Reviewed and Approved,

  
Ralph A. Butler, P.E.  
Director

State of Missouri  
County of Boone  
Subscribed and sworn to before me this  
17 day of July, 2017  
  
JACQUELINE L. MATYAS, Notary Public  
My Commission Expires: March 26, 2019



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