UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 31, 2023

Mr. Matthew Sanford
Interim Reactor Facility Director
University of Missouri-Columbia
Research Reactor Center
1513 Research Park Drive
Columbia, MO 65211

SUBJECT: THE CURATORS OF THE UNIVERSITY OF MISSOURI – U.S. NUCLEAR REGULATORY COMMISSION ROUTINE INSPECTION REPORT NO. 05000186/2022202

Dear Mr. Sanford:

From October 24-27, 2022, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a routine announced safety inspection at the University of Missouri-Columbia Research Reactor facility. The enclosed report presents the results of that inspection.

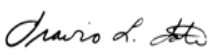
The inspection examined activities conducted under your license as they relate to public health and safety to ensure compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and representative records, observed various activities, and interviewed personnel.

Based on the results of this inspection, the NRC has determined that two Severity Level IV violations of NRC requirements occurred. The violations are being treated as non-cited violations (NCVs), consistent with Section 2.3.2.a of the Enforcement Policy. The NCVs are described in the subject inspection report. If you contest the violations or significance of the NCVs, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001, with copies to the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

In accordance with Title 10 of the *Code of Federal Regulations*, Section 2.390, "Public inspections, exemptions, requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

If you have any questions concerning this inspection, please contact Craig Bassett at (240) 535-1842, or by email to Craig.Bassett@nrc.gov.

Sincerely,


Signed by Tate, Travis
on 01/31/23

Travis L. Tate, Chief
Non-Power Production and Utilization Facility
Oversight Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-186
License No. R-103

Enclosure:
As stated

cc: See next page

cc:

Ronald Astrino, Reactor Manager
Reactor and Facilities Operations
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Missouri Department of Natural Resources
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Jefferson City, MO 65101

Test, Research and Training
Reactor Newsletter
Attention: Amber Johnson
Dept of Materials Science and Engineering
University of Maryland
4418 Stadium Drive
College Park, MD 20742-2115

SUBJECT: UNIVERSITY OF MISSOURI-COLUMBIA – U.S. NUCLEAR REGULATORY COMMISSION ROUTINE INSPECTION REPORT NO. 05000186/2022202 DATED: JANUARY 31, 2023

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No.:	50-186
License No.:	R-103
Report No.:	05000186/202202
Licensee:	The Curators of the University of Missouri
Facility:	University of Missouri-Columbia Research Reactor
Location:	Columbia, Missouri
Dates:	October 24-27, 2022
Inspector:	Craig Bassett
Accompanied by:	Michael Takacs, Security Specialist/Inspector
Approved by:	Travis L. Tate, Chief Non-Power Production and Utilization Facility Oversight Branch Division of Advanced Reactors and Non-Power Production and Utilization Facilities Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

The Curators of the University of Missouri
University of Missouri-Columbia Research Reactor
Inspection Report No. 05000186/2022202

The primary focus of this routine, announced safety inspection included the onsite review of selected aspects of the University of Missouri Research Reactor (MURR) facility safety program, including: (1) operator licenses, requalification, and medical examinations; (2) experiments; (3) organization and operations and maintenance activities; (4) review and audit and design change functions; (5) procedures; (6) fuel movement; (7) surveillance; and (8) abnormal occurrence follow-up. The U.S. Nuclear Regulatory Commission (NRC) staff determined the licensee's program was acceptably directed toward the protection of public health and safety, and in compliance with the NRC requirements.

Operator Licenses, Requalification, and Medical Examinations

- Operator training and requalification, as well as medical examinations, were completed as required by regulations and the requalification program.

Experiments

- The program for reviewing, changing, and conducting experiments satisfied technical specifications (TSs) and current procedural requirements.

Organization and Operations and Maintenance Activities

- Organization and staffing were in compliance with the TS requirements.

- Operations were conducted in accordance with procedures, appropriate logs were maintained, and the work control program was used for timely and effective completion of maintenance activities.

Review and Audit and Design Change Functions

- Review, audit, and oversight functions required by the TSs were completed by the Reactor Advisory Committee (RAC) as required by the TSs.

- Changes to the facility were evaluated using the criteria specified in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Changes, tests and experiments," and were reviewed and approved as required.

Procedures

- The procedure review, revision, control, and implementation program satisfied TS requirements.

Fuel Movement

- Fuel movements and inspections were conducted in accordance with TS and procedural requirements.

Surveillance

- Surveillance activities at the facility were completed within the TS-prescribed time frames.

Event Follow-up

- One previously identified Inspector Follow-up Item (IFI) and two event notifications/reports were reviewed and closed.

REPORT DETAILS

Summary of Facility Status

The University of Missouri-Columbia continued to operate the 10 megawatt research reactor in support of isotope production, irradiation services, research, education, and training.

1. Operator Licenses, Requalification, and Medical Examinations

a. Inspection Scope (Inspection Procedure (IP) 69003)

The inspector reviewed the following to verify that the requirements of 10 CFR Part 55, "Operators' Licenses," were met:

- results of the biennial licensed operator requalification exam for 2021
- results of the 2021 annual operating test records for licensed operators
- various reports and logs documenting operators' completion of licensed activities
- NRC Form 396, "Certification of Medical Examination by Facility Licensee," for selected licensed operators
- "Operator Requalification Program, University of Missouri Research Reactor (MURR)" submitted January 7, 1997
- MURR Administrative Procedure (AP), AP-RO-105, "MURR Operator Requalification Process," Revision (Rev.) 1

b. Observations and Findings

The inspector found that there were 11 senior reactor operators (SROs) and 9 reactor operators (ROs) currently licensed at MURR. In addition, there were five individuals in the operator training program. The inspector confirmed that the licensed SROs and ROs who were assigned to a shift/crew met the requalification program requirements for maintaining their licenses in active status. The inspector also confirmed that examination records documented the adequacy of licensee administered examinations. The inspector verified that operators' licenses were current and were renewed as required by 10 CFR 55.57, "Renewal of licenses." In addition, the inspector verified that the operators received biennial medical examinations as required by the regulations.

c. Conclusion

The inspector determined that operator training, requalification, and medical examinations were conducted as required by the MURR Operator Requalification Program and NRC regulations.

2. Experiments

a. Inspection Scope (IP 69005)

The inspector reviewed the licensee's program for conducting experiments and selected aspects of the following to verify compliance with TSs 3.8 and 6.5:

- listing of current experiments
- various reactor utilization request proposal and evaluation packages
- "RUR Summary Sheets Manual" listing summaries of experiments that can be performed in the "Flux Trap or All Positions" or in the "Reflector Only"
- MURR Procedure AP-RO-135, "Reactor Utilization Requests," Rev. 5
- MURR 2020 reactor operations annual report
- MURR 2021 reactor operations annual report

b. Observations and Findings

The inspector found that experiments conducted at the facility were required to be evaluated and reviewed using MURR Procedure AP-RO-135. The inspector noted that the procedure required different types of approval depending on the class of the experiment and whether the experiment required further review pursuant to 10 CFR 50.59. The inspector verified that the experiments were reviewed and approved as required by procedure.

The inspector confirmed that the experiments in progress during the inspection were conducted under the cognizance of the reactor manager and the licensed lead SRO, and in accordance with TS requirements (e.g., thermal, corrosive, reactivity limitations, etc.). The materials produced during the experiments were handled and transferred as required by TSs and licensee procedures.

c. Conclusion

The inspector determined that the program for reviewing, approving, and conducting experiments satisfied TS and procedural requirements.

3. Organization and Operations and Maintenance Activities

a. Inspection Scope (IP 69006)

To verify compliance with the licensee's TS requirements, the inspector reviewed selected aspects of the licensee's organization, operations, and preventative maintenance program, including:

- facility annual reports for the past 2 years
- various MURR control room logbooks for 2022
- current TSs for the facility and current MURR staffing
- selected compliance check and preventive and special maintenance procedures
- selected records for maintenance activities performed in 2021 and to date in 2022
- various other MURR procedures including: MURR Procedures, AP-RR-001, "Corrective Action Program," Rev. 14, and AP-RO-110, "Conduct of Operations," Rev. 29; and MURR Operating Procedure (OP), OP-RO-210, "Reactor Startup – Normal," Rev. 23 and OP-RO-220, "Reactor Shutdown or Power Reduction," Rev. 14
- selected corrective action program (CAP) records

b. Observations and Findings

(1) Organization and Staffing

The inspector found the organizational structure at the facility remained unchanged since the last inspection. Through the review and observation of operating shifts, the inspector confirmed that staffing during reactor operations consisted of at least two facility staff personnel (one SRO/RO and one knowledgeable individual) as required by TS 6.1.c.

(2) Operations

During the inspection, the inspector observed various operations activities. The inspector observed that written procedures and checklists were used for these activities as required by TSs. The inspector noted staff members were knowledgeable and professional in the conduct of their duties, adhered to procedures, and maintained the required logs and records.

(3) Maintenance

The inspector verified that specific maintenance and compliance check procedures were used by the licensee to document the results of the work that was completed. The inspector confirmed that equipment was monitored and maintained as required by TSs.

(4) Corrective Action Program

The inspector noted that the licensee's CAP was developed to provide staff members with a formal process to identify deficiencies and bring safety issues to management's attention for resolution. Based on a review of a sample of CAP documents, the inspector verified that the licensee's program to identify and record issues, and take corrective actions, was an effective method to resolve deficiencies and safety concerns at MURR.

c. Conclusion

The inspector determined that the organization and staffing complied with the TS requirements; operations and maintenance were completed in accordance with the TSs and procedures; and the licensee's CAP assisted in resolving safety concerns.

4. Review and Audit and Design Change Functions

a. Inspection Scope (IP 69007)

To verify compliance with the licensee's TS requirements for conducting reviews and audits and 10 CFR 50.59 evaluations, the inspector reviewed selected aspects of the licensee's program, including:

- current TSs for the facility
- facility annual reports for the past 2 years
- various "50.59 Screens" and modification records

- MURR Procedures AP-RR-003, “10 CFR 50.59 Evaluations,” Rev. 15 and AP-RO-115, “Modification Records,” Rev. 13
- meeting minutes from July 2021 through October 2022 for the RAC; Reactor Safety Subcommittee; Reactor Safety Procedure Review Subcommittee; Isotope Use Subcommittee; and Isotope Use Procedure Review Subcommittee

b. Observations and Findings

(1) Review and Audit Functions

The inspector found the composition of the RAC was as specified in TS 6.2.a. The inspector also found that the committee (or subcommittees) met as required by TS 6.2.b, and provided the reviews as specified in TS 6.2.a. The inspector noted that topics of the reviews were as required by TSs and provided independent oversight to ensure safe operations of the reactor. Based on records review and interviews, the inspector verified the 2021 audits pertaining to facility operations, the operator requalification program, corrective action items, and the emergency plan were completed as required by TS 6.2.e(1)i-iv.

(2) Design Change Function

The inspector noted that, in order to satisfy the regulatory requirements stipulated in 10 CFR 50.59, the licensee established a design change review program which was implemented through the procedures noted above. The inspector confirmed that the program included screening and safety reviews of changes, tests, or experiments to determine if, pursuant to 10 CFR 50.59, a change required the NRC’s approval prior to implementation. The inspector confirmed that the licensee was adhering to the procedures and regulations which guided the review process.

c. Conclusion

The inspector determined that review, audit, and oversight functions required by the TS were completed. The inspector also determined that changes to the facility were evaluated using the criteria specified in 10 CFR 50.59 and were reviewed and approved as required by procedure.

5. Procedures

a. Inspection Scope (IP 69008)

To verify compliance with the licensee’s TS requirements for procedures, the inspector reviewed selected aspects of the licensee’s program, including:

- current TSs for the facility
- facility annual reports for the past 2 years
- status of completed form FM-5 reviews for operations procedures
- FM-5, “Facility-Controlled Document Revision and Annual Review Form,” Rev. 21

b. Observations and Findings

The inspector reviewed the process to review, approve, and change procedures. The inspector noted that facility procedures were developed for the operation of the reactor, as required by TS 6.4.a. The inspector found that all operations procedures were reviewed and approved by the Reactor Manager as required by TS 6.4.c. Through observations during the inspection, the inspector confirmed that operations were conducted in accordance with approved procedures. The inspector also verified that a summary of procedures changes was included in the annual report as required by TS 6.6.e(5).

c. Conclusion

The inspector determined that the procedure review, revision, control, and implementation program satisfied TS requirements.

6. Fuel Movement

a. Inspection Scope (IP 69009)

To verify compliance with the licensee's TS requirements regarding reactor fuel, the inspector reviewed selected aspects of the licensee's program, including:

- current TSs for the facility
- MURR control room logbooks for 2022
- "Fuel Location Maps," for Cores 22-01 through 22-47
- MURR Procedure, OP-RO-250, "In-Pool Fuel Handling," Rev. 24
- completed FM-08 forms, "Fuel Movement Sheet," for Cores 22-01 through 22-47

b. Observations and Findings

The inspector reviewed the fuel movement process and observed fuel element movement operations during the inspection. The inspector verified that the licensee moved fuel according to established procedures and selected fuel movement sheets as required by TSs. The inspector confirmed that fuel handling tools were maintained and were secured when not in use. The inspector also compared the current location of selected fuel elements in the reactor core (as illustrated by a printed core configuration map) with the information maintained on the fuel status boards in the control room and on the fuel movement sheets. The inspector verified that fuel was inspected and used and stored in the required and approved locations.

c. Conclusion

The inspector determined that fuel movements and inspections were conducted in accordance with TS and procedural requirements.

7. Surveillance

a. Inspection Scope (IP 69010)

To verify compliance with the licensee's TS requirements for surveillances, the inspector reviewed selected aspects of the licensee's program, including:

- current TSs for the facility
- MURR control room logbooks for 2022
- facility annual reports for the past 2 years
- various completed compliance check procedures and associated records

b. Observations and Findings

The inspector verified that routine maintenance and surveillance activities including verifications, calibrations, and testing of various reactor systems, instrumentation, auxiliary systems, and security systems and alarms, were completed by the licensee during weekly routine shutdowns for reactor refueling. The inspector noted records documented that the required tests, checks, verifications, and calibrations were completed on schedule and in accordance with licensee procedures. The results of various completed compliance check procedures reviewed by the inspector were found to be within the TS and procedurally prescribed parameters.

c. Conclusion

The inspector determined that surveillance activities at the facility were completed within the TS-prescribed time frames and parameters.

8. Follow-up

a. Inspection Scope (IP 92701)

The inspector reviewed the licensee's actions taken in response to an IFI and three Licensee Event Notifications/Reports including:

- letter from the licensee to the NRC regarding an abnormal occurrence, dated October 25, 2021 (NRC Event No. 55516)
- letter from the licensee to the NRC regarding an abnormal occurrence, dated November 23, 2021 (NRC Event No. 55568)
- letter from the licensee to the NRC regarding an abnormal occurrence, dated November 23, 2021 (NRC Event No. 55583)

b. Observations and Findings

(1) 05000186/2021203-03 – IFI – Follow-up on the results of bench testing the component that caused the setpoint deviation in pressure transmitter 994B.

On October 12, 2021, pursuant to TS 6.6.c(1), the licensee notified the NRC of an abnormal occurrence at the facility. This was noted by the NRC as Event # 55516. The licensee subsequently issued a report to the NRC concerning this event dated

October 25, 2021. During an inspection in November 2021, the inspector reviewed the event and the licensee's corrective actions.

The inspector noted that the licensee was bench testing the component that caused the setpoint deviation. This test was scheduled to last for up to 12 months to try and determine the cause of the component malfunction. Since the component was to be tested for a lengthy period, follow-up on the results of the bench testing was identified as a follow-up item.

During this inspection, the inspector reviewed the results of the licensee bench testing of the component. The licensee initially bench tested the component for three months and found no deviation in function. In May 2022, the licensee began another test of the component and to date there were no deviations in function. This issue is considered closed.

(2) Abnormal Occurrence requiring notification of the NRC pursuant to TS 6.6.c(1)

On November 9, 2021, the licensee notified the NRC of an abnormal occurrence at the facility. This was noted by the NRC as Event # 55568. The licensee subsequently issued a report to the NRC concerning this event dated November 23, 2021.

During this inspection, the inspector reviewed this event and found that on November 8, 2021, while the reactor was shut down for maintenance, technicians conducted surveillance testing of the anti-siphon system high level rod run-in instrument channel. The test indicated the rod run-in actuation may not have occurred at the required water level above the anti-siphon isolation valves. TS 3.2.f.6 requires that the reactor shall not be operated unless the rod run-in functions that occurs when water level in the anti-siphon system is greater than or equal to 6 inches above the anti-siphon isolation valves. The licensee then began troubleshooting the system and determined the cause of the problem. This issue was corrected, and, upon retesting, the channel was found to be functioning properly and in compliance with the TS requirements.

The inspector reviewed the licensee's actions which included increasing the frequency of the set point checks of the system from semiannually to monthly. A standing order was also issued to ensure that all operators were aware of the problem and the increased frequency of the system checks. In addition, the licensee revised the Compliance Check Procedure pertaining to the system to indicate the parameters more clearly for the compliance check. The inspector found that the licensee's actions were satisfactory and complete.

The licensee was informed that the failure to maintain the anti-siphon system high level rod run-in instrument channel operable as required was a Severity Level IV violation of TS 3.2.a. However, as indicated above, the inspector determined that the problem was identified by the licensee and reported to the NRC. Corrective actions were identified and completed as well. As a result, this non-willful, non-repetitive, licensee-identified and licensee-corrected violation will be treated as an non-cited violation (NCV), consistent with Section 2.3.2.a of the NRC Enforcement Policy (NCV 05000186/2022202-01). This issue is considered closed.

(3) Abnormal Occurrence requiring notification of the NRC pursuant to TS 6.6.c(1)

On November 16, 2021, the licensee notified the NRC of an abnormal occurrence at the facility. This was noted by the NRC as Event # 55583. The licensee subsequently issued a report to the NRC concerning this event dated November 23, 2021.

During this inspection, the inspector reviewed this event. The inspector found that on November 15, 2021, while the reactor was shut down, operators shut down the pool coolant system and noticed that the "Reflector Hi-Low Diff Pressure Scram" annunciator alarm did not initiate as the pool coolant flow rate decreased to zero. This was determined to be an Abnormal Occurrence as defined by MURR TS 1.1 because MURR was not in compliance with one of the TS Limiting Conditions for Operation. TS 3.2.g states, "The reactor safety system and the number (N) of associated instrument channels necessary to provide the following scrams shall be operable whenever the reactor is in operation...." Specifically, the reactor safety scram function that should occur when the differential pressure across the reactor pool reflector (PT-917) instrument channel decreases below 2.52 pounds per square inch minimum in Mode 1 operation was not operable as required by TS 3.2.g.10.

During this inspection, the inspector reviewed the licensee's corrective actions. After identifying that the problem occurred because the safety scram signal from the PT-917 instrument channel alarm-meter unit failed, the alarm-meter unit was replaced with an exact spare, the PT-917 instrument channel was calibrated, and the reactor safety scram functions of the PT-917 instrument channel were retested satisfactorily. The licensee also revised MURR operating procedures dealing with reactor shut down, the primary coolant system, and the pool coolant system to ensure that Control Room operators continued to verify the correct plant shutdown indications on the annunciator panel. The inspector found that the licensee's actions were satisfactory and complete.

The licensee was informed that failure of the "Reflector Hi-Low Diff Pressure Scram" annunciator alarm to be operable as required was a Severity Level IV violation of TS 3.2.g.10. As indicated above, the inspector determined that the problem was identified by the licensee and reported to the NRC. Corrective actions were identified and completed as well. As a result, this non-willful, non-repetitive, licensee-identified and licensee-corrected violation will be treated as an NCV, consistent with Section 2.3.2.a of the NRC Enforcement Policy (NCV 05000186/2022202-02). This issue is considered closed.

c. Conclusion

The inspector reviewed a previously identified IFI and two Licensee Event Notifications/Reports which are now considered closed.

9. Exit Interview

The inspection scope and results were reviewed with the licensee on October 27, 2022. The inspector discussed the findings for each area reviewed. The licensee acknowledged the findings.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

R. Astrino	Reactor Operations Manager
C. Braun	Assistant Reactor Manager – Engineering
D. Doenges	Health Physics and Safety Manager
R. Gibson	Assistant Reactor Manager – Operations
R. Hudson	Reactor Training Manager
K. Kutikkad	Assistant Reactor Manager – Physics
S. McCall	Lead Senior Reactor Operator
M. Pinilla	Assistant Reactor Manager – Physics
L. Primmer	Senior Electrical Technician
J. Register	Senior Compliance Manager – Lead
J.D. Richardson	Lead Senior Reactor Operator
D. Robertson	Reactor Facility Director
J. Rugen	Interim Access Control Assistant
L. Simek	Lead Senior Reactor Operator

INSPECTION PROCEDURES USED

IP 69003	Class I Research and Test Reactor Operator Licenses, Requalification, and Medical Examinations
IP 69005	Class I Research and Test Reactor Experiments
IP 69006	Class I Research and Test Reactor Organization and Operations and Maintenance Activities
IP 69007	Class I Research and Test Reactor Review and Audit and Design Change Functions
IP 69008	Class I Research and Test Reactor Procedures
IP 69009	Class I Research and Test Reactor Fuel Movement
IP 69010	Class I Research and Test Reactor Surveillance
IP 97201	Follow-up

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

05000186/2022202-01	NCV	Failure of the rod run-in function that should occur when water level in the anti-siphon system is greater than or equal to 6 inches above the anti-siphon isolation valves as required by TS 3.2.f.6.
05000186/2022202-02	NCV	Failure of the reactor safety scram function that should occur when the differential pressure across the reactor pool reflector (PT-917) instrument channel decreases below 2.52 pounds per square inch minimum in Mode 1 operation as required by TS 3.2.g.10.

Closed

05000186/2021203-03	IFI	Follow-up on the results of bench testing the component that caused the setpoint deviation in pressure transmitter 994B.
05000186/2022202-01	NCV	Failure of the rod run-in function that should occur when water level in the anti-siphon system is greater than or equal to 6 inches above the anti-siphon isolation valves as required by TS 3.2.f.6.
05000186/2022202-02	NCV	Failure of the reactor safety scram function that should occur when the differential pressure across the reactor pool reflector (PT-917) instrument channel decreases below 2.52 pounds per square inch minimum in Mode 1 operation as required by TS 3.2.g.10.