



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

July 31, 2023

Mr. Matthew Sanford  
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 SAFETY INSPECTION REPORT  
NO. 05000186/2023201

Dear Mr. Sanford:

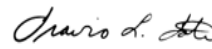
From May 15-18, 2023, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Missouri University Research Reactor facility. The enclosed report presents the results of that inspection, which were discussed on May 18, 2023, with you and members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, observed various activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

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 Publicly Available Records component of the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

If you have any questions concerning this inspection, please contact Andrew Waugh at (301) 415-0230, or by email at [Andrew.Waugh@nrc.gov](mailto:Andrew.Waugh@nrc.gov).

Sincerely,



Signed by Tate, Travis  
on 07/31/23

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 w/enclosure: GovDelivery Subscribers

SUBJECT: THE CURATORS OF THE UNIVERSITY OF MISSOURI – U.S. NUCLEAR  
REGULATORY COMMISSION SAFETY INSPECTION REPORT  
NO. 05000186/2023201 DATED: JULY 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: 05000186/2023201

Licensee: The Curators of the University of Missouri

Facility: Missouri University Research Reactor

Location: Columbia, MO

Dates: May 15-18, 2023

Inspectors: Andrew Waugh  
Craig H. Bassett

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  
Missouri University Research Reactor  
Inspection Report No. 05000186/2023201

The primary focus of this routine announced inspection was the onsite review of selected aspects of the Missouri University Research Reactor (MURR) facility safety program, including: (1) effluent and environmental monitoring; (2) review and audit and design change functions; (3) emergency preparedness; (4) radiation protection; and (5) transportation activities. The U.S. Nuclear Regulatory Commission (NRC) staff determined that the licensee's program was acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

### Effluent and Environmental Monitoring

- The inspectors determined that effluent and environmental was conducted in accordance with technical specifications (TSs) and regulatory requirements.

### Review and Audit and Design Change Functions

- The inspectors determined that the licensee's review and audit functions were conducted in accordance the TS requirements. Changes to equipment, procedures, and experiments were determined to be conducted in accordance with TS, procedural, and regulatory requirements.

### Emergency Preparedness

- The inspectors determined that the licensee's emergency preparedness program was conducted in accordance with the licensee's emergency plan, TS, procedural, and regulatory requirements.

### Radiation Protection

- The inspectors determined that the licensee's radiation protection program was conducted in accordance with TS, procedural, and regulatory requirements.

### Transportation Activities

- The inspectors determined that the licensee's radioactive material transportation program was in accordance with procedural and regulatory requirements.

## REPORT DETAILS

### Summary of Facility Status

MURR continued to operate in support of isotope production, reactor operator training, and various types of research. During the inspection, the reactor resumed operation following the weekly maintenance shutdown to support laboratory experiments and product irradiation.

#### 1. Effluent and Environmental Monitoring

##### a. Inspection Scope (Inspection Procedure [IP] 69004)

The inspectors observed portions of the licensee's environmental sampling process. The inspectors also reviewed the following to ensure the licensee effluent and environmental monitoring program was conducted as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection against Radiation," and TS 3.7 and 4.7:

- 2022 annual operating report
- POL-03, "Radiation Protection Program," dated February 7, 2023
- "2022 Dose to Individual Members of the Public," dated February 20, 2023
- select monthly effluent reports, dated 2022-present
- select personnel dosimetry records, dated 2022-present
- select environmental dosimetry records, dated 2022-present

##### b. Observations and Findings

The inspectors observed that the licensee's effluent releases were within the regulatory limits and were controlled, monitored, and recorded as required by TS 3.7 and 4.7. The inspectors found that the environmental monitoring program met TS 3.7, 4.7, and regulatory requirements. Radioactive waste was found to be stored as required by 10 CFR Part 20.

##### c. Conclusion

The inspectors determined that effluent and environmental was conducted in accordance with TSs and regulatory requirements.

#### 2. Review and Audit and Design Change Functions

##### a. Inspection Scope (IP 69007)

The inspectors reviewed the following to ensure that review and audit and design functions were conducted as required by 10 CFR 50.59, "Changes, tests and experiments," TS requirements:

- 2021 and 2022 annual operating reports
- various modification records including but not limited to: Modification No. 72-03, concerning the original design and implementation of the Safety System Monitoring

Circuit (known as the “White Rat”), Modification No. 73-02, “Modification of Pool and Primary Systems for 10 MW operation,” Modification No. 20-02, “Replacement of Primary Coolant Heat Exchanger Outlet Valves 540A and 540B”

- various “50.59 Screens” including but not limited to: Screen No. 22-14, “Power Level Interlock (PLI) Circuit ‘White Rate’ Temporary Monitoring Equipment,” Screen No. 22-08, “Primary Coolant System Replacement Strainers,” Screen No. 22-09, “Primary Coolant Strainer Modification,” and Screen No. 21-06, “Replacement of Primary Coolant Heat Exchanger Outlet Valves 540A and 540B”
- MURR Procedures AP-RR-003, “10 CFR 50.59 Evaluations,” and AP RO 115, “Modification Records”
- meeting minutes from April 2022 through April 2023 for the Reactor Advisory Committee (RAC) and subcommittees

b. Observations and Findings

(1) Review and Audit Functions

The inspectors found the RAC (or subcommittees thereof) met as required by TS 6.2.b, and provided the reviews as specified in TS 6.2.a. The inspectors noted that topics of the reviews were as required by TSs and provided independent oversight reactor operations. Based on records review and interviews, the inspectors verified the 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 inspectors noted that, 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 inspectors noted that this process also included the facility modification procedure. The inspectors confirmed that the program included screening and safety reviews of changes, tests, and experiments to determine if, pursuant to 10 CFR 50.59, a change required the NRC’s approval prior to implementation. The inspectors confirmed that the licensee was adhering to the procedures and regulations which guided the review process. One instance was noted in which the licensee performed a 50.59 Screen after the installation of a piece of equipment and that involved a security issue which was reviewed by the NRC and documented in Inspection Report No. 05000186/2022203, dated April 7, 2023.

c. Conclusion

The inspectors determined that the licensee’s review and audit functions were conducted in accordance the TS requirements. Changes to equipment, procedures, and experiments were determined to be conducted in accordance with TS, procedural, and regulatory requirements.

### 3. Emergency Preparedness

#### a. Inspection Scope (IP 69011)

The inspectors reviewed the following selected portions of the licensee's emergency preparedness program to verify compliance with Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and the licensee's emergency plan:

- MURR emergency plan, dated December 8, 2022
- select emergency locker inventory forms, dated 2022-present
- select personnel training records, dated 2022-present
- 2022 annual drill records
- letter to the NRC communicating emergency plan changes, dated December 8, 2022
- select emergency implementing procedures

#### b. Observations and Findings

The inspectors found that the emergency plan training was conducted, drills were performed, emergency response call lists were maintained and posted, and emergency equipment was maintained and available as required by the emergency plan and licensee procedures. The inspectors also found that implementing procedures were consistent with emergency plan requirements and revisions to the emergency plan were made in accordance with 10 CFR 50.54(q), "*Emergency Plans*."

#### c. Conclusion

The inspectors determined that the licensee's emergency preparedness program was conducted in accordance with the licensee's emergency plan, TS, procedural, and regulatory requirements.

### 4. Radiation Protection

#### a. Inspection Scope (IP 69012)

The inspectors toured the facility, observed radiation surveys, and observed radiological signs and postings. The inspectors also reviewed the following to ensure the licensee's radiation protection program adheres to the requirements of 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 10 CFR Part 20, and TS 3.7 and 4.7:

- 2022 annual operating report
- POL-03, "Radiation Protection Program," dated February 7, 2023
- select calibration records for radiation monitors and detectors
- select personnel dosimetry records, dated 2022-present
- select training records, dated 2022-present
- internal audit reports of the radiation protection and as low as reasonably achievable (ALARA) programs for 2022
- select radiation work permits
- select sample and survey results, dated 2022-present



b. Observations and Findings

The inspectors found that practices regarding the use of dosimetry, radiation monitoring equipment, placement of radiological postings, posting of notices, use of protective clothing, and the handling and storing of radioactive material or contaminated equipment was in accordance with regulations and the licensee's radiation protection program. The inspectors found that the licensee met the TS and procedural requirements concerning radiation survey, sampling, and monitoring. The inspectors also found that training was conducted for radiation workers and ALARA principles were implemented as required by licensee procedures.

c. Conclusion

The inspectors determined that the licensee's radiation protection program was conducted in accordance with TS, procedural, and regulatory requirements.

**5. Transportation Activities**

a. Inspection Scope (IP 86740)

The inspectors reviewed the following to ensure the licensee's program for transporting radioactive materials met NRC and Department of Transportation requirements:

- records of licensee employee's shipping training
- completed internal audits of various types of shipments
- selected records of radioactive material shipments made during 2022 and to date in 2023 including Type A and Type B shipments

b. Observations and Findings

The inspectors toured shipping and receiving areas and observed the preparation of various packages for shipment. The inspectors noted that the proper procedures were followed. The inspectors verified that the licensee maintained on file copies of consignees' licenses authorizing them to possess radioactive material as required by the regulations. The inspectors also confirmed that the licensee verified consignee information prior to initiating a shipment. The inspectors noted that the licensee staff received training every 2 years and were certified for shipping radioactive material, as required by 49 CFR Part 172.

Through records review and observation, the inspectors verified that, as required by 49 CFR Part 172: 1) shipping papers were completed; 2) packages were marked and labeled; and 3) conveyances were placarded when required. The inspectors also confirmed that, as required by 49 CFR Part 173, radionuclides and mixtures of radionuclides were determined, identified, and quantified, and radiation and contamination surveys were performed to ensure compliance with regulatory limits.

c. Conclusion

The inspectors determined that the licensee's radioactive material transportation program was in accordance with regulatory and procedural requirements.

**6. Follow-up**

a. Inspection Scope (IP 86740 and 92701)

The inspectors reviewed the following concerning an event notification the licensee made involving the loss of licensed material during a shipment:

- NRC Operations Center Event Notification 56122, "Loss of Radioactive Material in Transit," dated September 26, 2022
- "Reportable Event Report Pursuant to §20.2201(a)(ii)," submitted by MURR to the NRC through a letter dated October 12, 2022
- calculations made by the licensee following the loss of the radioactive material
- letter from the shipping service to the licensee in response to the event dated September 22, 2022

b. Observations and Findings

On September 8, 2022, the licensee made a routine shipment of research grade Lutetium (Lu)-177 to a consignee in California and the material was expected to arrive at the consignee's site the following day on September 9, 2022. On September 12, 2022, the consignee reported that the package did not arrive, and the shipper notified MURR that the material was lost via a phone call on September 21, 2022, and a follow-up letter dated September 22, 2022. The licensee subsequently notified the NRC Project Manager of the problem during a phone call on September 23, 2022, and an additional call to the NRC Operations Center on September 26, 2022.

During the licensee's probe of the event, they found that the package containing the Lu-177 was misplaced within the shipper's system likely due to a paperwork error. Despite an investigation of the incident, the shipper was unable to locate the shipment. The licensee performed calculations to determine the dose that a member of the public could have received. When the package left the MURR facility the external dose rate was measured at 3.3 millirem per hour (mrem/hr). By the time the package was reported as lost to MURR, the dose rate would have decayed to less than 1.0 mrem/hr. The dose at three feet from the package would be more representative of the dose received by an unknowing member of the public was calculated to be 23 mrem, which is below the 100 mrem limit to members of the public. Because the material was secured within a vial, a sealed lead pig, and sealed box, it is unlikely that a member of the public received any significant dose during the event. The shipment was never reported as found by the shipper or any other person or entity.

This issue is considered closed.

c. Conclusion

The inspectors determined that the event was addressed by the licensee and is now considered closed.

**7. Exit Interview**

The inspection scope and results were summarized on May 18, 2023, with members of licensee management and staff. The inspectors described the areas inspected and discussed the inspection results. The licensee acknowledged the results of the inspection.

## **PARTIAL LIST OF PERSONS CONTACTED**

### Licensee

M. Sanford	Interim Reactor Facility Director
R. Astrino	Reactor Manager
R. Hudson	Reactor Training Manager
C. Braun	Assistant Reactor Manager of Engineering
R. Gibson	Assistant Reactor Manager of Operations
D. Doenges	Health Physics & Safety Manager
T. Graham	Health Physics Supervisor
A. Breckbuhler	Radiation Technician
P. Williams	Shipping Manager

## **INSPECTION PROCEDURES USED**

IP 69004	Class I Research and Test Reactors Effluent and Environmental Monitoring
IP 69007	Class I Research and Test Reactor Review and Audit and Design Change Functions
IP 69011	Class I Research and Test Reactor Emergency Preparedness
IP 69012	Class I Research and Test Reactor Radiation Protection
IP 86740	Inspection of Transportation Activities
IP 92701	Follow-up

## **ITEMS OPENED, CLOSED, AND DISCUSSED**

### Opened:

None

### Closed:

Event Notification 56122 – The event involved the loss of radiative material while in transit. The inspectors determined that the event was addressed by the licensee and is now considered closed.