



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

May 28, 2021

Dr. J. David Robertson
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. 05000186/2021202

Dear Dr. Robertson:

From March 29 – April 1, 2021, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a routine, announced inspection at the University of Missouri-Columbia Research Reactor facility. The enclosed report documents 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, no findings of non-compliance 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 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 electronic mail at Craig.Bassett@nrc.gov.

Sincerely,

for

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

University of Missouri-Columbia

Docket No. 50-186

cc:

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

SUBJECT: THE CURATORS OF THE UNIVERSITY OF MISSOURI – U.S. NUCLEAR
REGULATORY COMMISSION ROUTINE INSPECTION REPORT
NO. 05000186/2021202 DATED: MAY 28, 2021

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

Docket No.: 50-186

License No.: R-103
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Report No.: 05000186/2021202

Licensee: The Curators of the University of Missouri

Facility: University of Missouri-Columbia Research Reactor

Location: Columbia, Missouri

Dates: March 29 – April 1, 2021

Inspector: 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
University of Missouri-Columbia Research Reactor
Inspection Report No. 05000186/2021202

The primary focus of this routine, announced inspection included the on-site review of selected aspects of the University of Missouri-Columbia Research Reactor (MURR) facility safety program, including: (1) effluent and environmental monitoring; (2) review and audit and design change functions; (3) procedures; (4); emergency preparedness; (5) radiation protection; and, (6) transportation activities. Various U.S. Nuclear Regulatory Commission (NRC) previously identified items were also reviewed. The NRC staff determined the licensee's programs were acceptably directed toward the protection of the public health and safety and in compliance with NRC requirements.

Effluent and Environmental Monitoring

- Effluent and environmental monitoring satisfied license and regulatory requirements.

Review and Audit and Design Change Functions

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

Procedures

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

Emergency Preparedness

- The emergency preparedness program was conducted in accordance with the emergency plan (E-Plan).

Radiation Protection

- The radiation protection program was completed, documented, and met regulatory requirements.

Transportation Activities

- Radioactive material (RAM) was shipped in accordance with the applicable regulations.

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 inspector reviewed the applicable licensee TS requirements for effluents and environmental monitoring and the following documents and reports to verify compliance with 10 CFR Part 20, "Standards for Protection against Radiation":

- memo to file, "2019 Dose to Individual Members of the Public"
- memo to file, "2020 Dose to Individual Members of the Public"
- quarterly environmental dosimetry results for 2020 and to date in 2021
- results of the analyses of environmental vegetation, soil, and water samples
- quarterly reports of environmental thermoluminescence dosimeter results
- December 2020 ALARA [As Low As Reasonably Achievable] review for effluents
- "University of Missouri-Columbia Research Reactor Reactor Operations Annual Report January 1, 2020, through December 31, 2020"
- TSs for MURR

b. Observations and Findings

(1) Gaseous and Liquid Releases

The inspector reviewed the annual report and various records documenting liquid and gaseous releases to the environment. The inspector confirmed that the releases were within the limits specified in 10 CFR Part 20, Appendix B, Table 3 as documented in the licensee's annual operations reports. The inspector also verified that airborne concentrations of gaseous releases were within the concentration limits stipulated in 10 CFR Part 20, Appendix B, Table 2 and TS 3.7.b.

The inspector confirmed that the licensee used COMPLY v1.6, an Environmental Protection Agency computer code, to calculate the highest dose a member of the public could receive in an unrestricted area due to facility gaseous releases. To this result, the licensee also added the results of an environmental thermoluminescent dosimeter located near the facility. The inspector found that, according to the licensee's calculations, the highest dose to a member of the public was 1.42 millirem per year (mrem/yr) for 2019 and 0.98 mrem/yr for 2020. The inspector noted that these doses were well below the 10 mrem/yr dose constraint stipulated in 10 CFR 20.1101, "Radiation protection programs," paragraph (d).

(2) Environmental Soil, Water, and Vegetation Samples

The inspector reviewed the annual report and the applicable records documenting the results of the environmental soil, water, and vegetation samples that were collected, prepared, and analyzed during 2019 and 2020. The inspector noted that environmental samples were taken as required and results of the sample analyses provided further verification that facility effluents were not measurably impacting the environment as required by TS 3.7.c.

(3) Environmental Radiation Monitoring

The inspector noted that the environmental gamma radiation monitoring was conducted using dosimetry badges in accordance with the applicable procedures. The inspector confirmed that the data indicated radiation doses were consistent with background levels. As a result, the inspector noted there were no radiation doses in uncontrolled areas from operation of the reactor that would result in a member of the public exceeding the limits in 10 CFR Part 20, Subpart D.

c. Conclusion

The inspector determined the licensee's effluent and environmental monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and TS limits.

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

a. Inspection Scope (IP 69007)

To verify compliance with 10 CFR 50.59 and TS requirements for review, audit and design change functions, the inspector reviewed selected aspects of the licensee's audit, review, and change programs, including:

- most recent version of the MURR TSs
- MURR Reactor Operations Annual Report for calendar year (CY) 2020
- select RAC and subcommittee meeting minutes from April 2020 to the present
- memo to file, "Documentation of the Annual Audit of Facility Operations for calendar year 2020 as required by Technical Specification 6.2.e.(1)i"
- memo to file, "Documentation of Annual Audit of Corrective Action Items Associated with Reactor Safety for calendar year 2020 as required by Technical Specification 6.2.e.(1)iii"
- memo to file, "Documentation of Annual Review of Emergency Plan Implementing Procedures for calendar year 2020 as required by Technical Specification 6.2.e.(1)iv and 6.4.c"
- various "50.59 Screen" forms completed by the licensee concerning new or established reactor license projects and changes to procedures

b. Observations and Findings

Through records review, the inspector verified that the RAC provided independent oversight in matters pertaining to safe operation of the reactor. The inspector noted that the RAC and the various subcommittees provided the review functions required by TS 6.2.a. The inspector also confirmed that the composition and meeting frequency of the RAC and subcommittees satisfied the requirements of TS 6.2.b.

The inspector verified that audits of facility operations, corrective actions, and emergency planning were performed within the specified periodicity as required by TS 6.2.e. In addition, the inspector noted that audit results were assessed by the responsible manager and any actions required as a result of the audit were placed in the MURR corrective action program to be followed until the corrective actions are complete.

The inspector reviewed recently completed 10 CFR 50.59 screen forms related to selected new or established Reactor License Projects. Based on the forms reviewed, the inspector confirmed that the facility design change program was implemented in accordance with the regulations and the applicable licensee procedures. The inspector also verified that the RAC reviewed any proposed changes in accordance with TS 6.2.a.(1).

c. Conclusion

The inspector determined the review, oversight, and audit functions required by the TS were completed by the RAC and subcommittees. The inspector also determined that changes to the facility, programs, and procedures were evaluated using the criteria specified in 10 CFR 50.59.

3. 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:

- most recent version of the MURR TSs
- MURR Reactor Operations Annual Report for CY 2020
- various reports related to procedure revisions and required reviews
- select health physics (HP) procedures contained in the "MURR Health Physics Control of RAM & Support Procedures Manual"
- select calibration procedures contained in the "MURR Health Physics Instrumentation & Reactor Chemistry Procedures Manual"
- select shipping procedures contained in the "MURR Shipping Procedures Manual"
- memo to file, "Documentation of Annual Review of Reactor Operations Procedures for calendar year 2020 as required by Technical Specification 6.4.c"
- MURR Policy POL-25, "Respiratory Protection Program," Revision 5

b. Observations and Findings

The inspector reviewed selected facility HP, calibration, and shipping procedures and the process employed by the licensee to change, review, and approve procedures. The inspector noted that the licensee developed procedures as required by TS 6.4.a and b. All procedures reviewed by the inspector were reviewed and approved by the RAC as required by TS. The inspector found that annual procedure reviews were conducted by management as required by TS 6.4.c. During the inspection, the inspector observed facility personnel using procedures to complete different tasks. The activities and operations observed by the inspector were completed in accordance with the applicable procedures.

c. Conclusion

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

4. Emergency Preparedness

a. Inspection Scope (IP 69011)

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 E-Plan, the inspector reviewed selected aspects of the licensee's program, including:

- current FM-104, "MURR Emergency Call List"
- select emergency implementing procedures
- MURR annual on-site emergency drill scenario for 2020
- completed forms, EP-RO-020, Attachment 2.1, "Emergency Locker Inventory"
- presentation, "Emergency Preparedness Drill, All-Staff Review," for 2020
- "Emergency Plan, University of Missouri Research Reactor," Revision 20
- letter from Office of City Manager reaffirming the support of the City of Columbia Fire Department

b. Observations and Findings

(1) Emergency Plan and Implementing Procedures

The inspector reviewed the E-Plan in use at the facility. The inspector verified that the latest revision dated January 3, 2019, was in accordance with the requirements of 10 CFR 50.54(q), "Emergency plans." The inspector noted that the E-Plan, as revised, continued to meet the requirements in Appendix E to 10 CFR Part 50. The inspector reviewed the E-Plan implementing procedures and verified updates were made using the MURR procedure review, revision, and control program. The inspector verified that the E-Plan and emergency procedures were reviewed annually as required by the E-Plan.

(2) Emergency Equipment and Inventories

The inspector verified that emergency equipment lockers were maintained at the University of Missouri-Columbia Police Department Headquarters and in the MURR lobby storage room. The inspector confirmed that the emergency lockers were inventoried by reactor operations staff on a quarterly basis as required by the E-Plan. The inspector also found that Emergency Call Lists were revised and updated and were available in the control room, the front lobby, and in the various controlled copies of MURR E-Plan manuals as required in the E-Plan.

(3) Drills

Through record reviews, the inspector determined that emergency drills were conducted annually and included the participation of off-site support groups on a biennial basis. The inspector noted that scenarios written for the drills were challenging and critiques were held following the drills. The inspector confirmed that the critiques identified strengths, as well as areas for improvement.

(4) Training

Through records review, the inspector confirmed that emergency training for operators was completed and tracked through the operator requalification program. The inspector verified that Facility Emergency Organization personnel participated in annual training as required by the E-Plan. The inspector also confirmed that emergency preparedness and response training for emergency support organizations was completed biennially as required by the E-Plan.

(5) Offsite Support

During an inspection in November 2020, the inspector and the Reactor Manager visited the University of Missouri-Columbia Hospital and met with the Coordinator for Safety and Emergency Management. The inspector confirmed that the hospital would provide response to MURR in case of emergency and participated in emergency drills organized by MURR. The inspector also verified that memoranda of understanding between the licensee and various support agencies were maintained as required by the E-Plan.

c. Conclusion

The inspector determined that the emergency preparedness program was conducted in accordance with requirements in the E-Plan.

5. Radiation Protection

a. Inspection Scope (IP 69012)

To verify compliance with 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 10 CFR Part 20, TS requirements, and HP procedures, the inspector reviewed selected aspects of the licensee's radiation protection program, including:

- most recent version of the MURR TSs
- MURR Reactor Operations Annual Report for CY 2020
- MURR personnel dosimetry records for 2019, 2020, and 2021 to date
- select records pertaining to radiation and contamination surveys by area/room for 2020 and to date in 2021
- select records, FM-17, "Radiation Work Permit," and associated Radiation Work Permit (RWP) log sheets issued in 2020
- select records, Certificate of Calibration completed by Ludlum Measurements
- completed Internal Audit Report, "Radiation Protection Program and ML Audit Module 2 (Personnel Protection)" for 2020
- completed Internal Audit Report, "2020 ALARA Audit – Assessment of the ALARA Program and Dose Goals"
- MURR Policy, POL-3, "MURR Radiation Protection Program," Revision 21
- completed forms documenting calibration of the Eberline PING stack monitor
- select records documenting MURR initial, annual, or refresher facility radiation worker training for 2020 and 2021 to date

b. Observations and Findings

(1) Surveys

The inspector reviewed radiation and contamination surveys of select areas, rooms, and labs in the MURR facility from 2020 to the present. The inspector confirmed that results were documented on the appropriate forms and evaluated as required by procedure. The inspector verified that surveys were completed as required by procedures and in accordance with the requirements in 10 CFR Part 20, Subpart F.

During the inspection, the inspector accompanied a facility HP technician (HP tech) while he completed a monthly radiation and contamination survey of an active laboratory. The inspector noted that the HP tech was knowledgeable and completed a thorough survey using appropriate survey techniques. Some elevated radiation levels were noted inside a lab hood but the inspector verified that there was lead shielding in place which reduced the dose to workers to acceptable levels.

(2) Postings and Notices

During tours of the facility, the inspector observed that signage, postings, and labels were used in accordance with requirements in 10 CFR Part 20, Subpart J. The inspector noted that RAM storage areas were properly

posted. The inspector confirmed that current copies of survey maps were posted at the entrances to controlled areas. The inspector also confirmed that copies of notices to workers were posted in the facility as required by 10 CFR 19.11, "Posting of notices to workers," including a copy of the most recent revision of NRC Form 3, "Notice to Employees."

(3) Dosimetry

The inspector verified that the licensee was appropriately monitoring individuals in accordance with the requirements in 10 CFR Part 20. The inspector observed the proper use of dosimetry badges for whole body monitoring and finger ring dosimetry for extremity monitoring. The inspector confirmed that dosimetry was processed monthly by a National Voluntary Laboratory Accreditation Program accredited vendor, Mirion Technologies, (GDS) Inc. The inspector examined dosimetry records for the past 2 years, and to date in 2021, which showed that the highest occupational doses were well below 10 CFR Part 20, Subpart C limits and extremity doses were also below the regulatory limit. The inspector also verified that annual dosimetry reports (i.e. NRC Form 5) were provided to each employee who received exposure greater than 100 mrem at the facility during 2020, as required by 10 CFR Part 19.

(4) Radiation Monitoring Equipment

During the inspection, the inspector observed the storage and use of portable survey instrumentation at the facility. The inspector also reviewed the records of selected survey meters, as well as records of area radiation monitors and stack air monitoring equipment. The inspector found that annual calibration of the portable meters was consistent with manufacturer's recommendations and appropriate records were maintained. The inspector confirmed that survey meters were maintained as required by 10 CFR Part 20, Subpart F. In addition, the inspector verified that area radiation monitoring equipment and stack monitors were source checked and calibrated as required by TS 4.7.a and b.

(5) Radiation Protection Training

The inspector reviewed documentation of the radiation protection training provided to licensee staff personnel. The inspector noted that records of training completion were maintained in individual training records stored in Document Control. Through a review of records, the inspector verified that initial training was provided to new personnel and annual refresher training to personnel who worked at the MURR facility for over a year. The inspector confirmed that the content of the training program satisfied the requirements in 10 CFR Part 19.

(6) Radiation Protection Program

The inspector verified that the radiation protection program was established in MURR Policy, POL-3, Revision 21, "MURR Radiation Protection Program," dated February 1, 2021, as well as through the facility procedures. The

inspector noted that the documents contained instructions concerning organization, control of RAM and radiation sources, training, monitoring, personnel responsibilities, and audits. The inspector confirmed that the facility conducted an annual audit to review program content and implementation as required by 10 CFR 20.1101(c).

(7) ALARA Program

The inspector verified that a program for maintaining radiation exposure to personnel ALARA was outlined and established in POL-3. The inspector noted that the program continued to produce dose and effluent reduction results through established ALARA goals and use of performance indicators. The inspector confirmed that MURR conducted monthly reviews and, through established investigation levels, implemented administrative controls to further reduce individual doses or effluents. The inspector found that implementation of the ALARA program was consistent with the requirements in 10 CFR 20.1101(b).

(8) Radiation Work Permit Program

The inspector reviewed the RWP program in place to control operations that could result in radiation safety hazards. The inspector reviewed a sample of the RWPs opened for use from 2020 and 2021 to date. The inspector noted the same issues that were noted during a licensee internal audit. The inspector found that there were various deficiencies on the RWP forms involving, among other issues, missing surveys, work summaries not documented, and Section VII of the form (close out of the form) not completed. The inspector noted that the licensee responded to the internal audit and took corrective actions. These actions involved training for all HP personnel and revising the RWP form to include a dose goal and total dose section, and a management review section to be completed by the HP supervisor. The inspector informed the licensee that proper implementation of the RWP program as required by procedure will be followed by the NRC as an Inspector Follow-up Item (IFI) and will be reviewed during a future inspection (IFI 05000186/2021202-01).

c. Conclusion

The inspector determined the radiation protection program was completed, documented, and met regulatory requirements.

6. Transportation Activities

a. Inspection Scope (IP 86740)

To verify compliance with Titles 10 and 49 of the Code of Federal Regulations, and procedural requirements for transferring or shipping licensed RAM, the inspector reviewed selected aspects of the licensee's program, including:

- selected records of RAM shipments made during 2020 and to date in 2021 including Type A, Type B, and radioactive waste shipments

- records of licensee employee Department of Transportation shipping training
- completed Internal Audit Report, “Type A Shipping Audit – MURR Type A Shipments”
- completed Internal Audit Report, “Type B Quality Assurance Program Audit - Waste”
- completed Internal Audit Report, “Type B Quality Assurance Program Audit – Fuel and Byproduct Material Shipping”

b. Observations and Findings

During the inspection, the inspector toured shipping and receiving areas and observed the preparation of a package of Lutetium-177 for shipment to an overseas location. All the proper marking, labeling, and surveys were taken. No problems were noted. The inspector also reviewed selected records of various types of RAM shipments for 2020 and to date in 2021. The inspector verified that the licensee maintained on file copies of consignees’ licenses authorizing them to possess RAM as required by the regulations. The inspector also confirmed that the licensee verified consignee information (i.e., possession of a license, address, and contact information) prior to initiating a shipment.

Based on observations of the package prepared for shipment during the inspection and review of selected records of previous shipments, the inspector verified that, as required by 49 CFR Part 172: 1) shipping papers were completed; 2) packages were properly marked and correctly labeled; and, 3) conveyances were placarded when required. The inspector also confirmed that, as required by 49 CFR Part 173: 1) radionuclides and mixtures of radionuclides were determined, identified, and quantified, and, 2) radiation and contamination surveys were performed to ensure compliance with specified limits. Additionally, the inspector confirmed the licensee selected the proper packaging for the materials transported.

The inspector noted that the licensee staff received general and specific training every 2 years and were certified for shipping RAM, as required by 49 CFR Part 172, Subpart H.

c. Conclusion

The inspector determined RAM was shipped in accordance with the applicable regulations.

7. Exit Interview

The inspector summarized the scope and results of the inspection on April 1, 2021, with members of licensee management and staff. The inspector described the areas inspected and discussed in detail the inspection findings. The licensee acknowledged the results of the inspection.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

R. Dobey	Technical Advisor
D. Doenges	Health Physics and Safety Manager
M. Eil	Health Physics Technician
B. Fairchild	Assistant Health & Safety Manager - Training
L. Foyto	Associate Director, Reactor and Facilities Operations
K. Kutikkad	Assistant Reactor Manager - Physics
J. Matyas	Access Control Coordinator
B. Meffert	Reactor Manager
D. Rathke	Document Management Coordinator
D. Robertson	Executive Director of MURR
C. Schnieders	Health Physics Supervisor
E. Weires	Assistant Shipping Manager

INSPECTION PROCEDURES USED

IP 69004	Class 1 Research and Test Reactor Effluent and Environmental Monitoring
IP 69007	Class 1 Research and Test Reactor Review and Audit and Design Change Functions
IP 69008	Class 1 Research and Test Reactor Procedures
IP 69011	Class I Research and Test Reactor Emergency Preparedness
IP 69012	Class 1 Research and Test Reactor Radiation Protection
IP 86740	Inspection of Transportation Activities

ITEMS OPENED, CLOSED, AND/OR DISCUSSED

OPENED

05000186/2021202-01 - IFI – Follow-up on the issue of properly using and completing RWP forms as required by POL-03 and AP-HP-105.

CLOSED

None

LIST OF ACRONYMS USED

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
49 CFR	Title 49 of the <i>Code of Federal Regulations</i>
ALARA	As low as reasonably achievable
CY	Calendar Year
E-Plan	Emergency Plan
HP	Health Physics
IFI	Inspector Follow-up Item
IP	Inspection Procedure
MURR	University of Missouri-Columbia Research Reactor
mrem/yr	Millirem per year

NRC	U.S. Nuclear Regulatory Commission
RAC	Reactor Advisory Committee
RAM	Radioactive Material
RWP	Radiation Work Permit
Tech	Technician
TSs	Technical Specifications