



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

June 25, 2019

Dr. J. David Robertson
Reactor Facility Director
University of Missouri-Columbia
Research Reactor Center
1513 Research Park Drive
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI-COLUMBIA – U.S. NUCLEAR REGULATORY
COMMISSION SAFETY INSPECTION REPORT NO. 05000186/2019-201

Dear Dr. Robertson:

From May 20-23, 2019, the U.S. Nuclear Regulatory Commission (NRC) conducted a routine, announced safety inspection at the University of Missouri-Columbia Research Reactor facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of that inspection.

During the inspection, the NRC staff 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. Within these areas, the inspection consisted of selected examination of procedures and representative records, observation of activities, and interviews with 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).

Should you have any questions concerning this inspection, please contact Mr. William Schuster at (301) 415-1590 or by electronic mail at William.Schuster@nrc.gov.

Sincerely,

/RA Elizabeth Reed for/

Anthony J. Mendiola, Chief
Research and Test Reactors Oversight Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

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

Enclosure:
As stated

cc: See next page

cc:

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Test, Research and Training
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Attention: Amber Johnson
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SUBJECT: UNIVERSITY OF MISSOURI-COLUMBIA – U.S. NUCLEAR REGULATORY
COMMISSION SAFETY INSPECTION REPORT NO. 05000186/2019-201
DATE: JUNE 25, 2019

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

Docket No.: 50-186

License No.: R-103

Report No.: 05000186/2019-201

Licensee: The Curators of the University of Missouri

Facility: University of Missouri-Columbia Research Reactor

Location: Columbia, Missouri

Dates: May 20-23, 2019

Inspector: William Schuster

Accompanied by: Earl Love
Senior Transportation and Storage Safety Inspector
Office of Nuclear Material Safety and Safeguards

Approved by: Anthony J. Mendiola, Chief
Research and Test Reactors Oversight Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

University of Missouri-Columbia
University of Missouri Research Reactor
NRC Inspection Report No. 05000186/2019-201

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

Effluent and Environmental Monitoring

- Effluent and environmental monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and technical specification (TS) limits.

Experiments

- The program for reviewing, approving, amending, and conducting experiments satisfied TS and procedural requirements.

Review and Audit and Design Change Functions

- Review, oversight, audit functions required by the TS were acceptably completed by the Reactor Advisory Committee (RAC).
- Changes to the facility were being evaluated using the criteria specified in Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.59, "Changes, tests and experiments," and were reviewed and approved by the RAC as required.

Procedures

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

Radiation Protection

- Surveys were being completed and documented acceptably.
- Postings met regulatory requirements.
- Personnel dosimetry was being worn as required and doses were within regulatory limits.

- Radiation monitoring equipment was being maintained and calibrated as required.
- Radiation protection training was being provided to facility personnel.

Transportation

- Radioactive material was being shipped in accordance with the applicable regulations.

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. Effluent and Environmental Monitoring

a. Inspection Scope (Inspection Procedure (IP) 69004)

To verify compliance with 10 CFR Part 20, "Standards for Protection against Radiation," and TS requirements for effluents and environmental monitoring, the inspector reviewed selected aspect of the licensee's program, including:

- "Technical Specifications for The University of Missouri Research Reactor"
- "University of Missouri-Columbia Research Reactor, Reactor Operations Annual Report, January 1, 2018 through December 31, 2018"
- Environmental Set 93, Spring 2018
- December 2018 [As Low As Reasonably Achievable (ALARA)] Review for Effluents
- Quarterly environmental dosimetry results for 2018
- Memo to file, "2018 Dose to Individual Members of the Public"

b. Observations and Findings

The inspector reviewed the annual report and records documenting liquid and gaseous releases to the environment. The liquid releases from the facility to the sanitary sewer also continued to be monitored as required, were acceptably analyzed, and were documented in the annual reports. The inspector reviewed the analyses of the liquid that had been released and noted that the releases were within the limits specified in 10 CFR Part 20, Appendix B, Table 3. The inspector determined that gaseous releases continued to be monitored as required, were acceptably analyzed, and were documented in the annual operating reports. Airborne concentrations of gaseous releases were noted to be within the concentrations stipulated in 10 CFR Part 20, Appendix B, Table 2 and TS 3.7.b. 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 gaseous releases. The highest calculated dose that could be received by a member of the public as a result of gaseous emissions from facility operations was determined to be 1.1 millirem per year (mr/yr) for 2018. These doses were below the 10 mr/yr dose constraint stipulated in 10 CFR 20.1101, "Radiation protection programs," paragraph (d). The inspector reviewed the annual report and records documenting the results of the environmental soil, water, and vegetation samples that were collected, prepared, and analyzed during 2018. The inspector noted that environmental samples continued to be taken and provide further verification that facility effluents are not measurably impacting the environment as required by TS 3.7.c. Environmental gamma radiation monitoring was conducted using dosimetry badges in accordance with the applicable procedures. The data indicated that

radiation doses were consistent with background levels; therefore, 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 Subpart D, "Radiation Dose Limits for Individual Members of the Public," to 10 CFR Part 20.

c. Conclusion

Effluent and environmental monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and TS limits.

2. Experiments

a. Inspection Scope (IP 69005)

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

- "Technical Specifications for The University of Missouri Research Reactor"
- "University of Missouri-Columbia Research Reactor, Reactor Operations Annual Report, January 1, 2018 through December 31, 2018"
- Memo to file, "Documentation of Annual Review of Reactor Utilization Requests [RURs] system for calendar year 2018," dated March 18, 2019
- Select records, "Reactor Utilization Requests"
- Select records, "Reactor Utilization Request Summary Pages"

b. Observations and Findings

The inspector reviewed the experimental review and approval process at the facility. The inspector verified that experiments utilizing the reactor were evaluated in accordance with TS 3.8 and AP-RO-135, "Reactor Utilization Requests." In 2018, the inspector noted no new RURs were approved and three RURs were amended. The inspector noted that none of the recent RURs required a 10 CFR 50.59 review and subsequent RAC review in accordance with TS 6.2.a.(1). The inspector reviewed an amended RUR and determined that the experiment amendment was appropriately analyzed. Specifically, the analysis provided for the amendment to the experiment showed that the changes ensured the experiment would continue to meet the irradiation container requirement in TS 3.8.s and restrictions to limit gaseous releases in TS 3.8.n. Based on records review, the inspector determined that experiments being conducted at the facility continued to meet the requirements in TS 3.8.

c. Conclusion

The program for reviewing, approving, amending, and conducting experiments satisfied TS and procedural requirements.

3. 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 and audit and design change functions, the inspector reviewed selected aspects of the licensee's program, including:

- "Technical Specifications for The University of Missouri Research Reactor"
- "University of Missouri-Columbia Research Reactor, Reactor Operations Annual Report, January 1, 2018 through December 31, 2018"
- Select committee and subcommittee meeting minutes from September 2018 to present, including: Reactor Advisory Committee, Reactor Safety Subcommittee, Reactor Safety Procedure Review Subcommittee, Isotope Use Subcommittee, Isotope Use Procedure Review Subcommittee
- Memo to file, "Documentation of the Annual Audit of Facility Operations for calendar year 2018 as required by Technical Specification 6.2.e.(1)i," dated March 18, 2019
- Memo to file, "Documentation of Annual Review of Operator Requalification Program for calendar year 2018 as required by Section 3.1 of the Program," dated March 18, 2019
- Memo to file, "Documentation of Annual Audit of Corrective Action Items Associated with Reactor Safety for calendar year 2018 as required by Technical Specification 6.2.e.(1)iii," dated March 8, 2019
- Memo to file, "Documentation of Annual Review of Emergency Plan Implementing Procedures for calendar year 2018 as required by administrative Technical Specification 6.4.c," dated March 18, 2019
- Memo from Gibson to Meffert, "Emergency Plan and Procedures Annual Audit," dated January 8, 2018.
- AP-RO-115 Modification Record #18-04, "Reactor Pressure Vessel Cover Gasket"

b. Observations and Findings

The composition and meeting frequency of the RAC and subcommittees satisfied the requirements of TS 6.2.b. The meeting minutes demonstrated that the RAC and subcommittees provided the review functions required by TS 6.2.a. Furthermore, based on the review of meeting minutes for the past year, the inspector found that the RAC and subcommittees provided appropriate guidance and direction for reactor operations, and ensured acceptable use and oversight of the reactor. Additionally, audits of facility operations, requalification, corrective actions, and emergency planning were being performed, within specified periodicity, as required by TS 6.2.e. Audit results were assessed by the responsible manager and any actions required as a result of the audit findings were placed in the MURR corrective action program. While not required by TS, the inspector noted that internal audits are being conducted in other program areas by the facility.

The inspector reviewed a recently completed facility modification related to the selection of a new reactor pressure vessel cover gasket material. Based on the

review, the inspector determined that the facility design change was screened to determine if the change required prior NRC approval along with adequate supporting documentation, historical operating data, information, and testing. As noted above, the inspector also verified that the RAC reviewed the proposed change in accordance with TS 6.2.a.(1).

c. Conclusion

Review, oversight, audit functions required by the TS were acceptably completed by the RAC. Changes to the facility were being evaluated using the criteria specified in 10 CFR 50.59 and were reviewed and approved by the RAC as required.

4. 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:

- "Technical Specifications for The University of Missouri Research Reactor"
- "University of Missouri-Columbia Research Reactor, Reactor Operations Annual Report, January 1, 2018 through December 31, 2018"
- Select procedures from "MURR Health Physics Control of RAM & Support Procedures Manual"
- Select procedures from "MURR Health Physics Instrumentation & Reactor Chemistry Procedures Manual"
- Memo to file, "Documentation of Annual Review of Reactor Operations Procedures for calendar year 2018 as required by administrative Technical Specification 6.4.c"
- Various reports related to procedure revisions and required reviews

b. Observations and Findings

The inspector reviewed facility procedures and the processes to review, approve, and change procedures. The inspector noted that required procedures were in effect as required by TS 6.4.a. The procedures were reviewed, approved, and changed in accordance with local processes and procedures. Radiological control and shipping procedures were in effect as required by TS 6.4.b. Annual procedure reviews were being conducted by management as required by TS 6.4.c. All procedures observed were approved and dated. During the inspection, the inspector observed facility personnel following procedures to complete tasks. Additionally, the procedures being used appeared to be up to date, effective, and able to be implemented for the intended purposes.

c. Conclusion

Procedure review, revision, control, and implementation satisfied TS requirements.

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 procedures for health physics, the inspector reviewed selected aspects of the licensee's program, including:

- "Technical Specifications for The University of Missouri Research Reactor"
- "University of Missouri-Columbia Research Reactor, Reactor Operations Annual Report, January 1, 2018 through December 31, 2018"
- Completed Internal Audit Form, "Radiation Protection Program: Personnel Protection" for the period July 2017 through December 2018
- MURR Administrative Policy, POL-3, "MURR Radiation Protection Program," Revision 18, issued May 1, 2019
- AP-HP-123, "Visitor Dosimetry – Reception Desk," Revision 14, dated March 20, 2019
- Completed RM-HP-101, "Stack Monitor Preventative Maintenance Checksheet," for December 2018
- Completed IC-HP Forms, "Impex Stack Monitor Calibration Datasheets," for March 2019
- Select records, FM-62, "Radiation Instrument Certificate of Calibration"
- Select records, FM-17, "Radiation Work Permit [RWP]"
- 2018/2019 RWP Log Sheet
- Select records, 2018 MURR dosimetry records for personnel
- Select records, 2018 Monthly ALARA review for personnel
- Select records, 2018/2019 MURR Initial/Annual/Renewal Facility Emergency Organization (FEO)/Non-FEO training
- Select records, radiation and contamination surveys by area/room for 2018

b. Observations and Findings

(1) Surveys

The inspector reviewed radiation and contamination surveys of select areas, rooms, and labs in the MURR facility from 2018 to the present day. The results were documented on the appropriate forms and evaluated as required, comments were provided if readings were higher than expected, and corrective actions were taken when readings or results exceeded set action levels. Any contamination detected in concentrations above established action levels was noted, access to the areas was limited, and the area or item was decontaminated. The inspector determined that surveys had been completed as required by procedures and in accordance with the requirements in Subpart F, "Surveys and Monitoring," to 10 CFR Part 20.

(2) Postings and Notices

During a tour of the facility, the inspector observed that signage, posting, and labels were used in accordance with requirements in Subpart J, "Precautionary Procedures," to 10 CFR Part 20. Radioactive material storage areas were noted to be properly posted. The inspector noted current copies of survey maps were typically posted at the entrances to controlled areas. Copies of notices to workers were posted in the facility, including a copy of the most recent revision of NRC Form 3, "Notice to Employees," as required by 10 CFR 19.11, "Posting of notices to workers."

(3) Dosimetry

The inspector observed the use of dosimetry badges for whole body monitoring and finger ring dosimetry for extremity monitoring. The dosimetry was processed monthly by a National Voluntary Laboratory Accreditation Program accredited vendor, Mirion. An examination of the dosimetry records for the past year showed that the highest occupational doses were well below Subpart C, "Occupational Dose Limits," to 10 CFR Part 20 limits of 5000 mr/yr total effective dose equivalent. The inspector also verified that annual dosimetry reports (i.e. NRC Form 5), as required by 10 CFR 19.13, "Notifications and reports to individuals," were provided to each employee who had received exposure greater than 100 mr at the facility during 2018. The inspector determined that the licensee was appropriately monitoring individuals in accordance with the requirements in 10 CFR 20.1502, "Conditions requiring individual monitoring of external and internal occupational dose."

(4) Radiation Monitoring Equipment

During the inspection, the inspector observed storage and use of portable survey instrumentation at the facility. The inspector reviewed the records of selected meters, detectors, area radiation monitors, and stack air monitoring equipment. Annual calibration and monthly source check frequency of the portable detectors and fixed meters and monitors were consistent with manufacturer's recommendations and appropriate calibration records were being maintained. The inspector verified that radiation monitoring equipment was being maintained as required by TS 4.7.a and TS 4.7.b. The inspector determined portable survey meters were being maintained as required by Subpart F to 10 CFR Part 20.

(5) Radiation Protection Training

The inspector reviewed documentation of the initial and annual refresher training for FEO and Non-FEO personnel. The course documentation consisted of training material and evaluation (quiz). Record of training completion was maintained in individual training records stored in Document Control. Through a review of records, the inspector verified that training was provided to new personnel as well as refresher training to personnel who had been at the MURR facility for over a year. The

content of the training program satisfied the requirements in 10 CFR 19.12, "Instruction to workers."

(6) Radiation Protection Program

The inspector determined that the radiation protection program was established in MURR Administrative Policy, POL-3, "MURR Radiation Protection Program," and as well as through the facility procedures. The programs contained instructions concerning organization, control of radioactive material and radiation sources, training, monitoring, personnel responsibilities, and audits. The inspector verified that the facility conducted an annual audit to review program content and implementation as required by 10 CFR 20.1101(c).

(7) ALARA Program

A program for maintaining radioactive exposure to personnel ALARA was outlined and established in MURR Administrative Policy, POL-3, "MURR Radiation Protection Program." MURR implementation of the ALARA program is well organized and established through various Health Physics (HP) procedures that discuss and set expectations for radiation safety culture. The program continued to produce dose and effluent reduction results through established ALARA goals and use of performance indicators. The inspector noted 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 is consistent with the requirements in 10 CFR 20.1101(b).

(8) Radiation Work Permit Program

The inspector reviewed the RWP process in place to control operations that could result in unresolved radiation safety hazards. The inspector reviewed a sample of the over 200 RWPs opened for use from 2018 to present day, including one that was in use during the inspection (i.e. RWP #19-083, "Pool pump down to remove bottom portion on flux trap"). The inspector noted that the instructions specified in procedures and those on the associated RWP form had been followed. Review by management and HP personnel had been completed, as required. The controls (e.g. precautions, personal protective equipment, radiation monitoring) specified in the RWP were appropriate and applicable for the type of work being done and the area being accessed.

c. Conclusion

Surveys were being completed and documented acceptably. Postings met regulatory requirements. Personnel dosimetry was being worn as required and doses were within regulatory limits. Radiation monitoring equipment was being maintained and calibrated as required. Radiation protection training was being provided to facility personnel.

6. Transportation

a. Inspection Scope (IP 86740)

To verify compliance with the regulations in 10 CFR, "Energy," 49 CFR, "Transportation," and procedural requirements for transferring or shipping licensed radioactive material, the inspector reviewed selected aspects of the licensee's program, including:

- Select records, Radioactive material shipments for 2018 to present
- Select Quality Assurance Type B Shipping Procedures, MURR Type B Program Material Specification Sheet, Type B Shipping Forms, Record and Report Forms,
- Completed Internal Audit Form, "Type B Quality Assurance Program Audit" for June 1, 2017 through December 31, 2018
- Memo to file, "Documentation of Annual Audit of the 'Shipping Quality Assurance Program for Type B Shipping Casks – Hazardous Waste' for calendar year 2018," dated March 18, 2019
- Select records, "DOT/IATA shipping training"
- Select records, "Type B QA shipping training"

b. Observations and Findings

During the inspection, the inspector toured shipping and receiving areas and reviewed selected records of various types of radioactive material shipments for 2018 and to date in 2019. The inspector verified that the licensee maintained on file copies of consignees' licenses to possess radioactive material as required. The licensee verified consignee information (i.e., possession of a license to receive radioactive materials, address, and contact information) prior to initiating a shipment. Based on observations of packages prepared for shipment during the inspection and review of selected past records, the inspector determined that: 1) shipping papers were completed as required by Subpart C, "Shipping Papers," of 49 CFR 172; 2) packages were appropriately marked as required by Subpart D, "Marking," of 49 CFR 172; 3) packages were appropriately labeled as required by Subpart E, "Labeling," of 49 CFR 172; 4) conveyances were placarded when required by Subpart F, "Placarding," of 49 CFR 172; 5) radionuclides and mixtures of radionuclides were appropriately determined and identified as required by 49 CFR 173.433, "Requirements for determining basic radionuclide values, and for the listing of radionuclides on shipping papers and labels"; and 6) surveys were performed to ensure compliance with limits as required by 49 CFR 173.441, "Radiation level limitations and exclusive use provisions," and 49 CFR 173.443, "Contamination control." Additionally, the inspector determined that the licensee was appropriately identifying and quantifying the radioisotopes and selected the proper packaging for the materials being transported. The inspector noted that staff members had received general and function-specific training every two years and were certified for shipping radioactive material, as required by Subpart H, "Training," of 49 CFR 172.

The inspector notes that MURR's transportation activities were also, separately, inspected for compliance with 10 CFR Part 21, "Reporting of Defects and

Noncompliance,” and 10 CFR Part 71, “Packaging and Transportation of Radioactive Material,” conducted May 20-23, 2019. The results of that inspection are available in NRC Inspection Report No. 71-0108/2019-201.

c. Conclusion

Radioactive material was being shipped in accordance with the applicable regulations.

7. Exit Interview

The inspection scope and results were summarized on May 23, 2019, 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
D. Elliott	Lead Hot Cell Technician
J. Ernst	Senior Advisor
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. Robertson	Executive Director
C. Schnieders	Health Physics Supervisor
P. Williams	Shipping Manager

INSPECTION PROCEDURES USED

IP 69004	Class 1 Research and Test Reactor Effluent and Environmental Monitoring
IP 69005	Class 1 Research and Test Experiments
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 69012	Class 1 Research and Test Reactor Radiation Protection
IP 86740	Inspection of Transportation Activities

ITEMS OPENED, CLOSED, AND/OR DISCUSSED

None

LIST OF ACRONYMS USED

ALARA	As low as reasonably achievable
10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
49 CFR	Title 49 of the <i>Code of Federal Regulations</i>
FEO	Facility Emergency Organization
HP	Health Physics
IP	Inspection Procedure
MURR	University of Missouri Research Reactor
NRC	U.S. Nuclear Regulatory Commission
RAC	Reactor Advisory Committee
RUR	Reactor Utilization Request
RWP	Radiation Work Permit
TS	Technical Specification