

September 15, 2016

Mr. William E. Bonzer, Reactor Manager  
Missouri University of Science and Technology  
Nuclear Reactor Facility  
1870 Miner Circle  
Rolla, MO 65409-0630

SUBJECT: MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY – NUCLEAR  
REGULATORY COMMISSION ROUTINE INSPECTION REPORT  
NO. 50-123/2016-201

Dear Mr. Bonzer:

On August 15-18, 2016, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted an inspection at the Missouri University of Science and Technology. The enclosed report documents the inspection results, which were discussed on August 18, 2016, with you and members of your staff.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations of activities in progress. Based on the results of this inspection, no safety concerns or non-compliances with NRC requirements were identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390, "Public inspections, exemptions, and 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 (PARS) component of 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).

W. Bonzer

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If you have any questions concerning this inspection, please contact Mr. Gary Morlang at 301-415-4092 or by electronic mail at [Gary.Morlang@nrc.gov](mailto:Gary.Morlang@nrc.gov).

Sincerely,

*/RA/*

Anthony J. Mendiola Chief  
Research and Test Reactors Oversight Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

Docket No. 50-123  
License No. R-79

Enclosure:  
As stated

cc w/encl: See next page

Missouri University of Science and Technology

Docket No.: 50-123

cc:

Homeland Security Coordinator  
Missouri Office of Homeland Security  
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Reactor Newsletter  
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Gainesville, FL 32611

W. Bonzer

- 2 -

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

Docket No: 50-123

License No: R-79

Report No: 50-123/2016-201

Licensee: Missouri University of Science and Technology

Facility: Nuclear Reactor Facility

Location: Rolla, MO

Dates: August 15-18, 2016

Inspector: Gary Morlang

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

## EXECUTIVE SUMMARY

### Missouri University of Science and Technology Nuclear Regulatory Commission Report No. 50-123/2016-201

The primary focus of this routine, announced inspection of facility operations was the onsite review of selected aspects of the Missouri University of Science and Technology Class II research reactor (MSTR, or the licensee) facility safety programs including: (1) organization and staffing; (2) procedures; (3) experiments; (4) health physics; (5) effluents and environmental monitoring; (6) committees, audits, and reviews; and (7) transportation. The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with U.S. Nuclear Regulatory Commission (NRC) requirements.

#### Organization and Staffing

- The licensee's organization and staffing were in compliance with Technical Specifications (TS).

#### Procedures

- Written procedures were being maintained in accordance with TS requirements.

#### Experiments

- Reactor experiments were being performed in accordance with the requirements of the TS.

#### Health Physics

- The licensee maintained an effective radiation protection program in compliance with regulatory and TS requirements, resulting in low radiation exposures to facility workers and users.

#### Effluents and Environmental Monitoring

- The licensee evaluated annual environmental releases as required by TS and reported results well below limits.

#### Committees, Audit and Reviews

The Radiation Safety Committee continued to perform independent oversight in accordance with TS requirements.

#### Transportation

- The licensee did not ship any radioactive material under the R-79 license since the previous transportation inspection.

## REPORT DETAILS

### Summary of Plant Status

The Missouri University of Science and Technology (MSTR, or the licensee) 200 kW pool-type research reactor continues to be operated in support of graduate and undergraduate instruction, laboratory experiments, reactor operator training, and various forms of research. During the inspection, the reactor was not operated due to equipment problems requiring the ordering of replacement parts.

#### 1. Organization and Staffing

##### a. Inspection Scope (IP 69001)

The inspector reviewed the following reactor operations records to ensure compliance with the requirements of TS Section 6.1.3, "Staffing":

- Reactor Console Logbook #18, from October 31, 2014 to the present
- Reactor Safety Committee Meeting Minutes for 2015 and 2016
- MSTR Standard Operating Procedure (SOP) SOP-102, "Pre-Startup Checklist," Revised (Rev.) January 21, 2011, January 2015 to the present
- MSTR SOP-105, "Reactor Shutdown Checklist," Rev. September 9, 2013, January 2015 to the present
- MSTR SOP-107, "Permanent Hourly Logs and Operational Data," Rev. January 3, 2008, January 2015 to the present
- MSTR Annual Progress Report for 2014/2015 and 2015/2016
- Hourly Log Sheets from January 2015 to the present
- Contact Phone Number List dated June 9, 2016

##### b. Observations and Findings

There were 3 licensed senior reactor operators and 6 licensed reactor operators at the facility. One reactor operator was away on an internship for the summer and will have to participate in accelerated requalification upon return to the facility. A review of the logs and records indicated that TS shift staffing was as required. The inspector noted that each time the senior reactor operator or reactor operator changed, an appropriate console log book entry was made. Additionally, the Senior Reactor Operator on duty had his name written on a placard attached to the reactor console. A current contact list was posted as required by TS Section 6.1.3.2.

The TS Level 1 Department Head changed on 9 August 2016. The licensee is required to report this change within 30 days to the NRC.

Enclosure

c. Conclusion

Shift staffing was being maintained in accordance with TS Section 6.1.3, "Staffing."

**2. Procedures**

a. Inspection Scope (IP 69001)

The inspector reviewed the following to ensure that procedures were in accordance with TS Section 6.4, "Operating Procedures":

- MSTR SOP-100, "Preamble," dated September 10, 2009
- MSTR SOP-101, "General Operations Procedure," dated November 19, 2009
- MSTR SOP-102, "Pre-Startup Checklist," dated January 21, 2011
- MSTR SOP-103, "Reactor Startup to Low Power," dated December 30, 2009
- MSTR SOP-104, "Reactor Power Changes and Stable Operations," dated February 9, 2012
- MSTR SOP-105, "Reactor Shutdown and Securing," dated September 9, 2013
- MSTR SOP-306, "Estimation of Activity and Reactivity Worth of a Sample dated," May 21, 2015
- MSTR SOP-312, "Critical Experiment Procedure," dated August 7, 2015
- MSTR SOP 702, "Irradiation Request Forms (IRF)," Rev. August 9, 2016
- MSTR Annual Progress Report for 2014/2015 and 2015/2016
- Reactor Safety Committee Meeting Minutes for 2015 and 2016

b. Observations and Findings

TS Section 6.4, "Operating Procedures," required that operating procedures be maintained for specific topic areas. It also specified a means for making minor and substantive changes to procedures. The inspector found that all specified topics were addressed by existing procedures. Facility Annual Reports addressed the procedures that had been updated during the year, and Reactor Safety Committee minutes reflected review and approval of procedure changes.

The inspector noted hand-written changes to procedures that dated as far back as 1995. Although editorial in nature, handwritten changes are to be reviewed by the Reactor Safety Committee at a subsequent meeting as per TS Section 6.4. An Inspector Follow-up Item (IFI-50/123-2012/201-1) was opened and discussed with the licensee on this issue. During the past 2 years, 25 procedures had been updated including all procedures with pen and ink changes. The IFI will be closed.

c. Conclusion

Procedures were as required by TS Section 6.4 and were being reviewed and updated, as required.

**3. Experiments**

a. Inspection Scope (IP 69001)

The inspector reviewed the following to ensure that the requirements of TS Sections 3.7 and 4.7, "Experiments," and Section 6.5, "Experiment Review and Approval," were being met:

- File of Completed Irradiation Request Forms (IRF) for 2015 and 2016
- Permanent Reactor Logbook #18, October 31, 2014 to the present
- MSTR SOP 702, "Irradiation Request Forms (IRF)," Rev. August 9, 2016
- MSTR SOP 710, "Insertion and Removal of Experiments." Rev. February 17, 1997
- MSTR Annual Progress Report for 2014/2015 and 2015/2016
- Reactor Safety Committee Meeting Minutes for 2015 and 2016

b. Observations and Findings

Pursuant to SOP 702, each IRF required review and approval by two individuals from among the following: a Senior Reactor Operator, the Reactor Director, and the Health Physicist. If the IRF was determined to involve a new safety issue, review by the Radiation Safety Committee was required. Once an experiment was authorized, it could be repeated indefinitely, as long as a Senior Reactor Operator found the sample to be in compliance with the authorization.

During 2015, 5 IRF's were reviewed and approved, and in 2016, 7 IRF's had been reviewed and approved.

When conducting irradiations of experiments for the first time, the licensee used a graded approach to the irradiation. Experiments were initially conducted at low power levels and checked for expected radiation levels. Once levels were verified as expected, the power level was raised to the desired exposure.

c. Conclusion

The licensee was complying with the TS and procedural requirements pertaining to experiment authorization and irradiation.

#### 4. Health Physics

##### a. Inspection Scope (IP 69001)

The following documents were reviewed to determine compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 19 and 20 and with TS Sections 3.6.1, "Radiation Monitoring Systems," 4.6.1, "Radiation Area Monitors," and requirements regarding radiation protection:

- Handbook of Radiological Operations
- MSTR SOP 615, "Radiation Work Permits," dated November 18, 2014
- 2015 and to date in 2016 Monthly Reactor Audit file
- 2015 and to date in 2016 Reactor Dosimetry file
- 2015 and to date in 2016 Reactor Sump Water Analysis File
- 2015 and to date in 2016 Monthly Contamination Survey file
- 2015 and to date in 2016 Monthly Radiation Survey file
- 2015 and to date in 2016 Quarterly As Low As Reasonably Achievable (ALARA) Reports
- 2015 and to date in 2016 Reactor Pool Water Analysis file
- 2015 and to date in 2016 Reactor Pool Water Tritium file
- 2015 and to date in 2016 Monthly HP Audit Reports
- 2015 and to date in 2016 Radiation Work Permit file
- 2015 and to date in 2016 Portable Survey Instrument Calibration Reports
- 2015 and to date in 2016 Argon-41 Monthly Release Forms

##### b. Observations and Findings

Through the review of procedures and records, observations during facility tours, and discussion with staff personnel, the inspector assessed the licensee's radiation protection program, including radiation protection training given to individuals.

The licensee maintained and adhered to written procedures and instructions for all aspects of the radiation safety program. During tours through the facility the inspector verified that warning signs and postings for radiation workers were in accordance with regulations and procedures. Protective clothing was available, if needed, but areas were maintained in a clean condition such that it was very rarely required.

The inspector reviewed the radiation monitoring instrumentation calibration program. Most survey instruments were calibrated using an in-house calibration facility. Permanently mounted process monitors were calibrated in-situ. High range ion chambers and neutron detectors were sent offsite for calibration. In all cases, calibration stickers were used to record the valid calibration interval; all devices inspected throughout the facility were found to be within their defined calibration interval.

Monthly reactor audits were very detailed and covered sealed sources, radiation area monitor calibration, hand held instrument calibration, contamination surveys, air release calculations each time the reactor was operated, radiation surveys, and monthly pool water analysis.

c. Conclusion

The radiation protection program was effective and in compliance with TS and regulatory requirements.

**5. Effluents and Environmental Monitoring**

a. Inspection Scope (IP 69001-02.07.e, f, and g)

The following documents were reviewed to determine compliance with 10 CFR Part 20 and with TS Sections 3.6.2 and 4.6.2, "Radioactive Effluents":

- MSTR Annual Progress Report for 2014/2015 and 2015/2016
- Argon-41 Release file
- Environmental Dosimetry files for 2015 and to date in 2016
- 2015 and to date in 2016 Air Release and Summary file
- 2015 and to date in 2016 Byproduct Release file
- Quarterly Environmental Dosimetry file for 2015 and to date in 2016

b. Observations and Findings

The licensee had 3 environmental dosimetry badges placed around the outside of the facility to monitor radiation levels. The maximum annual reading in 2015 was 83 mrem outside the basement door to the neutron beam lab. Although below the annual limit, the licensee was considering securing the area as beam port work was expected to increase.

The licensee analyzed air samples collected over the reactor pool surface to evaluate exposure to personnel in the reactor bay from Argon-41 and also samples collected at 1 of 3 exhaust fans to evaluate exposure to the public. Results showed compliance with 10 CFR Part 20 limits.

The licensee maintained good reactor water quality through pre-processing potable campus water used to make up for evaporative losses and continuous clean-up of circulating reactor pool water. Filters and resins from the pool clean-up system were collected as radioactive waste, but activity levels were minimal. Likewise, a small quantity of laboratory waste (vials, absorbent paper, gloves, etc.) was collected in the reactor building consisting of low activity.

c. Conclusion

The licensee evaluated annual environmental releases as required by TS and reported results well below 10 CFR 20 limits.

**6. Committees, Audits and Reviews**

a. Inspection Scope (IP 69001-02.09)

The inspector reviewed the following to ensure that the requirements of TS Section 6.2, "Review and Audit," were being implemented effectively:

- Reactor Safety Committee Meeting Minutes file for 2015 and 2016
- Monthly Health Physics Audits for 2015 and to date in 2016
- Annual Procedural Audits for 2015 by the Reactor Director
- External Audit by Missouri University Research Reactor dated December 1, 2015
- MSTR Progress Reports for 2014/2015 and 2015/2016
- Radiation Safety Committee Appointment Letter by the Vice Chancellor dated August 1, 2016

b. Observations and Findings

The licensee used a single independent oversight safety committee to fill requirements for both the reactor license and the campus byproduct material license. The committee consisted of a minimum of 5 members, one of which must be the Radiation Safety Officer, two of which must be reactor staff and at least 2 members from related academic fields. Currently, there are 13 members on the committee. The committee members were appointed by the Vice Chancellor - Administrative Services, providing a reporting chain to the Chancellor that was fully independent of the reactor operations line of reporting. Meetings were conducted quarterly, but only required annually by TS Section 6.2.2, "Charter and Rules." The Reactor Manager briefed the committee each quarter on matters relating to reactor safety.

c. Conclusion

The Reactor Safety Committee continued to perform independent oversight in accordance with TS requirements.

**7. Transportation**

a. Inspection Scope (IP 86740)

- Health Physics Radioactive Waste Pick-up Form
- 2015 and to date in 2016 Radioactive Shipment File

b. Observations and Findings

The inspector reviewed the file for radioactive shipments made under the reactor license (R-79) and found that there were no shipments made since the previous transportation inspection. The licensee did transfer radioactive waste to the University Materials License and allow the Health Physics Department personnel to remove the waste from the reactor facility.

c. Conclusion

The licensee did not ship any radioactive material under the R-79 license since the previous transportation inspection.

**8. Exit Interview**

The inspector met with members of licensee staff and management in an exit briefing on August 18, 2016. The inspector summarized the areas inspected and presented preliminary inspection findings.

### **PARTIAL LIST OF PERSONS CONTACTED**

W. Bonzer	Reactor Manager
C. Reisner	Senior Reactor Operator
A. Alchin	Electronics Technician and Senior Reactor Operator
M. Henry	Senior Administrative Assistant Missouri University of Science and Technology
F. Ahmed	Health Physicist
M. Bresnahan	University Radiation Safety Officer

### **INSPECTION PROCEDURE (IP) USED**

IP 69001	Class II Non-Power Reactors
IP 86740	Inspection of Transportation Activities

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

#### Open

None

#### Closed

50-123/2012-201-1	IFI	Follow-up item to ensure procedure pen and ink changes are reviewed and approved by the Reactor Safety Committee
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#### Discussed

None

### **PARTIAL LIST OF ACRONYMS USED**

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ALARA	As Low As Reasonably Achievable
HP	Health Physics
IFI	Inspector Follow-up Item
IP	Inspection Procedure
IRF	Irradiation Request Form
MSTR	Missouri University of Science and Technology Reactor
NRC	U.S. Nuclear Regulatory Commission
Rev	Revision
SOP	Standard Operating Procedure
TS	Technical Specification