

September 24, 2014

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 - NRC ROUTINE  
INSPECTION REPORT NO.: 50-123/2014-201

Dear Mr. Bonzer:

On August 25-28, 2014, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted an inspection at your Nuclear Reactor Facility (Inspection Report No. 50-123/2014-201). The enclosed report documents the inspection results, which were discussed on August 28, 2014, 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 and its enclosure 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 (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

W. Bonzer

- 2 -

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

Sincerely,

***/RA/***

Kevin Hsueh. 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:

NRC Inspection Report No.: 50-123/2014-201

cc:

See next page

Missouri University of Science and Technology

Docket No.: 50-123

cc:

Dr. Samuel Frimpong, Chair  
Mining and Nuclear Engineering Department  
226 McNutt Hall  
Missouri University of Science and Technology  
Rolla, MO 65409-0450

Homeland Security Coordinator  
Missouri Office of Homeland Security  
P.O. Box 749  
Jefferson City, MO 65102

Planner, Dept of Health and Senior Services  
Section for Environmental Public Health  
930 Wildwood Drive, P.O. Box 570  
Jefferson City, MO 65102-0570

Deputy Director for Policy  
Department of Natural Resources  
1101 Riverside Drive  
Fourth Floor East  
Jefferson City, MO 65101

A-95 Coordinator  
Division of Planning  
Office of Administration  
P.O. Box 809  
State Capitol Building  
Jefferson City, MO 65101

Test, Research, and Training  
Reactor Newsletter  
University of Florida  
202 Nuclear Sciences Center  
Gainesville, FL 32611

W. Bonzer

- 2 -

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

Sincerely,

*/RA/*

Kevin Hsueh, 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:

NRC Inspection Report No.: 50-123/2014-201

cc:

See next page

DISTRIBUTION:

PUBLIC                      PROB r/f                      RidsNrrDpr                      RidsNrrDprPrtb  
RidsNrrDprPrta              MCompton,                      GMorlang, NRR                      DHardesty, NRR

**ADAMS ACCESSION No.: ML14267A211**

**NRC-002**

OFFICE	NRR/DPR/PROB	NRR/DPR/PROB
NAME	GMorlang	KHsueh
DATE	9/ 24 /14	9/ 24 /14

**OFFICIAL RECORD COPY**

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

Docket No: 50-123

License No: R-79

Report No: 50-123/2014-201

Licensee: Missouri University of Science and Technology

Facility: Nuclear Reactor Facility

Location: Rolla, Missouri

Dates: August 25-28, 2014

Inspector: Mike Morlang

Approved by: Kevin Hsueh, Chief  
Research and Test Reactors Oversight Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

ENCLOSURE

## EXECUTIVE SUMMARY

Missouri University of Science and Technology  
Report No.: 50-123/2014-201

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, the licensee's) facility safety programs including organization and staffing; procedures; experiments; health physics; effluents and environmental monitoring; design changes; committees, audits, and reviews; and 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.

### Procedures

- Written procedures were being maintained in accordance with Technical Specification requirements.

### Experiments

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

### Health Physics

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

### Effluents and Environmental Monitoring

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

### Design Changes

- The licensee maintained a procedure to process facility changes in accordance with regulatory requirements but had not made such a change requiring NRC approval since the previous inspection.

Committees, Audit and Reviews

- The Radiation Safety Committee continued to perform independent oversight in accordance with Technical Specification 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 200 kW pool-type research reactor (MSTR) 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 operated to support these activities.

#### 1. Organization and Staffing

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

The inspector reviewed the following reactor operations records to ensure compliance with the requirements of technical specification (TS) Section 6.3.1:

- Reactor Console Logbook #17, from August 28, 2012 to present
- Reactor Safety Committee Meeting Minutes for 2013 and 2014
- MSTR Standard Operating Procedure (SOP) SOP-102, Pre-Startup Checklist, Revised (Rev.) January 21, 2011, August 2013 to present
- MSTR SOP-105, Reactor Shutdown Checklist, Rev. September 9, 2013, December 2012 to present
- MSTR SOP-107, Permanent Hourly Logs and Operational Data, Rev. January 3, 2008, August 2013 to present
- MSTR Annual Progress Report for 2012/2013 and 2013/2014
- Hourly Log Sheets from August 2013 to present
- Contact Phone Number List dated April 4, 2014

##### b. Observations and Findings

There were 2 licensed senior reactor operators and 4 licensed reactor operators at the facility. A review of the logs and records indicated that Technical Specification shift staffing was maintained 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 Technical Specification Section 6.3.1.2.

##### c. Conclusion

Shift staffing was being maintained in accordance with Technical Specification Section 6.3.1.



## 2. Procedures

### a. Inspection Scope (IP 69001)

The inspector reviewed the following to ensure that procedures were in accordance with Technical Specification Section 6.4 requirements:

- 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-100, Preamble dated September 10, 2009
- MSTR SOP-306, Estimation of Activity and Reactivity Worth of a Sample dated February 5, 1989
- MSTR SOP-312, Critical Experiment Procedure dated July 24, 1975
- MSTR Annual Progress Report for 2012/2013 and 2013/2014
- Reactor Safety Committee Meeting Minutes for 2013 and 2014

### b. Observations and Findings

Technical Specification 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 Technical Specification 6.4. An Inspector Follow-up Item (IFI-50/123-2012/201-1) was opened and discussed with the licensee on this issue. The licensee had updated 10 procedures during the last year however, some pen and ink changes still remain. This IFI will remain active and reviewed during the next inspection.

### c. Conclusion

Procedures were maintained as required by Technical Specification 6.4 and generally being reviewed and updated as required.

### 3. Experiments

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

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

- File of Completed Irradiation Request Forms (IRF) for 2013 and 2014
- Permanent Reactor Logbook #17, August 28, 2012 to present
- MSTR SOP 702, Irradiation Request Forms (IRF), Rev. April 10, 1995
- MSTR SOP 710, Insertion and Removal of Experiments. Rev. March 30, 1994
- MSTR Annual Progress Report for 2012/2013 and 2013/2014
- Reactor Safety Committee Meeting Minutes for 2013 and 2014

#### 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 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 2012, 5 IRF's were reviewed and approved, and in 2013, 10 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 Technical Specifications 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 Technical Specification Sections 3.6.1 and 4.6.1, Radiation Monitoring Systems and requirements regarding radiation protection:

- Handbook of Radiological Operations
- MSTR SOP 615, Radiation Work Permits, dated June 29, 1988
- 2013 and 2014 Monthly Reactor Audit file
- 2013 and 2014 Reactor Dosimetry file
- 2013 and 2014 Reactor Sump Water Analysis File
- 2013 and 2014 Monthly Contamination Survey file
- 2013 and 2014 Monthly Radiation Survey file
- 2013 and 2014 Quarterly As Low As Reasonably Achievable (ALARA) Reports
- 2013 and 2014 Reactor Pool Water Analysis file
- 2013 and 2014 Reactor Pool Water Tritium file
- 2013 and 2014 Monthly HP Audit Reports
- 2013 to present Radiation Work Permit file
- 2013 and 2014 Portable Survey Instrument Calibration Reports
- 2013 and 2014 Argon-41 Monthly Release Forms
- 2013 Reactor Extra Surveys for removal of old heat system piping
- 2014 Reactor Extra Surveys for removal of old heater from reactor bay

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 Technical Specifications 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 Technical Specification Sections 3.6.2 and 4.6.2, Radioactive Effluents:

- MSTR Annual Progress Report for 2012/2013 and 2013/2014
- Argon-41 Release file
- Environmental Dosimetry files for 2013 and 2014
- 2013 and 2014 Air Release file
- 2013 and 2014 Byproduct Release file
- 2013 and 2014 Air Release Summary file
- Quarterly Environmental Dosimetry file for 2013 and to date in 2014

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 2013 was 132 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 during the remainder 2014.

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 Technical Specifications and reported results well below 10 CFR 20 limits.

## 6. Design Changes

### a. Inspection Scope (IP 69001-02.08)

The inspector reviewed the following to ensure that the requirements of 10 CFR 50.59 were being implemented effectively:

- Reactor Safety Committee Meeting Minutes file for 2012, 2013 and 2014
- MSTR Annual Progress Report for 2012/2013 and 2013/2014
- MSTR SOP 310, Facility Modifications, Rev. April 28, 1997

### b. Observations and Findings

The licensee reported that no changes were made since the previous inspection conducted in 2013. The licensee had installed a new control rod drive position indicating system during the year 2013. This was documented as an Unresolved Item (URI 50-123/2013-201-1) in the 2013 inspection report as the licensee had not fully restored all the analog scram circuitry at the time of the inspection. The licensee completed the control rod drive position indication upgrade following the 2013 inspection. This URI is considered closed.

### c. Conclusion

The licensee maintained a procedure to process facility changes in accordance with regulatory requirements.

## 7. Committees, Audits and Reviews

### a. Inspection Scope (IP 69001-02.09)

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

- Reactor Safety Committee Meeting Minutes file for 2012, 2013 and 2014
- Monthly Health Physics Audits for 2013 and 2014
- Annual Procedural Audits for 2013 by the Reactor Director
- External Audit by Missouri University Research Reactor dated December 4, 2013
- MSTR Progress Reports for 2012/2013 and 2013/2014

### b. Observations and Findings

The licensee used a single independent oversight safety committee to fulfill requirements for both the reactor license and the campus byproduct material license. The committee consisted of a minimum of five members, one of which must be the Radiation Safety Officer, two of which must be reactor staff and at

least two members from related academic fields. Currently there are seven 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 Technical Specifications Section 6.2.2. 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 Technical Specification requirements.

**8. Transportation**

a. Inspection Scope (IP 86740)

- Health Physics Radioactive Waste Pick-up Form
- 2012 and 2013 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.

**9. Exit Interview**

The inspector met with members of licensee staff and management in an exit briefing on August 28, 2014. 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
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
IP 92701	Follow Up Items

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

#### Open

None

#### Closed

50-123/2013-201-1	URI	Unresolved Item to ensure licensee restored analog scrams to original condition following console rod control upgrade
-------------------	-----	-----------------------------------------------------------------------------------------------------------------------

#### Discussed

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
-------------------	-----	------------------------------------------------------------------------------------------------------------------

### **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
URI	Unresolved Item