

April 14, 2010

Mr. Ralph Butler, Director
Research Reactor Center
University of Missouri - Columbia
Research Park
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI – COLUMBIA RESEARCH REACTOR – NRC
ROUTINE INSPECTION REPORT NO. 50-186/2010-201

Dear Mr. Butler:

On March 22–25, 2010, the U.S. Nuclear Regulatory Commission (NRC, the Commission) completed an inspection at the University of Missouri - Columbia Research Reactor (Inspection Report No. 50-186/2010-201). The enclosed report documents the inspection results, which were discussed on March 25, 2010, with you and members of your staff.

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

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, 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 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 Craig Bassett at 404-358-6515 or by electronic mail at Craig.Bassett@nrc.gov.

Sincerely,

/RA/

Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

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

Enclosure: NRC Inspection Report No. 50-186/2010-201
cc w/encl: See next page

cc:

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

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

Docket No.: 50-186

License No.: R-103

Report No.: 50-186/2010-201

Licensee: Curators of the University of Missouri – Columbia

Facility: University of Missouri – Columbia Research Reactor

Location: Research Park
Columbia, Missouri

Dates: March 22–25, 2010

Inspector: Craig Bassett

Approved by: Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

EXECUTIVE SUMMARY

University of Missouri – Columbia
University of Missouri – Columbia Research Reactor
Report No.: 50-186/2010-201

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the University of Missouri - Columbia (the licensee's) 10 Megawatt Class I research and test reactor safety program including: 1) organizational structure and staffing; 2) review and audit and design change functions; 3) procedures, 4) radiation protection, 5) environmental monitoring; and 6) transportation of radioactive material since the last NRC inspection of these areas. The licensee's program was acceptably directed toward the protection of public health and safety, and in compliance with the U.S. Nuclear Regulatory Commission (NRC) requirements. No violations or deviations were identified.

Organization and Staffing

- The licensee's organization and staffing were in compliance with the requirements specified in Technical Specifications Section 6.1.

Review and Audit and Design Change Functions

- Review and oversight functions required by Technical Specifications Section 6.1 were acceptably completed by the Reactor Advisory Committee.
- The design change program and procedures, which outlined the review and evaluation of changes to structures, systems, and components, and procedures and other documentation at the facility, satisfied NRC requirements.

Procedures

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

Radiation Protection

- Surveys were completed and documented as outlined in the Annual Report.
- Postings and notices met regulatory requirements.
- Staff personnel were wearing dosimetry as required and recorded doses were within the NRC's regulatory limits.
- Radiation survey and monitoring equipment was being maintained and calibrated as required.
- The Radiation Protection and As Low As Reasonably Achievable Programs satisfied regulatory requirements.
- Annual reviews of the Radiation Protection Program were being completed by the licensee as required by Title 10 of the *Code of Federal Regulations* Part 20.

- Radiation protection training was being conducted and was acceptable.

Effluent and Environmental Monitoring

- Effluent monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and Technical Specifications limits.

Transportation of Radioactive Materials

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

REPORT DETAILS

Summary of Plant Status

The University of Missouri - Columbia Research Reactor (MURR) continued to be operated in support of isotope production, silicon irradiation, reactor operator training, and various types of research. During the inspection, the reactor was operated continuously following the weekly maintenance shutdown to support laboratory experiments and product irradiation.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure [IP] 69006)

To verify that the staffing and organizational structure requirements were being met as specified in Technical Specifications (TS), Section 6.1, Revision (Rev.) Number (No.) 13, which was implemented through Amendment No. 34 to Facility Operating License No. R-103, dated January 29, 2004, the inspector reviewed:

- Administrative controls and management responsibilities
- Current MURR organizational structure with respect to radiation protection
- Operations and radiation protection (also referred to as health physics) staffing requirements for safe operation of the facility
- MURR Reactor Operations Annual Report for the period from January 1, 2008, through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010

b. Observations and Findings

The inspector noted that the organizational structure had not changed since the last inspection in the area of radiation protection (refer to NRC Inspection Report No. 50-186/2009-201). The Health Physics (HP) Group was staffed with a Health Physics Manager, a Radioactive Waste Coordinator, a Project Manager, and three HP technicians. The Waste Coordinator and the Project Manager were both certified health physicists. At the time of the inspection, one HP technician position was open because an individual had been promoted to head the shipping group. Also, one of the health physicists was expected to leave soon to accept a job at another facility. The licensee was actively seeking qualified people to fill the open positions.

The organizational structure was in accordance with the requirements of the TS and staffing appeared to be adequate for the current level of operations. Qualifications of the staff members met program requirements. Review of records indicated that management responsibilities were discharged as required by applicable procedures.

c. Conclusions

The licensee's organization and staffing with respect to radiation protection were in compliance with the requirements specified in TS Section 6.1.

2. Review and Audit and Design Change Functions

a. Inspection Scope (IP 69007)

In order to verify that the licensee had established and conducted reviews and audits as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20 and TS Section 6.1 and to ensure that facility changes were reviewed and approved in accordance with 10 CFR 50.59, the inspector reviewed:

- Radiation Protection Plan Audit for 2008 and 2009
- Selected audits and reviews completed by management and HP personnel
- Selected Subcommittee meeting minutes from October 2008 to the present including the Isotope Use Subcommittee, the Reactor Safety Subcommittee, and the Reactor Procedure Review Subcommittee
- MURR Reactor Advisory Committee meeting minutes, and related documents, from October 2008 to the present
- Selected Modification Records and 50.59 Screen Forms processed during 2009
- MURR Procedure AP-RO-115, "Modification Records," Rev. 4, issued October 29, 2008
- MURR Procedure AP-RR-003, "10 CFR 50.59 Evaluations," Rev. 4, issued July 6, 2006
- MURR Administrative Policy, POL-3, "MURR Radiation Protection Program," Rev. 8, issued September 16, 2008
- MURR Reactor Operations Annual Report for the period from January 1, 2008, through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010

b. Observations and Findings

(1) Review and Audit Functions

The inspector reviewed the meeting minutes of the Reactor Advisory Committee (RAC) and the meeting minutes of various subcommittees from October 2008 to the present. The minutes, and associated documents, indicated that the RAC met at the required frequency and that a quorum was present. The topics considered during the committee meetings and during the subcommittee meetings were appropriate and as stipulated in the TS.

The inspector reviewed the latest audits of the licensee's Radiation Protection (RP) program. It was noted that a member of one of the subcommittees of the RAC or other designated persons, including management and HP personnel, conducted audits and reviews of the RP program and the full RAC reviewed the results. No significant issues were identified during the audits but several areas for improvement were noted. The inspector also noted that a new format for the audit and review of the

RP program had been developed since the last inspection. This was done to facilitate completion of the review and audit by someone in either the Health Physics Group or the Regulatory Assurance Group, or by a member of the RAC. The new format appeared to be adequate and effective.

(2) Design Change Functions

The regulatory requirements concerning change control stipulated in 10 CFR 50.59 were implemented at the facility through MURR Procedures AP-RR-003 and AR-RO-115. The procedures were developed to address activities that would result in changes to the facility Hazards Summary Report (HSR), modifications to the facility, changes to MURR procedures, new tests or experiments not described in the HSR, revisions to NRC approved analysis methodology, and/or proposed compensatory actions to address degraded or non-conforming conditions. The procedures adequately incorporated criteria provided by the regulations with additional requirements mandated by local conditions.

The inspector reviewed selected Modification Records and 50.59 Screen Forms processed during 2009. The completed forms showed that the proposed changes and/or modifications were acceptably reviewed in accordance with the procedures. It was noted that one of the proposed changes or modifications dealt with replacing the current NMC RAK stack monitoring system with an improved Lab Impex system. The appropriate reviews and forms had been completed as required. The inspector noted that none of the modifications proposed in 2009 were determined to constitute a safety question or concern and none required a license or TS amendment.

c. Conclusions

Review and oversight functions required by the TS were acceptably completed by the RAC. The design change program was comprehensive and satisfied NRC requirements.

3. Procedures

a. Inspection Scope (IP 69008)

To verify compliance with TS Sections 6.1.b and 6.1.c, the inspector reviewed selected portions of the following:

- MURR Procedure AP-DC-100, "Controlled Document Revisions," Rev. 9, issued January 14, 2010
- MURR Procedure AP-DC-104, "Protocol Control," Rev. 3, issued January 14, 2010
- MURR Procedure AP-HP-123, "Visitor Dosimetry – Reception Desk," Rev. 7, issued February 4, 2010

- MURR Procedure AP-RR-005, "Security of "For Official Use Only" Information," Rev. 3, issued November 5, 2009
- MURR Procedure BP-SH-059, "Packaging and Shipment of Radioactive Material Using Spectratek Services Reusable Type A Package," Rev. 2, issued February 3, 2010
- MURR Procedure FB-SH-125, "Biennial Inspection and Preventive Maintenance BMI-1 Shipping Case," Rev. 0, issued March 18, 2010
- MURR Administrative Policy, POL-18, "Procedure Writer's Guide," Rev. 7, issued October 5, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2008, through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010

b. Observations and Findings

Technical Specification 6.1.c required that the RAC review procedure changes with safety significance. The Reactor Procedure Review Subcommittee was established and chartered to fulfill this requirement. The inspector verified that the subcommittee was meeting as required to review current procedure revisions and changes.

The inspector noted that nearly all of the procedures at MURR had been through a full review and revision process. The procedures reviewed by the inspector had been reviewed during the annual review as required.

The inspector observed various activities during the inspection. All were conducted in accordance with the appropriate procedures and no problems were noted. Procedure compliance was acceptable.

c. Conclusions

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

4. Radiation Protection

a. Inspection Scope (IP 69012)

The inspector reviewed the following to verify compliance with 10 CFR Part 20 and the applicable licensee TS requirements and procedures:

- Radiation protection (Rad Worker) training records
- MURR dosimetry records for 2008, 2009, and 2010 to date
- Dose Report Review Forms for October 2009 – February 2010
- Selected radiation and contamination survey records for the past year
- Radiological signs and posting in various facility laboratories and in the Beam Port Floor area

- Calibration and periodic check records for selected radiation survey and monitoring instruments for the past two years
- MURR Procedure AP-HP-105, "Radiation Work Permit," Rev. 9, issued September 23, 2009, and the associated form, Form FM-17, "Radiation Work Permit"
- MURR Procedure AP-HP-117, "MURR Initial Radiation Worker Training Program," Rev. 9, issued November 8, 2007, and the associated forms, Form FM-26, "MURR Training Questionnaire," and Form FM-29, "Initial Training Packet"
- MURR Procedure AP-HP-119, "High Radiation Area Access," Rev. 2, issued February 13, 2009
- MURR Procedure AP-HP-123, "Visitor Dosimetry – Reception Desk," Rev. 7 issued February 4, 2010
- MURR Procedure AP-HP-125, "Review of Unplanned Radiation Exposure," Rev. 2, issued April 18, 2007
- MURR Procedure AP-HP-130, "Reactor License Projects Annual Review," Rev. 3, issued December 17, 2008
- MURR Procedure IC-HP-300, "Calibration - Radiation Survey Instruments," Rev. 5, issued March 18, 2009, and the associated form, Form FM-62, "Radiation Instrument Certificate of Calibration"
- MURR Procedure IC-HP-333, "Calibration - Eberline BC-4 Beta Swipe Counter," Rev. 5, issued February 13, 2009
- MURR Procedure IC-HP-335, "Calibration - Portal Monitor Gamma-60 - S/N 900644," Rev. 7, issued April 29, 2009
- MURR Procedure OP-HP-220, "Tritium Bioassay," Rev. 5, issued July 14, 2009
- MURR Procedure OP-HP-306, "Daily Facility Checks," Rev. 2, issued October 14, 2009
- MURR Procedure RP-HP-100, "Contamination Monitoring - Performing a Swipe," Rev. 5, issued January 18, 2008
- MURR Procedure RP-HP-120, "Personnel Radioactive Contamination," Rev. 6, issued April 29, 2009, and the associated forms, Form FM-54, "Report of Personnel Contamination," and Form FM-76, "Personnel Contamination Log"
- MURR Procedure SV-HP-119, "Property Release," Rev. 3, issued March 29, 2009
- MURR Administrative Policy, POL-3, "MURR Radiation Protection Program," Rev. 8, issued September 16, 2008
- MURR Administrative Policy, POL-17, "MURR Training Booklet (Security, Emergency, and Health Physics)," Rev. 0, issued October 17, 2008
- MURR Reactor Operations Annual Report for the period from January 1, 2008, through December 31, 2008, issued February 23, 2009
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The inspector also toured the MURR facility, observed the use of dosimetry and survey meters, and conducted a radiation survey using an NRC-issued meter. Licensee personnel were interviewed as well.

b. Observations and Findings

(1) Surveys

Daily, monthly, and other periodic contamination and radiation surveys, outlined in the licensee's Reactor Operations Annual Report for 2009, were completed by HP staff members. Any contamination detected in concentrations above established action levels was noted and the areas were decontaminated. Results of the surveys were typically documented on survey maps and posted at the entrances to the various areas surveyed so that facility workers and visitors would be aware of the radiological conditions that existed therein.

(2) Postings and Notices

Copies of current notices to workers were posted in appropriate areas in the facility. The copies of NRC Form-3 noted at the facility were the latest issue, as required by 10 CFR Part 19, and were posted in various areas throughout the facility such as on the main bulletin board, in main hallways, and at the entrance to the Beam Port Floor area. The inspector determined that radiological signs, as well as the survey maps noted above, were typically posted at the entrances to controlled areas. Other postings also showed the industrial hygiene hazards that were present in the areas as well.

(3) Dosimetry Use and Results

Through direct observation the inspector determined that dosimetry was acceptably used by facility and contractor personnel. The inspector determined that the licensee used optically stimulated luminescent (OSL) dosimetry for whole body monitoring and thermoluminescent dosimeters (TLDs) in the form of finger rings and wrist badges for extremity monitoring. The dosimetry was supplied and processed by a National Voluntary Laboratory Accreditation Program accredited vendor (Landauer).

An examination of the OSL results indicating radiological exposures at the facility for the past two years showed that the highest occupational doses, as well as doses to the public, were within 10 CFR Part 20 limits. The records showed that approximately half of the facility personnel received occupational exposures of zero to only a few millirem above background. The highest annual whole body exposure received by a single individual for 2008 was 1,140 millirem (mr) deep dose equivalent (DDE). The highest annual extremity exposure for 2008 was 6,420 mr shallow dose equivalent (SDE) and the highest skin dose that year was 1,109 mr SDE. The highest annual whole body exposure received by a single individual for 2009 was 887 mr DDE. The highest annual extremity exposure for 2009 was 6,080 mr SDE and the highest skin dose was 900 mr SDE. In 2008, the highest whole body exposure was received by a reactor operator. In 2009, the highest whole body exposure was received by a

person in the shipping group. The highest extremity exposure in 2008 was received by a person processing samples while the highest extremity exposure in 2009 was received by a person in the Facility Operations group. Review of exposure records also showed that the Reactor Operations Group received approximately 55% of the facility's annual dose for 2008 and approximately 53.5% of the facility's annual dose for 2009.

The facility also collected and analyzed urine samples for Tritium (H-3) bioassay purposes. The highest attributable dose in 2008 from H-3 was 1.97 mr committed effective dose equivalent (CEDE). The highest H-3 attributable dose in 2009 was approximately 1.57 mr CEDE.

(4) Radiation Monitoring Equipment

Examination of selected radiation monitoring equipment indicated that the instruments had the acceptable up-to-date calibration sticker attached. The instrument calibration records indicated that the calibration of swipe counters and portal monitors was typically completed by licensee staff personnel. Other instruments, such as portable survey meters, friskers, and neutron detectors were shipped to vendors for calibration. Calibration frequency met procedural requirements and records were maintained as required. The inspector noted that Area Radiation Monitors (ARMs), as well as air monitors and stack monitors, were also being calibrated as required. These monitors were typically calibrated by licensee staff personnel.

(5) Radiation Work Permit Program

The inspector reviewed selected Radiation Work Permits (RWPs) that had been written, used, and closed out during 2009 and those issued for 2010. It was noted that the instructions specified in MURR Procedure AP-HP-105, Attachment 7.1, and those on the associated forms (Form FM-17, "Radiation Work Permit Instructions") had generally been followed. Appropriate review by management and health physics personnel had generally been completed. The controls specified in the RWPs were acceptable and applicable for the type of work being done.

(6) Radiation Protection Training

The inspector reviewed the radiation protection training (also known as rad worker training) given to MURR staff members, to those authorized to use the experimental facilities of the reactor, to students, and to visitors. The training satisfied the requirements of 10 CFR Part 19 and the training program was acceptable. It was noted that the rad worker annual refresher training for all staff personnel was completed by each individual on the anniversary date of their initial training. Additional training was generally conducted for all facility personnel during the later part of each year to review any current issues that affected those at the facility. The inspector reviewed the annual current issues training given in 2009 which

included aspects of security, emergency actions, and health physics. It was noted that the training had been completed in late November and early December.

(7) Radiation Protection Program

As noted in past reports, the licensee's Radiation Protection and As Low As Reasonably Achievable (ALARA) programs continued to be established and described in the MURR Administrative Policy, POL-3, "MURR Radiation Protection Program," and implemented through the various HP procedures that had been reviewed and approved. The programs contained instructions concerning organization, training, monitoring, personnel responsibilities, and audits. The programs, as outlined and established, appeared to be acceptable. The inspector verified that annual reviews of the Radiation Protection Program were being completed by the licensee as required by 10 CFR Part 20. The ALARA program provided instructions and guidance for keeping doses as low as reasonably achievable and was consistent with the guidance in 10 CFR Part 20.

(8) MURR ALARA Program

In 2000, the licensee's total cumulative facility dose was 46.7 rem. The Manager of Health Physics and the HP staff, along with other MURR managers and group leaders, recognized that improvements could be made in this area. Consequently, each group established an ALARA goal for the next year and the facility dose was then tracked by group, as well as for each individual. With emphasis placed on achieving the various groups' ALARA goals, the facility dose in 2001 was 42.9 rem. Due to the establishment of aggressive ALARA goals, continued efforts on dose reduction, worker awareness, and engineered improvements, the facility dose was 34 rem in 2002, 26.9 rem in 2003, and 27 rem in 2004. In 2005, the facility dose was 30.7 rem. During that year the licensee began extensive planning and preparation for two major projects that were planned for 2006.

In 2006, the licensee successfully completed two major tasks including the replacement of the beryllium reflector and the removal and replacement of two primary reactor heat exchangers. Even though the facility dose increased, the total cumulative dose was held to 33.8 rem, less than the annual dose received in 2000, 2001, or 2002. In 2007, the cumulative facility dose was 33.6 rem. During 2008 and 2009, MURR management and staff continued their efforts to maintain personal doses ALARA. The total cumulative facility dose for 2008 increased slightly and was 33.7 rem. It was noted that the total cumulative facility dose for 2009 had decreased substantially and was 27.9 rem. This was due in part to a decrease in the amount of product irradiation work performed during the year.

(9) Facility Tours

On various occasions during the inspection, the inspector toured the Hot Cell area, Beam Port Floor area, and selected support laboratories with licensee representatives. During one tour of the Beam Port Floor, the inspector conducted a radiation survey along with a licensee representative. The readings noted by the inspector were generally similar to those found by the licensee. No unmarked radioactive material was noted and no other anomalies were noted. The inspector noted that facility radioactive material storage areas were properly posted. Radiation and High Radiation Areas were posted as required and properly controlled.

c. Conclusions

The inspector determined that the Radiation Protection and ALARA Programs, as implemented by the licensee, satisfied regulatory requirements because:

- 1) surveys were completed and documented acceptably to permit evaluation of the radiation hazards present;
- 2) postings met regulatory requirements;
- 3) personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits;
- 4) radiation survey and monitoring equipment was being maintained and calibrated as required;
- 5) the Radiation Protection Program was acceptable and was being reviewed annually as required; and
- 6) the radiation protection training program was acceptable.

5. Effluent and Environmental Monitoring

a. Inspection Scope (IP 69004)

The inspector reviewed the following to verify compliance with the requirements of 10 CFR Part 20 and TS Section 3.7:

- Environmental monitoring program outlined through various procedures
- Monthly ALARA Environmental Review Reports for 2009 and to date in 2010
- Liquid Batch Release Review Forms for 2009 associated with the Monthly ALARA Environmental Review Reports
- MURR Procedure IC-HP-310, "Calibration - Eberline Model PING 1A Stack Monitor - Particulate Channel," Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-311, "Calibration - Eberline Model PING 1A Stack Monitor - Iodine Channel," Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-312, "Calibration - Eberline Model PING 1A Stack Monitor - Gas Channel," Rev. 5, issued January 18, 2008
- MURR Procedure OP-HP-200, "Air Sampling - Containment Building Tritium," Rev. 3, issued December 17, 2008
- MURR Procedure OP-HP-221, "Environmental Sample - Analysis," Rev. 5, issued June 6, 2007
- MURR Procedure OP-HP-222, "Air Sampling - Containment Building Ar-41," Rev. 4, issued January 18, 2008

- MURR Procedure OP-HP-353, "Waste Tank Sample - Analysis," Rev. 5, issued March 18, 2009
- MURR Procedure SV-HP-110, "Environmental Sampling," Rev. 4, issued February 15, 2008
- MURR Procedure WM-SH-105, "Radioactive Waste Processing," Rev. 4, issued August 7, 2008
- MURR Reactor Operations Annual Report for the period from January 1, 2008, through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010

b. Observations and Findings

(1) Gaseous and Liquid Releases

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 limits. The dose rate to the public, as a result of the gaseous releases, was below the dose constraint specified in 10 CFR 20.1101(d) of 10 mrem per year. COMPLY code results indicated an annual dose to the public of 4.1 mr for 2008 and data for 2009 indicated an annual dose to the public of 4.0 mr.

It was noted that the licensee had determined that the receptor exposed to the highest dose as a result of air effluent from the reactor was located in a building 150 meters to the north north east of MURR. The building was on land owned by the university and was considered to be on-site. The building was occupied eight hours per day, five days per week (8 hrs/day, 5 days/week) which resulted in an occupancy factor of 0.24. Thus, by applying this occupancy factor (0.24) for each year (calculated dose multiplied by the occupancy factor), the resulting annual dose to the public for 2008 was 0.98 mr and the annual dose to the public for 2009 was 0.96 mr.

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 noted that the results indicated that the releases were within the limits specified in 10 CFR Part 20, Appendix B, Table 3.

(2) Environmental Soil, Water, and Vegetation Samples

The inspector reviewed the environmental soil, water, and vegetation samples that were collected, prepared, and analyzed during 2009. These samples had all been collected and analyzed as required and within the time frame established by procedure. No problems were noted.

(3) Environmental Monitoring using TLDs

On-site and off-site gamma radiation monitoring was completed using the reactor facility stack effluent monitor and various environmental TLDs in accordance with the applicable procedures. Review of the data indicated that there were no measurable doses above any regulatory limits.

In 2008, the highest unrestricted area dose was measured in an unoccupied area north northwest from the MURR stack and was 81.6 mr. The highest unrestricted area dose in 2009 was measured in an unoccupied area south from the MURR stack and was 71.7 mr for all of 2009.

c. Conclusion

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

6. Transportation

a. Inspection Scope (IP 86740)

To verify compliance with regulatory and procedural requirements for transferring or shipping licensed radioactive material, the inspector reviewed the following:

- Selected records of various types of radioactive material shipments
- Selected training records for staff personnel authorized to ship hazardous material in accordance with the regulations specified by the Department of Transportation and the International Air Transport Association
- MURR Procedure AP-SH-001, "Administrative Procedure, Radioactive Materials Shipping," Rev. 6, issued December 22, 2009
- MURR Procedure BPB-SH-002, "20WC-1 Packaging and Shipment of Type B Non-Waste Radioactive Material," Rev. 9, issued February 3, 2010
- MURR Procedure BPB-SH-005, "DOT 6M Packaging and Shipment of Type B Non-Waste Radioactive Material," Rev. 7, issued April 8, 2009
- MURR Procedure BPB-SH-008, "Type B(U) F-327 Series Packaging of Type B Non-Waste Radioactive Material," Rev. 6, issued April 8, 2009
- MURR Procedure BP-SH-007, "F-327 Packaging and Shipment of Type A Non-Waste Radioactive Material," Rev. 5, issued December 22, 2009
- MURR Procedure BP-SH-010, "Packaging and Shipment of Non-Waste Radioactive Materials in Excepted Packages," Rev. 3, issued February 3, 2010
- MURR Procedure BP-SH-011, "Shipment of Non-Waste DOT 7A Type A (Gemstone) Radioactive Material Package," Rev. 4, issued February 3, 2010
- MURR Procedure BP-SH-013, "Packaging and Shipment of Radioactive Material Using MURR Reusable Type A Package," Rev. 3, issued April 8, 2009

- MURR Procedure BP-SH-014, "Packaging and Shipment of Radioactive Material Using an Overpack," Rev. 2, issued April 8, 2009
- MURR Procedure BP-SH-052, "Radioactive Material Shipment Package Documentation and Labeling," Rev. 5, issued November 5, 2009
- MURR Procedure BP-SH-099, "Packaging of Radioactive Material Using MURR Model 1500," Rev. 2, issued February 3, 2010
- MURR Procedure FB-SH-001, "Unirradiated Fuel Shipment Using the 110-Gallon USA DOT 6M Type B Package," Rev. 0, issued July 7, 2007
- MURR Procedure FB-SH-005, "Type B Shipment of Spent Fuel Using BMI-1 Shipping Container," Rev. 1, issued August 16, 2006
- MURR Procedure WM-SH-100, "Radioactive Waste - Preparation and Storage," Rev. 5, issued June 5, 2009
- MURR Procedure WM-SH-300, "MURR Exclusive Use Shipment of LSA or SCO Radioactive Waste," Rev. 7, issued September 24, 2009

b. Observations and Findings

During the inspection, the inspector closely observed the preparations for a shipment of Chromium-51 material from the facility. After the material was moved from the Hot Cell to the shipment staging area in a shielded shipping container, the container was surveyed and placed in a Type A package. Surveys of the package were then completed, labels were applied, and shipping papers were prepared. The inspector verified that the shipping papers contained the appropriate information and that the appropriate markings were placed on the outside of the package. Proper techniques were followed in conducting surveys of the package and the quality assurance checks of the shipments. Staff members conducting these shipments were knowledgeable of their duties and conducted a thorough review of all documentation.

During the aforementioned observations, the inspector also verified that the licensee maintained on file copies of consignees' licenses to possess radioactive material as required. It was also noted that the license of each specific consignee was verified to be current prior to initiating a shipment. The training of the staff members responsible for shipping the material was also reviewed. The inspector verified that the shippers had received training covering the various requirements of the Department of Transportation (DOT) and the International Air Transport Association and that the training was current.

Through records review and discussions with licensee personnel, the inspector determined that the licensee had shipped spent fuel, radioactive waste, and other types of radioactive material since the previous inspection in this area. The records indicated that the radioisotope types and quantities were calculated and dose rates measured as required. The radioactive material shipment records reviewed by the inspector had been completed in accordance with DOT and NRC regulations.

c. Conclusion

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

7. Exit Interview

The inspection scope and results were summarized on March 25, 2010, with members of licensee management and staff. The inspector described the areas inspected and discussed in detail the inspection findings. The licensee did not identify any of the material provided to or reviewed by the inspector during the inspection as proprietary. No dissenting comments were received from the licensee.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

K. Brooks	Associate Director, Product and Service Operations
R. Butler	Director of MURR
M. Diaz de Leon	Health Physicist
R. Dobey	Health Physics Manager
J. Ernst	Associate Director, Regulatory Assurance Group and Interim Chief Operating Officer
L. Foyto	Reactor Manager
A. Gaddy	Compliance Specialist
N. Hogue	Health Physics Technician
L. Juengermann	Shipping Manager
M. Kraus	Safety Associate and CAP Coordinator
K. Kutikkad	Assistant Reactor Manager, Physics
R. Maxey	Health Physics Technician
C. McKibben	Senior Advisor
J. Mitchell	Health Physics Technician
C. Mohesky	Training Coordinator
D. Nickolaus	Health Physics Technician
S. Oberhaus	Health Physics Technician Specialist
D. Rathke	Access Control Coordinator
E. Werner	Health Physics Technician

INSPECTION PROCEDURES USED

IP 69004:	Class 1 Research and Test Reactor Effluent and Environmental Monitoring
IP 69006:	Class 1 Research and Test Reactor Organization, Operations, and Maintenance Activities
IP 69007:	Class 1 Research and Test Reactor Review and Audit and Design Change Functions
IP 69012:	Class 1 Research and Test Reactor Radiation Protection
IP 86740:	Inspection of Transportation Activities

OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

None

LIST OF ACRONYMS USED

ARM	Area Radiation Monitor
ALARA	As low as reasonably achievable
CAP	Corrective Action Program
CEDE	Committed effective dose equivalent
10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
DDE	Deep dose equivalent
DOT	Department of Transportation
H-3	Tritium
HP	Health physics
HSR	Hazards Summary Report
IATA	International Air Transport Association
IP	Inspection Procedure
Mrem	Millirem
MURR	University of Missouri - Columbia Research Reactor
No.	Number
NRC	U. S. Nuclear Regulatory Commission
OSL	Optically stimulated luminescent (dosimeter)
RAC	Reactor Advisory Committee
Rev.	Revision
RP	Radiation Protection
RWP	Radiation Work Permit
SDE	Shallow dose equivalent
TLD	Thermoluminescent dosimeter
TS	Technical Specification
URI	Unresolved Item