

February 22, 2006

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

SUBJECT: NRC SPECIAL INSPECTION REPORT NO. 50-186/2006-201

Dear Mr. Butler:

This letter refers to the special inspection conducted on January 9-18, 2006, at your 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.

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 noncompliances of NRC requirements were identified. No response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," 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 (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

Should you have any questions concerning this inspection, please contact Craig Bassett at 404-562-4712.

Sincerely,

**/RA/**

Brian E. Thomas, Branch Chief  
Research and Test Reactors Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

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

Enclosures: NRC Inspection Report No. 50-186/2006-201

cc w/enclosure: Please see next page

University of Missouri-Columbia

Docket No. 50-186

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**ACCESSION NO.: ML060320544**

**TEMPLATE #: NRR-106**

OFFICE	PRT:RI		PRT:LA		PRT:BC	
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DATE	2/21/2006		2/3/2006		2/21/2006	

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

Docket No.: 50-186

License No.: R-103

Report No.: 50-186/2006-201

Licensee: Curators of the University of Missouri - Columbia

Facility: University of Missouri - Columbia Research Reactor

Location: Research Park  
Columbia, Missouri

Dates: January 9-18, 2006

Inspector: Craig Bassett

Approved by: Brian E. Thomas, Branch Chief  
Research and Test Reactors Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

## EXECUTIVE SUMMARY

University of Missouri - Columbia  
Report No.: 50-186/2006-201

This special, announced inspection included onsite review of licensee activities during an extended maintenance shutdown which involved changing out the beryllium reflector of the reactor and conducting beamport liner maintenance. The inspection included a review of the licensee's programs concerning organization and staffing, review and audit and design change functions, training, maintenance and surveillance, fuel handling, reactor operations, radiation protection, and procedure control used during this period. The shutdown was well planned and well executed and the licensee's programs were directed toward the protection of public and facility worker health and safety and were in compliance with NRC requirements. No safety concerns or violations of regulatory requirements were identified.

### Organization and Staffing

- The licensee's organization and staffing were in compliance with the requirements specified in Technical Specifications Section 6.1.
- Staffing for the maintenance shutdown was adequate which ensured that the appropriate coverage and support was available for all the jobs involved in the project.

### 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 and the Reactor Safety Subcommittee.
- The evaluation of changes to the facility and to procedures satisfied NRC requirements.

### Training

- Operator and support personnel job specific training was completed prior to the shutdown.
- Mock-up training was given to those working on beamport liner maintenance.

### Maintenance and Surveillance

- Maintenance activities conducted during the shutdown were well planned and properly coordinated and were completed in accordance with procedure as required.
- The surveillance program satisfied Technical Specification requirements.
- Problems were dealt with in an effective manner as they arose.

### Fuel Handling

- Fuel movements and inspections were conducted in accordance with Technical Specification and procedural requirements.

### Reactor Operations

- Reactor operations were conducted in accordance with procedures as required.
- Shift turnovers, communication, and personnel cognizance of changing facility conditions were acceptable.

### Radiation Protection

- Continuous HP coverage provided workers with the information they needed to maintain their doses ALARA.
- Surveys were completed acceptably to permit evaluation of the radiation hazards present.
- Personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits.
- Postings met regulatory requirements.

### Procedures

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

## REPORT DETAILS

### **Summary of Plant Status**

The University of Missouri - Columbia Research Reactor (MURR) was shut down on Sunday, January 8, 2006, in preparation for an extended maintenance shutdown. The maintenance shutdown included changing out the beryllium reflector that surrounds the reactor. That required, among other related jobs, partially dismantling the outer pressure vessel. The shutdown also included replacing four of the graphite reflector wedges located outside the beryllium reflector. In order to replace the graphite wedges, it was necessary to retract Beamports A, B, and C. Since these beamports had to be moved, the licensee also conducted some maintenance in those areas including replacing various vent and fill tubing. During the inspection, the coordination of the work activities and the progress of the various jobs involved were observed and the implementation of the licensee's safety programs was verified.

### **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, Amendment No. 33, dated January 29, 2004, and that staffing for the shutdown was adequate, the inspector reviewed:

- current MURR organizational structure
- administrative controls and management responsibilities
- staffing for beryllium change out project

#### b. Observations and Findings

The inspector noted that the organizational structure had not changed since the last inspection at the facility (refer to NRC Inspection Report No. 50-186/2005-203). The organization and staffing at the facility were as specified in the TS.

It was noted that, for the shutdown and beryllium change out project, management, operations, and support personnel had been divided into two groups. Each group consisted of the following: 1) a team of reactor operators which handled the reactor dismantlement, beryllium reflector, and graphite reflector wedge work (augmented by Facility Support Operations [FSO] personnel); 2) a team of FSO personnel to accomplish the beamport liner removal and reinsertion and maintenance work (augmented by staff from other MURR organizations); 3) various individuals who took pictures and maintained documentation of the work as it progressed; 4) a team of Health Physics (HP) personnel to provide continuous coverage for all the beryllium change out and beamport work; 5) a team of HP helpers to conduct periodic surveys of the facility during the shutdown and provide other analytical support; and, 6) a team of people from various MURR organizations that provided all other team members with clean personal protective clothing.

Each group worked a 12-hour day, one group on day shift and one group on night shift, for the duration of the shutdown. Each manager or lead person and operations or support person on day shift had a counterpart on the night shift. The two groups were well organized and aware of their individual responsibilities. The organization and staffing provided sufficient coverage for the all the work undertaken during the project.

c. Conclusions

The licensee's organization and staffing were in compliance with the requirements specified in TS Section 6.1. Staffing for the maintenance shutdown was adequate which ensured that the appropriate coverage and support was available for all the jobs involved in the project.

**2. Review and Audit Functions**

a. Inspection Scope (IP 69007)

In order to verify that the licensee had established and conducted reviews and audits as required by 10 CFR Part 20 and TS Section 6.1, the inspector reviewed:

- Reactor Advisory Committee meeting minutes, and related documents, from January 2005 to the present
- Selected Subcommittee meeting minutes from February 2005 to the present including the Isotope Use Subcommittee, the Reactor Safety Subcommittee, and the Procedure Review Subcommittee
- MURR Procedure AP-RR-003, "10 CFR 50.59 Evaluations," Rev. 3, issued July 27, 2005
- selected AP-RR-003 Attachment 1, "50.59 Screen" forms, Numbers 05-40 through 05-58
- MURR Procedure AP-RO-115, "Modification Records," Rev. 2, issued October 20, 2005

b. Observations and Findings

(1) Review Functions

The inspector reviewed the meeting minutes of the Reactor Advisory Committee (RAC) and the meeting minutes of various subcommittees, including the Reactor Safety Subcommittee, from January 2005 to the present. The most recent meeting held by the RAC was on November 1, 2005. The most recent meeting held by the Reactor Safety Subcommittee was on January 4, 2006. The minutes, and associated documents, indicated that the committees met at the required frequency and that a quorum was present. The topics considered during the meetings were appropriate and as stipulated in the TS. It was noted that the shutdown plans and scheduled work were reviewed during each of these meetings so that the committees were kept abreast of the plans for the beryllium change out project.



(2) Design Change Functions

The inspector reviewed design change reviews that had been conducted by the licensee concerning work to be done and procedures to be used during the beryllium change out project. The reviews were documented on forms associated with MURR Procedure AP-RR-003, "10 CFR 50.59 Evaluations," Rev. 3, issued July 27, 2005. The 50.59 Screen forms had been completed, reviewed, and approved as required. None of the screens required that a 50.59 Evaluation be conducted.

c. Conclusions

Review and oversight functions required by the TS were acceptably completed by the RAC and the Reactor Safety Subcommittee. The evaluation of changes to the facility and to procedures satisfied NRC requirements.

**3. Training**

a. Inspection Scope (IP 69003)

The inspector reviewed selected aspects of the following to ensure compliance with the "Operator Requalification Program - University of Missouri Research Reactor (MURR)" dated January 7, 1997, and to ensure that operations and support personnel received proper instruction on, and were acquainted with, the responsibilities and duties of their respective jobs for the shutdown:

- operator training records for 2005 and specifically for the beryllium change out
- training records for support personnel provided by Health Physics

b. Observations and Findings

A review of the logs and records showed that training was conducted in anticipation of the beryllium change out project. Procedures to be used were reviewed and discussed by all operators and the appropriate support personnel. The training given was augmented by having those who had participated in past change out operations relate their experiences. Lessons learned from past beryllium change out projects were reviewed as well.

For those individuals who were assigned to work on the Beamport Floor and assist with retracting and reinserting Beamport Liners A, B, and C, a mockup was fabricated of the beamport face and teams were given instruction and practiced the proper method of accomplishing that work. For those individuals who were asked to assist in periodic surveys of the facility, training was given by Health Physics personnel in the methods and techniques to properly complete an adequate survey.

c. Conclusions

Operator and support personnel training was completed prior to the shutdown. Mock-up training was given to those working on the beamport liner maintenance.

#### 4. Maintenance and Surveillance

##### a. Inspection Scope (IP 69006, 69010)

To verify that the licensee was meeting the requirements of their Preventive Maintenance Program, complying with TS Sections 2, 3, 4, and 5, and following the steps of the Beryllium Change Out Procedure, the inspector reviewed selected aspects of:

- MURR Compliance Procedure CP-10, "Rod Drop Times," dated May 13, 1985
- MURR Compliance Procedure CP-25, "Offset Removal, Installation, and Control Blade Inspection," dated October 5, 2005
- MURR Procedure AP-RR-015, "Work Control Procedure," Rev. 7, issued December 9, 2005
- MURR Procedure EX-RO-120, "Beamport "A" Operation," Rev. 2, issued August 15, 2005
- MURR Procedure GS-RA-100, "MURR Equipment Tag Out," Rev. 5, issued September 16, 2005
- MURR Operator Aid OA-21, "MURR Maintenance Guidelines," Rev. 3, issued May 3, 2005
- MURR Procedure OP-RO-250, "In-Pool Fuel Handling," Rev. 7, issued August 15, 2005
- MURR Procedure OP-RO-466, "Pool Level Control - Pool Coolant System," Rev. 3, issued April 26, 2004
- MURR Procedure OP-RO-741, "Waste Tank System Operation," Rev. 7, issued December 30, 2005
- MURR Procedure RP-HP-139, "Beamport Radiation Level Monitoring During Reactor Startup," Rev. 2, issued June 2, 2005
- MURR Procedure RP-RO-200, "Measurement of Differential Worth of a Shim Blade, RTP-11(D)," Rev. 1, issued August 15, 2005
- MURR Procedure RP-RO-201, "Measurement of Total Reactivity Worth of Flux Trap Loadings RTP-17(B)," Rev. 1, issued August 15, 2005
- Procedure Number RTP-5, "Procedure for Regulating Blade Calibration by the Positive Period Method," Rev. dated July 15, 2002
- Procedure Number RTP-21, "Procedure for Control Rod Drop Timer Using Spare Magnet," Rev. dated January 2, 2003
- Preventive Maintenance (PM) Card, RX—2, "Neutron Source," Rev. dated March 15, 2005
- PM Card, RX-S-1, "Inspect, Align, Remove, and Install the Offset Mechanism," Rev. dated July 26, 2000
- MURR Procedure SM-RO-011, "Beryllium Reflector Replacement," Rev. 0, issued December 29, 2005, and associated appendices as follows:
  - Appendix 9.1A, "System Line-Up to Pump Pool Water to Waste Tank System"
  - Appendix 9.1B, "System Line-Up to Transfer Water From T-300/301 to Waste Tank System"
  - Appendix 9.1C, "Recirculate Waste Tank Water Via Pool Clean-Up System"
  - Appendix 9.2, "System Line-Up to Transfer Water From Waste Tank System to Pool"

- Appendix 9.3, "Return Water Movement Systems to Normal"
- Appendix 9.4, "Cleaning Waste Tank System for Accepting Pool Water"
- Appendix 9.5, "System Line-Up to Transfer Water From Waste Tank System to T-300/301"
- Appendix 9.6, "Pool Sweep Pump Using Skimmer System"
- Appendix 9.7, "Pool Water Volumes vs. Height"
- Appendix 9.8, "In-Pool Sample Handling/Storage"
- Appendix 9.9, "Pressure Vessel Alignment Procedure"
- Appendix 9.10, "Tie-Rod Loosening and Tightening Sequence"
- Appendix 9.11, "Upper Pressure Vessel Spool Piece Removal/Installation Rigging"
- Appendix 9.12, "Pressure Vessel and Valve 502 Bolt Tightening Sequence"
- Appendix 9.13, "Leak Check of In-Pool Primary Coolant System Flanges"
- Appendix 9.14, "Physics Startup and Tests"
- Appendix 9.15, "Tool Identification Picture"
- Appendix 9.16, "Weir Cooling"
- Appendix 9.17, "In-Pool Heat Exchanger Temperature Detector"
- MURR Procedure SM-RO-635, "Retracting and Reinserting Beamport "A" Liner," Rev. 0, issued December 20, 2005
- MURR Procedure SM-RO-636, "Retracting and Reinserting Beamport "B" Liner," Rev. 0, issued December 20, 2005
- MURR Procedure SM-RO-637, "Retracting and Reinserting Beamport "C" Liner," Rev. 0, issued December 20, 2005
- Standard Operating Procedure (SOP) II.3, "Control Blade Offset Mechanism Removal," Rev. dated May 23, 1997

b. Observations and Findings

(1) Maintenance

The inspector observed facility activities on various occasions during the shutdown on both day shift and night shift. All the maintenance activities observed were conducted in accordance with the applicable procedures. The shutdown was conducted in an efficient and well-organized manner. It was apparent that careful planning and preparations had been made prior to the start of the beryllium change out project.

As noted above, the shutdown included maintenance activities that affected both the reactor and three of the beamports. Separate crews worked in each area. The majority of the reactor maintenance was completed by reactor operators while the beamport maintenance was completed by support personnel. As noted previously, both groups had been trained and the work progressed generally according to the schedule, the flow chart, and the Gantt Chart that had been developed for the shutdown. As problems arose, they were dealt with following discussions among the managers and crew leaders and after agreement was reached on how to proceed. Former employees with a great deal of "corporate knowledge" were also contacted to ensure that appropriate decisions were made on ways to correct difficult problems.

(2) Surveillance

Following the change out of the beryllium and graphite reflectors and the work on the beamports, the appropriate surveillance verifications and calibration of equipment, including the testing of various reactor systems, instrumentation, auxiliary systems, and security systems and alarms, were completed. The licensee used "Compliance Procedures" (CPs) or MURR Operations Procedures to conduct these verifications as required. The data recorded in the Logbooks and on the CP records indicated that the verifications and calibrations were within the prescribed parameters. The results reviewed by the inspector were noted to be within the limits established in the TS as well.

c. Conclusions

Maintenance activities conducted during the shutdown were well planned and coordinated and completed in accordance with procedure as required. The surveillance program satisfied TS requirements. Problems were dealt with appropriately as they arose.

**5. Fuel Handling**

a. Inspection Scope (IP 69009)

To ensure that the licensee was following the requirements of TS Sections 3.8, 4.1, and 4.3, the inspector reviewed selected aspects of the following:

- Fuel Status Board located in the Control Room
- MURR Fuel Status/Location Maps sheets developed by the Assistant Reactor Manager - Physics
- Fuel Movement Sheets developed for fuel movements that occurred prior to and following the beryllium change out and maintenance shutdown
- MURR Procedure RP-RO-100, "Fuel Movement," Rev. 4, issued May 18, 2005
- MURR Procedure OP-RO-250, "In-Pool Fuel Handling," Rev. 7, issued August 15, 2005
- MURR Form FM-8, "Fuel Movement Sheet," Rev. 6

b. Observations and Findings

(1) Fuel Movement

The inspector reviewed the fuel movement forms that had been developed for the shutdown and the subsequent startup. They had been prepared as required for core refueling and rearrangement of fuel storage in the pool. The inspector also compared the location of fuel elements in the reactor core with the information maintained on the Fuel Status Board in the Control Room and on the fuel movement sheet for the latest core, Core Number 06-04. The inspector observed the fuel movement process following the beryllium change out as well. The inspector verified that fuel was moved according to established procedure and in conjunction with the specific fuel movement sequence sheets developed by the Assistant Reactor Manager-Physics for

each core loading. Two independent visual inspection verifications were completed prior to moving each fuel element from one location to another. The inspector noted that proper radiation control and security precautions, required by procedure, were taken.

(2) Problems with Refueling the Reactor

Following the beryllium change out, the operating crew began to refuel the reactor. After three fuel elements had been placed in the proper locations, they found that the next fuel element would not insert easily into the next designated core position as required. In reviewing the problem, the licensee noted that the outer pressure vessel had not been aligned properly during reassembly following the change out. Senior licensee managers were called in (on Sunday) to consult on the problem and, after careful review of the problem, corrective actions were developed. These actions included: 1) reviewing the records documenting past beryllium change outs to check for similar problems and solutions in this area; 2) developing, reviewing, and approving an amended procedure to partially disassemble the pressure vessel, align it correctly, and then reassemble it as required; and 3) calling in additional operations and support personnel to assist with this effort.

Following completion of the corrective actions, including completion of the amended procedure, the outer pressure vessel was found to be in proper alignment. The licensee then completed the remainder of the fuel movements and the beryllium change out procedure, MURR SM-RO-011, and no further problems were encountered.

c. Conclusions

Fuel movements and inspections were conducted in accordance with TS and procedural requirements.

**6. Reactor Operations**

a. Inspection Scope (IP 69006)

To verify that the licensee was operating the reactor and conducting operations in accordance with TS Section 3 and procedural requirements, the inspector reviewed selected portions of the following:

- Operations Shift Turnover sheets for January 2006
- MURR Control Room Logbooks for the period from December 2005 through January 2006
- MURR Console Watch Logbooks for the period from December 2005 through January 2006
- MURR Compliance Procedure CP-10, "Rod Drop Times," dated May 13, 1985
- MURR Procedure AP-RO-110, "Conduct of Operations," Rev. 5, issued October 20, 2005 and the associated forms, FM-11, "Reactor Shutdown Checksheet," FM-56, "Reactor Routine Patrol," FM-57, "Long Form Startup Checklist," and FM-58, "Short Form Startup Checklist"

- MURR Procedure EX-RO-120, "Beamport "A" Operation," Rev. 2, issued August 15, 2005
- MURR Procedure OP-RO-210, "Reactor Startup - Normal," Rev. 6, issued May 3, 2005
- MURR Procedure OP-RO-220, "Reactor Shutdown or Power Reduction," Rev. 4, issued August 15, 2005
- MURR Procedure OP-RO-250, "In-Pool Fuel Handling," Rev. 7, issued August 15, 2005
- MURR Procedure OP-RO-466, "Pool Level Control - Pool Coolant System," Rev. 3, issued April 26, 2004
- MURR Procedure OP-RO-741, "Waste Tank System Operation," Rev. 7, issued December 30, 2005
- MURR Procedure RP-RO-200, "Measurement of Differential Worth of a Shim Blade, RTP-11(D)," Rev. 1, issued August 15, 2005
- MURR Procedure RP-RO-201, "Measurement of Total Reactivity Worth of Flux Trap Loadings RTP-17(B)," Rev. 1, issued August 15, 2005
- Procedure Number RTP-5, "Procedure for Regulating Blade Calibration by the Positive Period Method," Rev. dated July 15, 2002
- Procedure Number RTP-21, "Procedure for Control Rod Drop Timer Using Spare Magnet," Rev. dated January 2, 2003

b. Observations and Findings

(1) Reactor Operation

Following the beryllium change, the licensee completed MURR Procedure RPT-21, "Procedure for Control Rod Drop Timer Using Spare Magnet," loaded Core 06-03, completed CP-10, MURR Compliance Procedure CP-10, "Rod Drop Times," for all rods, and initiated a reactor startup in order to complete the required physics testing. The operators followed the proper startup, testing, and shutdown procedures using MURR Procedure OP-RO-210, "Reactor Startup - Normal," and MURR Procedure OP-RO-220, "Reactor Shutdown or Power Reduction." Following the physics testing, the MURR refueling sequence was followed, Core No. 06-03 was unloaded, and Core No. 06-04 was loaded. The crew then commenced another FM-57, "Long Form Startup Checklist" as required and subsequently MURR Procedure RP-RO-200, "Measurement of Differential Worth of a Shim Blade, RTP-11(D)," was completed for each control rod. RTP-5, "Procedure for Regulating Blade Calibration by the Positive Period Method," was also completed for the regulating blade. A remote visual inspection of the fuel vault was accomplished during this process as required. The Long Form Startup Checklist was finally completed and normal 10 megawatt operations resumed at 11:50 p.m. on January 17, 2006.

(2) Staff Communication

During the inspection, the inspector attended shutdown management and operations crew shift turnover meetings held daily at 6:00 a.m. and 6:00 p.m. and at 6:30 a.m. and 6:30 p.m. respectively. The progress made during the shift and the status of the reactor and the beamport was discussed in detail on

each occasion as required. All operators of the relief crews reviewed the appropriate logs and records and all personnel were briefed on the upcoming shift activities and scheduled events.

It was noted that, on each crew, there was a person assigned to take pictures of the various activities in progress and a separate person to read the steps of, and ensure proper sign-off of, the procedure and maintain a separate log of the project and note any problems that were encountered. All these pictures and data were used by the licensee to document the entire shutdown and outline areas for improvement. This will enable those planning future beryllium change out projects to avoid past problems and make any necessary changes to procedures as needed.

c. Conclusions

Reactor operations were conducted in accordance with procedures as required. Shift turnovers, communications, and personnel cognizance of changing facility conditions were acceptable.

## 7. 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 training program records
- selected radiation and contamination survey records for the beryllium change out and maintenance shutdown project
- radiological signs and posting on the Reactor Bridge and in the Beamport Floor area
- MURR dosimetry records for each shift during the shutdown
- MURR Center Security, Emergency, and Health Physics Indoctrination Booklet last updated March 30, 2004
- MURR Procedure AP-HP-105, "Radiation Work Permit," Rev. 4, issued October 21, 2005, and the associated form, Form FM-17, "Radiation Work Permit" used for the Beryllium Change Out:
  - RWP 06-01, "Replace Beryllium Reflector and Associated Maintenance," approved January 8, 2006
  - RWP 06-02, "Retract and Replace Beamport Liners A, B, and C In Association with Beryllium Change Out," approved January 8, 2006
- MURR Procedure AP-HP-117, "MURR Initial Radiation Worker Training Program," Rev. 6, issued February 4, 2005, and the associated forms, Form FM-26, "MURR Training Questionnaire," and Form FM-29, "Initial Training Packet"
- MURR Procedure AP-HP-125, "Review of Unplanned Radiation Exposure," Rev. 0, dated January 31, 2003
- MURR Procedure OP-HP-220, "Tritium Bioassay," Rev. 3, issued August 18, 2005

- MURR Procedure RP-HP-100, "Contamination Monitoring - Performing a Swipe," Rev. 4, issued December 19, 2005
- MURR Procedure RP-HP-120, "Personnel Radioactive Contamination," Rev. 3, issued May 8, 2003, 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. 1, issued April 30, 2003

The inspector also toured the licensee's facility, witnessed the use of dosimetry and survey meters, and observed personnel entering and exiting controlled areas and monitoring for personal contamination.

b. Observations and Findings

(1) Surveys

During the shutdown, continuous HP coverage was provided for the beryllium change out and the beamport liner maintenance activities. Accordingly, contamination and radiation surveys were conducted in the active work areas as needed to support all the ongoing work. It was also noted that, during the shutdown period, HP assistants conducted contamination surveys every two hours in the remainder of the reactor containment and the main passageways of the facility. Any contamination detected in concentrations above established action levels was noted and the affected area was decontaminated. Team members were continually updated as to the radiation levels and contamination levels in the affected work areas.

Air sampling was conducted for the Reactor Containment, as well as for specific jobs conducted on the beamport floor. None of the samples indicated airborne activity in excess of the regulatory limits.

(2) Dosimetry

Through direct observation the inspector determined that dosimetry was acceptably used by facility personnel. It was noted 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. In addition, the licensee issued individual electronic personnel dosimeters (EPDs) to each individual working on or supporting the shutdown projects each shift.

An examination of the EPD results, indicating radiological exposures at the facility for the shutdown, showed that the highest occupational doses were well within 10 CFR Part 20 limits. The highest whole body exposure received by a single individual for the shutdown was 294 millirem (mr). The total whole body exposure received by everyone participating in the shutdown was 4718 mr. As a means to compare the total exposure received during the shutdown, the inspector reviewed the exposure records for past beryllium change out



projects. The review indicated that the total exposure received during the 1997 beryllium change out was 6587 mr and the total exposure received during the 1989 beryllium change out was 4960 mr. Urine samples for Tritium (H-3) bioassay purposes were also collected and analyzed but the final results of the analyses of those samples were not available during the inspection. Preliminary data indicated no exposures in excess of the licensee's action level or in excess of the regulatory limits.

(3) ALARA Program

An administrative limit of 300 millirem (mr) for the entire project was established for each individual working on the beryllium change out (reactor operators) and an administrative limit of 130 mr was established for every other person involved in the project, including those working on the beamport liner maintenance. The licensee also stipulated that management authorization had to be granted for anyone to exceed these limits.

The EPD results were tabulated at the end of each shift and everyone was made aware of their respective dose prior to starting a new work day. Also, team leaders and managers reviewed the EPD results to ensure that no one received more than their allowed limit and to equalize the dose of the individuals involved in the jobs which required work in an area of increased radiation levels.

(4) Radiation Work Permit Program

The inspector reviewed all Radiation Work Permits (RWPs) that had been written for, and used during, the shutdown. It was noted that the instructions specified in MURR Procedure AP-HP-105, "Radiation Work Permit," Attachment 7.1, Form FM-17, "Radiation Work Permit Instructions" had been adequately followed. Appropriate review by management and health physics personnel had been conducted. The controls specified in the RWPs were acceptable and applicable for the type of work being done.

(5) Postings and Notices

Copies of current notices to workers were posted in appropriate areas in the facility. Radiological signs and survey maps 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. 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.

(6) Facility Tours

The inspector toured the Reactor Bridge and Beam Port Floor areas and selected support areas on numerous occasions. The inspector noted that facility radioactive material storage areas were properly posted. No unmarked

radioactive material was noted. Radiation and High Radiation Areas were posted as required.

c. Conclusions

The inspector determined that the radiation protection program, as implemented by the licensee, satisfied regulatory requirements because: 1) continuous HP coverage provided workers with the information they needed to maintain their doses ALARA; 2) surveys were completed acceptably to permit evaluation of the radiation hazards present; 3) personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits; and, 4) postings met regulatory requirements.

**8. 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. 5, issued June 28, 2005
- MURR Procedure AP-DC-102, "Document Control," Rev. 3, issued June 28, 2005
- MURR Procedure SM-RO-011, "Beryllium Reflector Replacement," Rev. 0, issued December 29, 2005
- MURR Procedure SM-RO-635, "Retracting and Reinserting Beamport "A" Liner," Rev. 0, issued December 20, 2005
- MURR Procedure SM-RO-636, "Retracting and Reinserting Beamport "B" Liner," Rev. 0, issued December 20, 2005
- MURR Procedure SM-RO-637, "Retracting and Reinserting Beamport "C" Liner," Rev. 0, issued December 20, 2005

b. Observations and Findings

The inspector noted that, because the Special Maintenance procedures used for this shutdown had been developed during past shutdowns, they had not been used in some time. Therefore, the licensee had revised and/or reformatted the procedures in accordance with the current MURR Procedure Writer's Guide. Following this revision and reformatting effort, the procedures were submitted to the MURR Procedure Review Subcommittee for review. The procedures were reviewed and approved as required. The inspector verified that the licensee was implementing the procedure review, revision, and control program that had recently been developed.

c. Conclusions

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

**9. Exit Interview**

The inspection scope and results were summarized on January 18, 2006, 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 personnel

K. Brooks, Associate Director, Product and Service Operations  
R. Butler, Director of MURR  
J. Custer, Lead Senior Reactor Operator  
M. Dixon, Assistant Reactor Manager - Operations  
R. Dobey, Manager, Health Physics  
J. Ernst, Associate Director, Regulatory Assurance Group  
L. Foyto, Reactor Manager  
J. Fruits, Work Control Manager  
A. Gaddy, Document Control Coordinator  
J. Hemphill, Health Physicist  
C. Herbold, Assistant Reactor Manager - Engineering  
R. Hudson, Operations Training Coordinator  
M. Kilfoil, Senior Reactor Service Project Specialist  
K. Kutikkad, Assistant Reactor Manager, Physics  
B. McCracken, Reactor Facilities Engineer  
C. McKibben, Senior Advisor  
S. Meier, Senior Reactor Service Project Specialist  
W. Meyer, Chief Operating Officer  
W. Oladrian, Manager, Facility Support Operations  
A. Saale, Lead Senior Reactor Operator  
S. Sample, Lead Senior Reactor Operator  
M. Wallis, Lead Senior Reactor Operator  
T. Warner, Lead Senior Reactor Operator

## **INSPECTION PROCEDURES USED**

IP 69003 Class I Research and Test Reactor Operator Licenses, Requalification, and Medical Activities  
IP 69006: Class I Research and Test Reactor Organization, Operations, and Maintenance Activities  
IP 69007: Class I Research and Test Reactor Review and Audit and Design Change Functions  
IP 69008 Class I Research and Test Reactor Procedures  
IP 69009 Class I Research and Test Reactor Fuel Movement  
IP 69010 Class I Research and Test Reactor Surveillance  
IP 69012: Class I Research and Test Reactor Radiation Protection

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

### Opened

None.

### Closed

None.

## LIST OF ACRONYMS USED

ARM	Area Radiation Monitor
ALARA	As low as reasonably achievable
CFR	Code of Federal Regulations
CP	Compliance Procedure
EPD	Electronic personnel dosimeters
FSO	Facility Support Operations
HP	Health physics
IP	Inspection Procedure
IR	Inspection Report
LSA	Limited Surface Activity
LSRO	Lead Senior Reactor Operator
mCi	Millicurie
mr	millirem
MURR	University of Missouri - Columbia Research Reactor
NRC	Nuclear Regulatory Commission
OSL	Optically stimulated luminescent (dosimeter)
PDR	Public Document Room
RAC	Reactor Advisory Committee
Rev.	Revision
RWP	Radiation Work Permit
SNM	Special Nuclear Material
TLD	Thermoluminescent dosimeter
TS	Technical Specification