

May 8, 2001

Dr. Edward A. Deutsch, Director  
Research Reactor Center  
University of Missouri-Columbia  
Research Park  
Columbia, MO 65211

SUBJECT: NRC INSPECTION REPORT NO. 50-186/2001-201

Dear Dr. Deutsch:

This letter refers to the inspection conducted on April 9-12, 2001, at the University of Missouri-Columbia Research Reactor (MURR) facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of this inspection.

Various aspects of your safety and operations programs were inspected including selective examinations of procedures and representative records, interviews with personnel, and observation of activities in progress. Based on the results of this inspection, no significant safety issues were identified.

In accordance with 10 CFR 2.790 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/NRC/ADAMS/index.html>.

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

Sincerely,

*/RA/*

Ledyard B. Marsh, Chief  
Events Assessment, Generic Communications  
and Non-Power Reactors Branch  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

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

Enclosure: NRC Inspection Report No. 50-186/2001-201

cc w/enclosure:

Please see next page

University of Missouri-Columbia

Docket No. 50-186

cc:

University of Missouri  
Associate Director  
Research Reactor Facility  
Columbia, MO 65201

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

Docket No.: 50-186

License No.: R-103

Report No.: 50-186/2001-201

Licensee: University of Missouri-Columbia

Facility: University of Missouri-Columbia Research Reactor (MURR)

Location: Research Park  
Columbia, Missouri

Dates: April 9-12, 2001

Inspectors: Craig Bassett  
Thomas Dragoun

Approved by: Ledyard B. Marsh, Chief  
Events Assessment, Generic Communications,  
and Non-Power Reactors Branch  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

## EXECUTIVE SUMMARY

This was a routine, announced inspection of activities at the University of Missouri-Columbia Research Reactor facility related to operation of the 10 Megawatt (Mw) Class 1 non-power reactor (NPR). It included onsite review of the licensee's programs dealing with organizational structure and functions, operations, design control, review and audit, operator requalification, maintenance and surveillance, fuel handling, experiments, procedural control, and emergency preparedness since the last NRC inspection of this facility. The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

### ORGANIZATIONAL STRUCTURE AND FUNCTIONS

- The organizational structure and staffing were consistent with Technical Specification requirements.

### OPERATIONS

- The effectiveness of MURR's shift turnovers, communication, and operator cognizance of facility conditions has improved.

### DESIGN CONTROL, REVIEW AND AUDIT

- The evaluation of changes to facilities and procedures satisfied NRC requirements.
- An audit program is being developed by the licensee.

### OPERATOR REQUALIFICATION

- Operator requalification was conducted as required by the Requalification Program.

### MAINTENANCE

- The maintenance program satisfied NRC requirements.

### SURVEILLANCE

- The surveillance program satisfied Technical Specification requirements.

### FUEL HANDLING

- Fuel movement was conducted in accordance with regulatory requirements.

### EXPERIMENTS

- The program for experiments satisfied Technical Specification and procedural requirements.



### PROCEDURES

- The procedural control and implementation program satisfied Technical Specification requirements.

### EMERGENCY PREPAREDNESS

- The emergency preparedness program was conducted in accordance with the Emergency Plan.



## REPORT DETAILS

### **Summary of Plant Status**

The licensee's ten megawatt (10 Mw) non-power reactor continues to be operated in support of laboratory experiments, reactor operator training, and various types of research. During the inspection, the reactor was started-up and operated as required to support laboratory experiments and product irradiation.

#### 1. ORGANIZATIONAL STRUCTURE AND FUNCTIONS (39745)

##### a. Scope

The inspector reviewed selected aspects of the following:

- organization and staffing
- management and staff responsibilities

##### b. Observations and Findings

Since the last inspection at the facility, various changes have been made in the operations organization. An individual was hired to fill the position of Chief Operating Officer (COO). This person reports to the Facility Director and is responsible for all aspects of facility activities. A Reactor Manager and an Assistant Reactor Manager - Operations have also been hired. A person from within the organization has been appointed to the position of Assistant Reactor Manager - Engineering and the former Reactor Physicist has been appointed as the Assistant Reactor Manager - Physics. The Assistant Managers all report to the Reactor Manager who, in turn, reports to the Facility Director through the COO. It was also noted that four additional people have been hired and are in training to become Reactor Operators (ROs).

Through a review of the logs and interviews with operations personnel, the inspector determined that all four operations crews are staffed with four individuals; three are qualified reactor operators and one individual is in training. Record reviews and direct observations verified that shift turnover briefings are held when the day shift crew arrives to relieve the night shift or vice versa and the shift activities are discussed in detail.

From the above observations, the inspector determined that the organizational structure was consistent with the requirements of Technical Specifications Section 6.1.a and Figure 6.0. Staffing satisfied the requirements of Technical Specifications Section 6.1.i.

The inspector noted that the licensee's current organizational structure continues to make use of a Lead Senior Reactor Operator (LSRO) who is in charge of each crew rather than the more traditional shift supervisor. However, the licensee has discontinued the unusual practice of assigning a Senior Reactor Operator (SRO) as the LSRO for one shift then assigning another SRO that duty for the following shift, thus rotating the responsibility among all members of the crew. The current practice

is to assign an LSRO as the lead person for a period of at least six months, thus providing more stability in the line organization. This appeared to produce more continuity and better communication within and among the crews in the daily operations.

c. Conclusions

The organizational structure and staffing were consistent with Technical Specification requirements.

2. OPERATIONS (39745)

a. Scope

The inspector reviewed selected aspects of the following:

- operational logs and records
- shift turnover activities

b. Observations and Findings

The operating logs and records were clear and provided an indication of operational activities, including documentation of events. Operators on the various crews were aware of the facility status which was reflected in briefings and on a status board that was maintained current in the Control Room.

Shift turnover briefings and weekly staff meetings were held and the maintenance activities were discussed. LSROs, the other individuals on the crews, and specialists or supervisors from other departments were aware of the scheduled daily activities and any conflicts in scheduling were resolved (see Section 5 below).

c. Conclusions

The effectiveness of MURR's shift turnovers, communication, and operator cognizance of facility conditions has improved.

3. DESIGN CONTROL, REVIEW AND AUDIT (40745)

a. Scope

The inspector reviewed selected aspects of:

- implementation of revised 10 CFR 50.59 requirements
- screening and evaluation of changes
- change control records
- safety review records
- Reactor Advisory Committee meeting minutes
- responses to safety reviews and audits



b. Observations and Findings

(1) Change Control

The revised 10 CFR 50.59 regulatory requirements were implemented March 12, 2001, with issuance of procedure AP-RR-003, Revision 0. The procedure adequately incorporated criteria provided by the regulation with additional requirements mandated by local conditions. For example, some plant equipment is "owned" by the campus facility engineering organization.

Staff training in the new process was provided. All new and revised procedures generated by the new Performance Enhancement Plan (PEP) will be screened. Non-routine maintenance will be identified for screening by the on-duty LSRO. Screening numbers were assigned by the newly appointed Document Control Coordinator. Records showed that changes were acceptably reviewed in accordance with licensee administrative controls. None of the changes required a license amendment.

(2) Review and Audit

Records showed that the safety reviews were conducted by the Reactor Advisory Committee (RAC) or a designated subcommittee as required. Topics of these reviews were sufficient to provide guidance, direction, and oversight, and to ensure acceptable use of the reactor.

The subject of audits of reactor operations was discussed with the licensee. No formal audit program has been established and none is mentioned in the Technical Specifications. However, in the past, peer review-type audits have been completed. Persons from the University of Missouri-Rolla and the University of Illinois conducted audits at the MURR facility and MURR personnel conducted audits at the other facilities in return. This provided an independent review of the facility and reactor operations. But, because the University of Illinois research reactor has shut down, this arrangement will no longer be possible. The inspector discussed this situation with the COO who indicated that a new audit program was being formulated. The licensee was informed that this issue will be identified and followed by the NRC as an Inspector Follow-up Item (IFI) and will be reviewed during future inspections (IFI 50-186/2001-201-01).

c. Conclusions

The design change program satisfied NRC requirements. An audit program is being developed by the licensee.

#### 4. OPERATOR REQUALIFICATION (41745)

##### a. Scope

The inspector reviewed selected aspects of:

- the Requalification Program
- status of operator licenses
- operator training and examination records
- operator active duty status
- operator physical examination records

##### b. Observations and Findings

The Requalification Program was maintained up to date and RO and SRO licenses were current. Records showed that operator training was consistent with the Requalification Program requirements and there are currently four individuals in training to become reactor operators as noted above. Records confirmed that the operators were acceptably completing written and operating examinations. The applicable logs and records also showed that operators maintained active duty status as required. Biennial physical examinations of the operators were conducted as well.

##### c. Conclusions

Operator requalification was conducted as required by the Requalification Program.

#### 5. MAINTENANCE (39745)

##### a. Scope

The inspector reviewed selected aspects of:

- control of maintenance activities
- discrepancy log
- maintenance procedures
- equipment maintenance records
- maintenance program initiatives

##### b. Observations and Findings

The reactor was shut down each Monday to perform maintenance and operated around the clock for the remainder of the week. The maintenance list/schedule was coordinated at weekly meetings. The meeting was chaired by a Lead Senior Reactor Operator who controlled and issued the approved Maintenance Day Work List. The list was widely distributed. Routine preventative maintenance needs for the month were issued by specialists in operations, machine shop, and electronics shop. Discrepancy log entries, identified by reactor operators during routine "patrols", were also reviewed during the meeting. Corrective maintenance was recorded in a

“modification record”, minor preventative maintenance was indicated as completed on a checklist. All maintenance is required to be recorded in the console log. Step 35 of the reactor start up checklist required the operator to verify that all safety system maintenance was complete and satisfactory prior to reactor operation. Corrective maintenance instructions and precautions are documented by the facilities engineer on the Work Authorization form.

On recommendation of an architect and engineering consultant (Sargent-Lundy), a condition assessment of all equipment was undertaken. This data was used to identify changes needed in the maintenance program and develop a predictive maintenance program.

On March 30, 2001, a draft final report “Work Control Process Improvement Team” was issued. This effort was not in the original PEP. Elements of a new work control program were provided in a detailed flow chart. Included were two new staff positions: Work Control Manager and Planner Scheduler. The licensee stated that implementation was underway, candidates for the two positions were identified, and the new Document Control Coordinator position was already filled.

c. Conclusions

The maintenance program satisfied NRC requirements.

6. SURVEILLANCE (61745)

a. Scope

The inspector reviewed selected aspects of:

- surveillance procedures
- surveillance and Limiting Conditions for Operation (LCO) data sheets and records

b. Observations and Findings

Surveillance and certain LCO verifications were completed on schedule and in accordance with licensee procedures. The licensee terminology for this program was “Compliance Check” and followed the same schedule each year. The reviewed results were within the TS and procedurally prescribed parameters.

c. Conclusions

The surveillance program satisfied Technical Specification requirements.

7. FUEL MOVEMENT (60745)

a. Scope

The inspector reviewed selected aspects of the following:

- fuel movement procedures
- fuel movement records

b. Observations and Findings

Fuel was shuffled at least weekly since the low core excess reactivity prevented startups after xenon ingrowth during the weekly maintenance shutdown. The Assistant Reactor Manager - Physics indicated that peak fuel burn-up in TS 3.8(a) was the primary consideration in determining the fuel loading. Records of fuel element locations were satisfactory.

c. Conclusions

Fuel movement was conducted in accordance with regulatory requirements.

8. EXPERIMENTS (69745)

a. Scope

The inspector reviewed selected aspects of:

- program requirements
- experimental procedures
- logs and records
- experimental administrative controls and precautions

b. Observations and Findings

The experiments conducted at the facility are typically routine procedures that have been in place for several years. One new or unknown-type experiment had been initiated recently and had been reviewed and approved as required. The experiments were completed with the cognizance of the Reactor Manager and the Lead Senior Reactor Operator and in accordance with Technical Specification requirements (e.g., reactivity limitations). The results of the experiments were documented in appropriate experimental logs, data sheets, or records. Engineering and radiation protection controls were implemented as required to limit exposure to radiation.

A requirement in SOP VIII.1.1.D.1 states that active Reactor Utilization Requests (RURs) will be reviewed by the Reactor Manager and the Principle Experimenter on an annual basis. Although there was evidence that this had been done for most of the experiments, there was no formal documentation of this. The licensee was informed that the issue of documenting the annual review of active RURs will be

identified and followed by the NRC as an IFI and will be reviewed during future inspections (IFI 50-186/2001-201-02).

c. Conclusions

The program for experiments satisfied Technical Specification and procedural requirements.

9. PROCEDURES (42745)

a. Scope

The inspector reviewed selected aspects of:

- procedure writer's guide
- control of changes
- procedural implementation

b. Observations and Findings

The "Writer's Guide", issued in October 2000, provided clear and detailed information regarding procedure development. New procedures issued using this guide were consistent and user friendly. Use of this guide constitutes a licensee program strength.

TS 6.1(c) requires the RAC to review procedure changes with safety significance. In 1974, a "Reactor Procedure Review Subcommittee" was chartered to fulfil this requirement. The charter was revised in 1995 and new members appointed in January 2000. The COO stated that the procedure upgrade effort has the top priority in the PEP. Completion was targeted for June 2001. Contractors were used to assist with drafting procedures. Most drafts were ready for subcommittee review. Minutes of meetings indicated that the subcommittee met frequently during the past few months to deal with the backlog. Only a few procedures were completed thus far. The COO stated that operators will be trained prior to implementation of the revised procedures.

Reactor operators were observed properly using the startup checklist and the reactor startup procedure. These procedures require the duty operator to enter his initials as each step is completed.

c. Conclusions

The procedural control and implementation program satisfied Technical Specification requirements.



## 10. EMERGENCY PREPAREDNESS (82745)

### a. Scope

The inspector reviewed selected aspects of:

- the Emergency Plan and implementing procedures
- emergency response supplies, equipment, and instrumentation
- training records
- offsite support
- emergency drills and exercises

### b. Observations and Findings

The Emergency Plan (E-Plan) in use at the reactor and satellite emergency facilities was the same as the version most recently approved by the NRC. The E-Plan was reviewed annually as required. Implementing procedures were reviewed and revised as needed to execute the E-Plan effectively. Facilities, supplies, equipment, and instrumentation were being maintained, controlled, and inventoried as required in the E-Plan. Through records review and interviews with licensee personnel, emergency responders were determined to be knowledgeable of the proper actions to take in case of an emergency. The agreement with the City of Columbia Fire Department had been maintained and updated as necessary. Communications capabilities were acceptable with support groups and had been periodically tested. Emergency drills had been conducted annually as required by the E-Plan. Off-site support organization participation was also as required by the E-Plan. Critiques were held following the drills to discuss the strengths and weaknesses identified during the exercise and to develop possible solutions to any problems identified. The results of these critiques were documented and filed. Emergency preparedness and response training for staff members was being completed as stipulated by the E-Plan. Training for off-site personnel was conducted and documented as well.

The subjects of evacuation alarms and of the associated training were also reviewed. Additionally, the inspectors discussed elements of the MURR evacuation and SCRAM system with facility personnel. It was noted that, in order to prompt an evacuation of the MURR facility, there are evacuation alarm initiating switches located at two different locations in the facility. One is located in the reactor Control Room and the other is located in the administrative area of the facility. Both switches can be used to cause an evacuation alarm and both cause a reactor SCRAM. The switch in the Control Room is in an open, readily accessible area but the one in the administrative area was located up under a desk behind a set of doors. At the time of the inspection, access to the doors was blocked by a 2-drawer filing cabinet (on wheels) and a cardboard box. (However, access to the switch only took between ten to twenty seconds.) In talking to the reactor operators they indicated that, in the event of an emergency and the switch in the Control Room could not be accessed, an operator would be dispatched to the administrative area to actuate the switch there. If, for some reason, an operator could not get to the administrative area, the administrative staff would be contacted to actuate the switch. The reactor operators

were trained on the use of both of the switches and the administrative staff members had received limited training on the use of the switch in the administrative area. The evacuation switch in the administrative area was tested semiannually, whereas, the switch in the Control Room was tested several times each year. No regulatory problems were noted.

c. Conclusions

The emergency preparedness program was conducted in accordance with the Emergency Plan.

11. FOLLOW-UP ON PREVIOUSLY IDENTIFIED ITEMS (92701)

a. Inspection Scope

The inspector reviewed the licensee's actions taken in response to previously identified Inspector Follow-up Items.

b. Observation and Findings

- (1) VIO 50-186/2000-202/203-01 (Closed) - Failure to perform a 50.59 evaluation for the removal of shielding from the Spent Fuel Element Irradiation Facility. During this inspection the licensee amended one of the near-term corrective action as follows: "Establishing controls requiring revisions to step-by-step fuel movement procedures be approved by at least two individuals (Senior Reactor Operator and Reactor Physicist or Reactor Manager)." Near-term and long-term corrective actions described in a November 3, 2000, licensee letter were complete and satisfactory. Additional corrective actions that will be taken to avoid further violations, as described in the licensee's Performance Enhancement Plan (PEP), will be reviewed in a future inspection (Inspector Follow up Item 50-186/2001-201-03).
- (2) VIO 50-186/2000-202/203-02 (Closed) - Offset mechanism and control blade B were removed without defueling the two corresponding fuel elements. Corrective actions described in a November 3, 2000, licensee letter were complete and satisfactory. The ongoing actions described in the PEP will be reviewed as discussed above.
- (3) IFI 50-186/2000-202-01 (Open) - Evaluate the licensee's organization function. During an inspection in April 2000, problems were noted involving command and control and with communications. The licensee subsequently took numerous corrective actions to address these and other problems. During this inspection it was noted that the licensee has implemented a PEP which includes various corrective actions. Because several actions in the PEP remain to be completed, this item will remain open and will be reviewed by the NRC during a subsequent inspection.

- (4) IFI 50-186/2000-202-02 (Open) - Assess operator cognizance of facility conditions including effectiveness of shift turnover briefings. The licensee indicated that staff awareness of equipment status is expected to improve after implementation of a proposed Work Control Program. The implementation of this program will be reviewed in a future inspection.
- (5) VIO 50-186/2000-202-03 (Closed) - Failure to perform a 10 CFR 50.59 review for removal of shielding from the Spent Fuel Element Irradiation Facility. During the inspection in April 2000, a problem was noted for failure to perform a 10 CFR 50.59 review prior to the removal of shielding from the Spent Fuel Element Irradiation Facility. During this inspection the licensee's corrective actions were reviewed and found to have been completed (see Item (2) above).
- (6) IFI 50-186/2000-202-04 (Open) - Implement Standing Orders regarding countersignatures for fuel movement and changes to fuel movement procedures. The administrative controls were in place. The effectiveness of these controls will be reviewed in a future inspection.
- (7) IFI 50-186/2000-202-05 (Open) - Implement procedure documentation, review, training, conduct, changes, and precautions. A comprehensive overhaul of the procedures program is a priority effort in the PEP. Implementation of this program will be reviewed in a future inspection.
- (8) IFI 50-186/2000-202-06 (Closed) - Evaluate effectiveness of emergency response training. During this inspection the inspector interviewed various individuals, including several students, to determine the adequacy of the emergency training given. All individuals indicated that they understood what the various emergency signals and alarms were and what actions to take in case one sounded or was activated. Through interviews and training document reviews, it was concluded that the emergency response training is adequate.

c. Conclusions

One Inspector Follow-up Item and two violations, identified during previous inspections, were closed. The other previously identified items remain open.

12. Exit Interview

The inspection scope and results were summarized on April 12, 2001, with members of licensee management and staff. The inspector described the areas inspected and discussed in detail the inspection findings.

No dissenting comments were received from the licensee. The licensee did not identify as proprietary any of the material provided to or reviewed by the inspector.

## **PARTIAL LIST OF PERSONS CONTACTED**

### **Licensee Personnel**

C. Anderson, Lead Senior Reactor Operator  
B. Bocker, Senior Reactor Operator  
R. Butler, Chief Operating Officer  
E. Deutsch, Director, MURR  
M. Dixon, Assistant Reactor Manager - Operations  
J. Ernst, Health Physics Manager  
L. Foyto, Assistant Reactor Manager - Engineering  
J. Fruits, Lead Senior Reactor Operator  
A. Gaddy, Document Control Coordinator  
P. Hobbs, Reactor Manager  
R. Hudson, Senior Reactor Operator  
K. Kutikkad, Assistant Reactor Manager - Physics  
W. Meyer, Associate Director, Reactor Income Generating Operations  
C. McKibben, Senior Advisor  
A. Saale, Reactor Operator  
M. Wallis, Lead Senior Reactor Operator

### **Other Personnel**

J. Burns, Vice Provost for Research

### **Accompanying NRC Personnel**

A. Adams, Senior Project Manager, REXB, DRIP

## **INSPECTION PROCEDURES USED**

IP 39745 Class I Non-Power Reactors Organization, Operations, and Maintenance Activities  
IP 40745 Class I Non-Power Reactor Review and Audit and Design Change Functions  
IP 41745 Class I Non-Power Reactor Operator Licenses, Requalification, and Medical Activities  
IP 42745 Class I Non-Power Reactor Procedures  
IP 60745 Class I Non-Power Reactor Fuel Movement  
IP 61745 Class I Non-Power Reactor Surveillance  
IP 69745 Class I Non-Power Reactor Experiments  
IP 82745 Class I Non-Power Reactor Emergency Preparedness  
IP 92701 Followup

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

### **Opened**

50-186/2001-201-01	IFI	Follow up on the licensee's efforts to implement an effective audit program for operations.
50-186/2001-201-02	IFI	Follow up on the licensee's actions to ensure documentation for the annual review of active Reactor Utilization Requests.

50-186/2001-201-03      IFI    Complete Performance Enhancement Plan to prevent future violations of regulatory requirements.

Closed

50-186/2000-202/203-01    VIO    Failure to evaluate a facility change to determine if prior NRC review and approval was required before implementing the change in accordance with 10 CFR 50.59.

50-186/2000-202/203-02    VIO    Failure to follow procedure and meet the conditions of the Technical Specification for having the reactor shutdown and secured.

50-186/2000-202-03      VIO    Failure to perform a 10 CFR 50.59 review for removal of shielding from the Spent Fuel Element Irradiation Facility.

50-186/2000-202-06      IFI    Evaluate effectiveness of emergency response training.

Discussed

50-186/2000-202-01      IFI    Evaluate the licensee's organization function.

50-186/2000-202-02      IFI    Assess operator understanding of facility conditions.

50-186/2000-202-04      IFI    Review effectiveness of corrective actions in the fuel-handling area.

50-186/2000-202-05      IFI    Determine whether procedural implementation is acceptable.

**LIST OF ACRONYMS USED**

CFR	Code of Federal Regulations
COO	Chief Operating Officer
DRIP	Division of Regulatory Improvement Programs
IFI	Inspector Follow-up Item
IP	Inspection Procedure
LCO	Limiting Conditions for Operation
LSRO	Lead Senior Reactor Operator
MURR	University of Missouri-Columbia Research Reactor
Mw	Megawatt
NPR	Non-Power Reactor
NRC	Nuclear Regulatory Commission
PDR	Public Document Room
PEP	Performance Enhancement Plan
RAC	Reactor Advisory Committee
REXB	Events Assessment, Generic Communications, and Non-Power Reactors Branch
RO	Reactor Operator
RUR	Reactor Utilization Request
SOP	Standard Operating Procedure
TS	Technical Specification

VIO	Violation
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