

December 19, 2002

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

SUBJECT: NRC INSPECTION REPORT NO. 50-186/2002-202

Dear Mr. Butler:

This letter refers to the inspection conducted on November 18-21 and 25, 2002, 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 component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/NRC/ADAMS/index.html>.

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

Sincerely,

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
Operating Reactor Improvements Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-186

License No.: R-103

Enclosure: NRC Inspection Report No. 50-186/2002-202

cc w/enclosure: Please see next page

University of Missouri-Columbia

Docket No. 50-186

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.: 50-186/2002-202

Licensee: University of Missouri-Columbia

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

Location: Research Park
Columbia, Missouri

Dates: November 18-21 and 25, 2002

Inspectors: Craig Bassett
Lawrence Berg

Approved by: Patrick M. Madden, Section Chief
Research and Test Reactors Section
Operating Reactor Improvements Program
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 research and test reactor (RTR). It included an on-site 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

- MURR operations shift turnovers, communication, and operator cognizance of facility conditions were acceptable.
- Progress has been made towards establishing a safety conscious work environment, but continued attention is needed in this area.

DESIGN CONTROL, REVIEW AND AUDIT

- The evaluation of changes to facilities and procedures satisfied NRC requirements.
- The Reactor Advisory Committee and associated subcommittees are meeting as required and reviewing the topics outlined in the Technical Specifications.

OPERATOR REQUALIFICATION

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

MAINTENANCE

- The Work Control Program, as it now exists, has enhanced the maintenance program at the facility.

SURVEILLANCE

- The surveillance program satisfied Technical Specification requirements.

FUEL HANDLING

- Fuel movement was conducted in accordance with procedural requirements.

- A fuel misalignment that occurred on September 18, 2002, had been reviewed and reported by the licensee and corrective actions taken.

EXPERIMENTS

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

PROCEDURES

- The procedural upgrade program, initiated in 2000, was continuing.
- The current procedure revision, control, and implementation program satisfied Technical Specifications requirements.

EMERGENCY PREPAREDNESS

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

REPORT DETAILS

Summary of Plant Status

The licensee's 10 megawatt (10 MW) research and test reactor continues to be operated in support of laboratory experiments, reactor operator training, and various types of research. During the inspection, the reactor was being operated 24-hours per day (except during the maintenance period on Monday morning) to support laboratory experiments and conduct product irradiation.

1. ORGANIZATIONAL STRUCTURE AND FUNCTIONS

a. Inspection Scope (Inspection Procedure [IP] 39745)

The inspectors reviewed selected aspects of the following:

- MURR organization and staffing
- management and staff responsibilities outlined in the Technical Specifications (TSs)
- MURR Operations Logbooks Nos. 292 and 293

b. Observations and Findings

The organizational structure had not changed since the last inspection in the area of reactor operations (refer to NRC Inspection Report No. 50-186/2001-203). The inspectors noted that the position of MURR facility director had not been filled since the former director left last year. In the interim, the chief operating officer (COO) is filling the position of director. The inspectors were informed that the person occupying the position of manager, product and service operations at the facility has temporarily been designated as COO until a new director is named and the current interim director resumes his duties as the COO.

Through a review of the reactor operations logs for the period from August 2002 to the present and interviews with operations personnel, the inspectors determined that all four operating crews are staffed with four to five individuals; three are qualified reactor operators and one or two individuals per crew are operator trainees. Record reviews and direct observations verified that shift turnover briefings are held during each shift change and that shift activities are discussed in detail.

From the above observations, the inspectors also determined that the organizational structure was consistent with the requirements of TS Section 6.1.a and Figure 6.0, Revision 12, dated September 20, 1999. Staffing during reactor operation satisfied the requirements of TS Section 6.1.i.

c. Conclusions

The organizational structure and staffing were consistent with TS requirements.

2. OPERATIONS AND CONTROL

a. Inspection Scope (IP 39745)

The inspectors reviewed selected aspects of the following:

- reactor operations logs and records from January 2002 to the present
- shift turnover sheets for September, October, and November 2002
- documentation of Safety Conscious Work Environment training for 2001 and 2002
- MURR Administrative Procedure AP-RR-010, "Facility Access Description and Decision-Making," Rev. 0, approved November 20, 2000 (superceded)
- MURR Administrative Procedure AP-RR-010, "Facility Access Criteria," Rev. 4, approved November 13, 2002
- MURR Administrative Procedure AP-RR-011, "Facility Access Process," Rev. 3, approved November 13, 2002
- MURR Administrative Procedure AP-RR-020, "Safety Concern - Nuclear Significant," Rev. 0, approved November 26, 2002
- MURR Administrative Procedure AP-RR-021, "Safety Concern - Occupational," Rev. 0, approved November 26, 2002
- MURR Administrative Procedure AP-RR-022, "Administrative Concern and Conflict Resolution," Rev. 0, approved November 26, 2002
- MURR Administrative Procedure AP-RR-023, "MURR Safety Oversight Committee," Rev. 0, approved November 26, 2002
- MURR Administrative Procedure AP-RR-024, "Ombudsmen Program," Rev. 0, approved November 26, 2002
- MURR Administrative Procedure AP-RR-025, "Concern Investigation," Rev. 0, approved November 26, 2002

b. Observations and Findings

(1) Staff Communication

The inspectors observed fuel handling on Monday, November 18, 2002, and observed three reactor startups that evening. The operations were conducted as planned and in accordance with the appropriate procedures. The inspectors also attended shift turnover meetings on Monday and Wednesday. The current status of the facility was reviewed on each occasion and all shift operators were informed of the daily activities and planned events.

The inspectors attended a "Plan of the Day" meeting on Tuesday. The meeting, chaired by the reactor manager, was held daily and representatives from all organizations at the facility were in attendance. Each organization had the opportunity to provide input and discuss their work group's activities planned for that day. Safety-significant issues were also discussed and any concerns were resolved. The inspectors noted that this meeting provided staff supervisors and members with an opportunity to be aware of current facility conditions and upcoming activities.

(2) Employee Protected Activities and Safety Conscious Work Environment

Following various internal problems at the facility, the NRC sent a letter to the licensee on March 5, 2001, requesting that the University of Missouri-Columbia provide the NRC with an assessment of the freedom of MURR employees to report problems without fear of retaliation, and an assessment by the University of the continuing effectiveness of corrective actions taken to address the past chilling effect at the reactor facility. Two assessments were completed and the results were forwarded to the NRC on July 25, 2001. On August 10, 2001, the University submitted a letter to the NRC, which supplemented the two assessments by providing a summary of actions that were to be taken at MURR to further improve the safety conscious work environment. The actions consisted of initiating various enhancement activities at MURR. These activities included: 1) establishing an Ombudsmen Program, 2) providing training, 3) initiating focus groups, 4) establishing a policy applicable to everyone at MURR, and 5) setting up additional channels of communications with the director of MURR.

During this inspection, the inspector reviewed the licensee's actions concerning these issues. These enhancement activities and the results are outlined below.

(a) The Ombudsmen Program

On November 26, 2002, the University of Missouri-Columbia Vice Provost for Research and the Interim Director of MURR signed a procedure initiating the Ombudsmen Program at the facility, MURR Administrative Procedure AP-RR-024, "Ombudsmen Program," Rev. 0. The Ombudsmen Program consists of a three-member panel that will act as a contact point for receiving employee concerns related to nuclear and radiation safety, which cannot be resolved through other means, namely, the supervisory chain, the Corrective Action Program, or the MURR Safety Oversight Committee (MSOC). If any person at MURR has gone through the other channels and still feels that a problem has not been resolved, then the person can bring the matter before the Ombudsmen Panel.

This program was initially set to be initiated in 2001 and was to be a program for the researchers at the facility to use. However, various other staff members at MURR wanted to be involved in the planning and implementation of the program. Subsequently, the MURR Improvement Team (MIT), a group established to promote unity at MURR and promote a safety conscious work environment (SCWE), reviewed the program and helped rewrite and review the implementing procedure.

Because the program has just been established, no issues have been brought before the panel. No specific training concerning the program is contemplated but the procedure will be reviewed in the next "All Staff" meeting in November, a copy will be posted on the lunch room bulletin board, and further discussions will be held at the "All Staff" meeting to be held in December.

(b) SCWE Training

The licensee determined, through the assessments that were completed, that there was a lack of understanding regarding SCWE among the staff, supervisors, and management. Therefore, MURR provided training during November 6, 7, and 8, 2001, regarding the attributes of a safety conscious work environment. These three one-day sessions were attended by all MURR staff. Additional training was provided for supervisors and management during the week so that they could be more proactive in soliciting safety concerns. The inspectors verified that the training had been conducted as indicated.

The University's response concerning SCWE training also indicated that it was their intent to provide significant annual training of three hours or more on SCWE for all managers, supervisors, and MSOC members. No specific annual training has been held in 2002, but meetings and training were conducted regarding the Organizational Alignment Initiative and job satisfaction (discussed further below). Management indicated that, because of the nature of the alignment training, this training would take the place of the SCWE training this year.

(c) Focus Groups

The University and MURR indicated that MURR management would meet with all MURR staff, via small groups, to discuss the results of the assessments that were completed and to review employee perceptions regarding the freedom to raise safety concerns. Meetings were held on September 17, 19, 20, and 21, October 10, 12, 15, 16, 17, 24, and 25, 2001, and a make-up session was held on April 12, 2002. The inspectors verified that all MURR staff members having unescorted access to the facility attended one of these focus group meetings.

The University's response concerning focus groups also indicated that it was their intention that the groups would continue to meet on a regular basis. No additional focus group meetings have been held to date in 2002, although the MIT is interested in this matter as well and is working with management to establish more group meetings in the future. Also, management indicated that the Organizational Alignment Initiative provided the opportunity for department and working group interactions and these sessions were considered to be the focus group meetings for this year.

(d) Policy on SCWE

The letter from the University to NRC indicated that MURR would develop and implement a policy applicable to anyone with facility access that specifically expresses zero tolerance for harassment, retaliation, or discrimination. During the inspection the inspectors verified that such a policy had been established and was in effect. The policy entitled, "Policy Prohibiting Discrimination for Raising Safety Concerns," was dated September 5, 2001, and was signed by the Interim Director. The policy stated that MURR has zero tolerance for any form of discrimination and provides examples of such. The policy is posted on

the main bulletin board at MURR. Various staff members interviewed were aware of the policy and expressed the attitude that they would not be apprehensive about bringing a safety concern to the attention of management or to government authorities.

(e) Communications with the MURR Director

There are currently three programs that are in place to allow MURR staff to communicate more freely with the facility director. These programs include the MURR Lunch Program, Open Office Hours, and 'Direct to the Director' Mailbox. Twice a month, three randomly selected staff members join the director for lunch away from the facility. This is done to provide the staff with an opportunity to have open and candid discussion with the director. Also, the director holds open office hours weekly. During one week the open hours are held in a conference room so that any interested party can attend and express their concerns and opinions. During the subsequent week staff members sign-up to have a private interview with the director so that any matters that may be confidential in nature can be discussed. Lastly, there is a mailbox in the lunchroom that is designated as 'Direct to the Director' that anyone can use to drop off a note or letter to the director. Only the director has a key to the mailbox.

The inspectors verified that these programs are currently in place at the facility. However, only the lunch program and the open office hours are used. There have been no communications with the director through the mailbox in several months. The lunch and open office hours programs appear to be well received and provide the staff with another avenue of communication with management.

During the review of the licensee's actions regarding SCWE, the inspector noted that other initiatives have been completed as well. The licensee has developed several new procedures to facilitate reporting of all types of safety concerns. The new procedures are as follows:

- (1) MURR Administrative Procedure AP-RR-020, "Safety Concern - Nuclear Significant," Rev. 0, approved November 26, 2002;
- (2) MURR Administrative Procedure AP-RR-021, "Safety Concern - Occupational," Rev. 0, approved November 26, 2002;
- (3) MURR Administrative Procedure AP-RR-022, "Administrative Concern and Conflict Resolution," Rev. 0, approved November 26, 2002;
- (4) MURR Administrative Procedure AP-RR-023, "MURR Safety Oversight Committee," Rev. 0, approved November 26, 2002; and
- (5) MURR Administrative Procedure AP-RR-025, "Concern Investigation," Rev. 0, approved November 26, 2002.

As stated in these procedures, the objective is to ensure that a solid commitment exists to prevent or eliminate an atmosphere in which personnel feel intimidated to report safety concerns. These procedures appear to provide another path for resolution of problems that may develop or exist.

Another action recently completed by the licensee was the Organizational Alignment Initiative. The MURR MIT, with the support of management, had a contractor develop and distribute a questionnaire concerning job satisfaction and communication in July 2002. After MURR staff completed the questionnaire, training sessions were developed by the contractor to address the issues that resulted from the answers to the questions and to provide a forum for further discussions and communication. Two-day training sessions were held in October to align the facility strategic goals with its cultural practices. Management attended a total of seven days of training. Although the emphasis was on process reengineering, team building, and conflict resolution, management viewed this training as furthering the concept of SCWE as well.

(3) Facility Access

Prior to this year, access to the facility was outlined by administrative procedure, AP-RR-10, "Facility Access Description and Decision-Making," Rev. 0, dated November 20, 2000. The procedure defined the parameters for access to MURR and the criteria for establishing the appropriate access level and type for each individual seeking entry. Because of recent interactions by staff members and complaints to management, as well as recent heightened security constraints, the procedure was revised to include criteria for denying or revoking unescorted access privileges and to stipulate the criteria for background checks for newly hired individuals.

The current revised procedure, AP-RR-10, "Facility Access Criteria," Rev. 4, dated November 13, 2002, states that access to the facility is a privilege and final approval for access to MURR is at the discretion of the director, COO, or the reactor manager. Access decisions are based on the need for access and the status of the security conditions at the time of the request. Also, unescorted access may be denied or revoked if an individual behaves in a manner that demonstrates that the individual is untrustworthy or unreliable, or if the individual makes a threat toward the MURR facility or any of its staff, or if the individual behaves in a hostile or aggressive manner toward any staff member.

Access to the facility appears to be appropriately handled and universally applied. This past summer various staff members filed several complaints against a particular individual for being belligerent and unable to control one's temper. Following counseling sessions and warnings, the individual was asked to leave and find another position. The individual has since found other employment.

a. Conclusions

MURR operations shift turnovers, communication, and operator cognizance of facility conditions were acceptable. Progress has been made toward establishing a safety-conscious work environment, but continued inspection follow-up is needed in this area.

3. DESIGN CONTROL, REVIEW AND AUDIT

a. Inspection Scope (IP 40745)

The inspectors reviewed selected aspects of:

- Administrative Procedure AP-RR-003, "10 CFR 50.59 Evaluations," Revision (Rev.) 0, issued March 12, 2001.
- AP-RR-003 Attachment 1, 50.59 Screen Form
- AP-RR-003 Attachment 2, 50.59 Evaluation Form
- Administrative Procedure AP-RO-115, "Modification Records," Rev. 0, issued September 16, 2002
- Reactor Advisory Committee meeting minutes from October 2001 through the present

b. Observations and Findings

(1) Change Control

The regulatory requirements stipulated in the revision of 10 CFR 50.59 were implemented at the facility through Administrative Procedure, AP-RR-003, "10 CFR 50.59 Evaluations," Rev. 0, issued March 12, 2001. The procedure adequately incorporated criteria provided by the regulation with additional requirements mandated by local conditions.

All new and revised procedures being generated at the facility have been or are being screened with respect to the above procedure. Non-routine maintenance activities and facility modifications are now routinely identified for screening by the Work Control Group with input from the on-duty lead senior reactor operator (LSRO). The procedure changes and modification packages are processed through and controlled by the document control coordinator.

The inspectors reviewed selected 50.59 Screen Forms and 50.59 Evaluation Forms processed within the last three months. The completed forms showed that changes were acceptably reviewed in accordance with AP-RR-003. None of the changes reviewed by the inspectors required a license amendment.

(2) Safety Committee Review

Records of the meetings held from October 2001 to date in 2002 by the Reactor Advisory Committee (RAC) and those of the various safety subcommittees were reviewed. The records showed that meetings were held as required and safety reviews were conducted by the RAC or a designated subcommittee. Topics of these reviews were sufficient to provide guidance, direction, and oversight, and to ensure acceptable use of the reactor.

c. Conclusions

The design change program satisfied NRC requirements. The RAC and associated subcommittees are meeting as required and reviewing the topics outlined in the TS.

4. OPERATOR REQUALIFICATION

a. Inspection Scope (IP 69003)

The inspectors reviewed selected aspects of:

- Operator Requalification Program dated January 7, 1997
- status of operator licenses
- operator training and examination records for the year 2002
- MURR Operator Active Status Log for the year 2002

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 five individuals in training to become reactor operators as noted above. Records confirmed that the operators were acceptably completing written and operating examinations. MURR Operator Active Status Logs and records also showed that operators maintained active duty status as required.

Operators were receiving a biennial physical examination as required.

c. Conclusions

Operator requalification was conducted as required by the Requalification Program.

5. MAINTENANCE

a. Inspection Scope (IP 39745)

The inspectors reviewed selected aspects of:

- Administrative Procedure AP-RR-015, "Work Control Procedure," Rev. 0, issued July 3, 2001
- Administrative Procedure AP-RR-012, "Commitment Tracking System," Rev. 0, issued May 11, 2001

b. Observations and Findings

The reactor is routinely shut down each Monday to perform maintenance and then operated continuously for the remainder of the week. In the past, the maintenance list/schedule was coordinated at weekly meetings chaired by the LSRO on day shift.

The LSRO controlled and issued the approved Maintenance Day Work List, which outlined the maintenance activities that would be conducted the following Monday. The list was widely distributed to the various operations and support groups at the facility. Routine preventative maintenance needs for the month were issued by specialists in operations, machine shop, and electronics shop and were discussed during the maintenance meeting.

Because the LSROs rotated shifts, the person conducting the maintenance meeting and coordinating all the maintenance activities one week was not the person involved with maintenance the following week. This practice created a system that was not always efficient and effective. Consequently a Work Control Program was developed and a new organization was established at the facility to handle maintenance activities. The organization consists of a work control manager (WCM), a planner/scheduler, and a chief research engineering technician. They are responsible to ensure that all maintenance activities are screened, planned and implemented, post maintenance testing is performed, and the entire process is then documented appropriately. A planning and scheduling software package, *Maximo*, has been implemented to assist in this effort. The software appears to be easy to use and versatile in its application.

c. Conclusions

The Work Control Program, as it now exists, has enhanced the maintenance program at the facility.

6. SURVEILLANCE

a. Inspection Scope (IP 61745)

The inspectors reviewed aspects of:

- selected MURR Compliance Procedures (CPs)
- selected CP data sheets and records

b. Observations and Findings

Surveillance verifications concerning the testing of various security systems and alarms 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 TS requirements.

7. FUEL HANDLING

a. Inspection Scope (IP 60745)

The inspectors reviewed selected aspects of the following:

- MURR Operating Procedure RP-RO-100, "Fuel Movement," Rev. 0, issued May 7, 2001
- MURR Operating Procedure RP-RO-210, "Reactor Startup - Normal," Rev. 2, issued July 19, 2002
- MURR Operating Procedure RP-RO-250, "Fuel Handling," Rev. 2, issued October 18, 2002
- Fuel Status Board located in the Control Room

b. Observations and Findings

(1) Fuel Movement

As noted above, the inspectors reviewed the fuel movement process and verified that fuel is moved according to established procedure and the specific fuel movement sheets developed for each core loading. The inspectors observed a refueling operation during the afternoon of November 18, 2002, and verified the location of fuel in the reactor core is noted and maintained on a status board. The inspectors also verified that the procedures governing fuel handling and movement had been revised to reflect recent changes, namely that a fuel height tool be used to verify the fuel height in the core and that two individuals, one of whom is a senior reactor operator, conduct a visual inspection of the core from various angles, with and without binoculars.

(2) Mis-positioned Fuel Element Event

Technical Specification Section 3.8.c, Rev. 12, dated September 20, 1999, states that the reactor core shall consist of eight fuel assemblies. Exception: The reactor may be operated to 100 watts above shutdown power on less than eight assemblies for purposes of reactor calibration or multiplication studies.

On Wednesday, September 18, 2002, at 6:17 a.m., an unscheduled reactor shutdown occurred due to a malfunction of the reactor containment airlock doors. Refueling, made necessary by the shutdown, was subsequently completed following repair and testing of the doors. Following completion of the startup check, a reactor startup was initiated at 3:32 p.m. The calculated estimated critical position (ECP) of the control rods was determined to be 16.48 inches. As required by procedure, licensee personnel were completing a 1/M plot as a check to ensure that the ECP was correct. When rod withdrawal was stopped two inches below ECP to perform another 1/M-ECP comparison, the operators noticed that there was a significant difference between the two. The difference in the predicted rod height at criticality was indicative of a significant difference between the calculated and actual reactivity of the core.

A MURR Event Review Team was assembled to review the event and establish criteria for restart. Upon checking the instrumentation no problems were found and no errors were noted in the calculations. At that point the startup was terminated and the control rods were reinserted at 5:12 p.m. Because the reactor startup was terminated before criticality, the reactor was not operated above shutdown power.

The reactor pressure vessel head was then removed for inspection of the core. The operators found that the fuel element in position F5 was not fully seated. Physical measurement verified that the element was about 35 inches above the seated position. Prior to removing the fuel element from this misaligned position, the fuel handling tool was used to grapple the element and then to apply a slight downward force on the element. The fuel element did not move from the misaligned position. The element was then withdrawn and inspected. No abnormalities were noted and the element was inserted correctly into core position F5 as directed by the fuel movement sheet. After an Event Review Team and management meeting and review, the reactor was authorized to be restarted. A reactor startup check was initiated at 0:02 a.m., a startup begun at 1:58 a.m., and the reactor attained criticality at 2:26 a.m. on Thursday, September 19, 2002.

On September 23, 2002, the licensee selected a Root Cause Analysis (RCA) team to investigate the event and identify the root cause of the problem. The team found that lack of attention to detail during fuel element insertion and unlatching was the cause of the event. Lack of attention to detail during use of the core measuring template and during review of "off normal" pre-startup data were also determined to have been contributing factors.

Refueling at MURR is typically accomplished through the use of a fuel handling tool with a buoyancy assist tank and an air operated mechanical gripper assembly. When a fuel element is placed into the proper position and the gripper assembly released, the procedure calls for the operator to allow the handling tool to float up off the element, on its own, with no assistance from the operator. This is to ensure that the tool is fully disengaged from the fuel element. When set up and used correctly, the tool cannot float on its own if a fuel element is attached. Therefore, the RCA team concluded that the operator moving the fuel element on the day of the misalignment placed the element in the proper location, but did not allow the tool to completely disengage from the element. Then the operator apparently raised the tool with the element attached and the element became disengaged after being almost completely withdrawn from its position in the core. The RCA team indicated that this probably occurred because of work habits resulting from performance of repetitive tasks and the tendency to accept "workarounds" without seeking problem resolution. The design of the fuel handling tool was such that there was recurring water leakage into the flotation tank. This deficiency resulted in the need for operators to "workaround" the problem, i.e., to "assist" or lift the handling tool off of a fuel element.

As noted above, another problem arose after the fuel element was thought to have been placed in position F5. The refueling procedure requires that the height of all the fuel elements be checked using a special template that fastens to the bottom of the fuel handling tool. This check is performed by placing the template over the top of a pair of fuel elements and checking the height of the elements based upon a mark on

the fuel handling tool with respect to the flooring of the deck over the reactor pool. Although this check was performed, it also failed to indicate that the fuel element was not properly positioned and seated.

A further problem was noted with the visual check that was required to be conducted following fuel movement and following the check with the template. The procedure required a visual inspection of the core and elements prior to replacing the reactor vessel head. The RCA team found that the inspections were error-prone due to the depth of the water, the water glow, and the heat waves caused by the hot fuel.

A final problem was noted with lack of attention to detail in recording and reviewing the data during the pre-startup. The primary coolant flow and core delta pressure were normal but the core discharge pressure exceeded the specified limit. Therefore, the data indicated the existence of off-normal conditions prior to reactor startup. However, since this data was recorded and reviewed by the same person, there was no independent review of the data which could have indicated that there was a problem with the core.

The inspectors also noted that there was no requirement to have an operator in the control room during refueling to monitor the instrumentation. Although the operators engaged in a refueling operation can look through the windows and see the instrument gauges in the control room, they are some distance from the instrument readouts and can miss small perturbations in the readings. The refueling procedure requires that the source range monitor be turned on during fuel handling, but does not specify that the data be monitored. During the refueling on September 18, the source range data clearly indicated the mis-positioning of the element if F5 at the time of the occurrence, but it was not noticed.

As a result of the problems noted by the Event Review Team, management, and the RCA team, the licensee implemented the following corrective actions:

(a) Actions prior to continuing reactor startup on September 18, 2002:

- (i) Required an independent second visual inspection of the reactor core following fuel movement.
- (ii) Required that the visual inspection of the reactor core be performed at various angles, both with and without binoculars.
- (iii) Required that the correct response on the Source Range chart recorder was verified following each fuel element movement.
- (iv) Trained all operators on the rationale and importance of allowing the fuel tool to float up on its own, with no assistance, when each element is unlatched.
- (v) Trained all operators on the necessity of analyzing and understanding the reason why when a change occurs in a logged parameter.

(b) Other subsequent follow-up corrective actions:

- (i) Design and build a new tool with no visual interference for checking the height of the fuel elements.
- (ii) Correct the leakage of water into the fuel tool buoyancy tank.

The inspectors verified that the licensee had completed these corrective actions. In addition, the licensee is considering making it a requirement to have an operator in the control room at all times during refueling and fuel movements.

The inspectors determined that this problem had been identified and reviewed by the licensee and reported to the NRC as required by the TS. Corrective actions had been identified and had been completed by the licensee. As a result, the licensee was informed that this licensee-identified and corrected violation will be treated as a Non-Cited Violation (NCV), consistent with Section VI.A of the NRC Enforcement Policy (NCV 50-186/2002-202-01). This issue is considered closed.

c. Conclusions

Fuel movement was conducted in accordance with procedural requirements. A fuel misalignment that occurred on September 18, 2002, had been reviewed and reported by the licensee and corrective actions taken.

8. EXPERIMENTS

a. Inspection Scope (IP 69005)

The inspectors reviewed selected aspects of:

- listing of Reactor Utilization Requests
- listing of current experiment

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 TS 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.

c. Conclusions

The program for experiments satisfied TS and procedural requirements.

9. PROCEDURES

a. Inspection Scope (IP 42745)

The inspectors reviewed selected aspects of:

- TS Sections 6.1.b and 6.1.c
- Standard Operating Procedures

b. Observations and Findings

As noted in a previous report (IR 50-186/2001-201), 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 constituted a licensee program strength.

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

c. Conclusions

The procedural upgrade program, initiated in 2000, is continuing. The current revision, control, and implementation program satisfied TS requirements.

10. EMERGENCY PREPAREDNESS

a. Inspection Scope (IP 82745)

The inspectors reviewed selected aspects of:

- Emergency Plan for the University of Missouri Research Reactor Facility, Rev. 12, dated January 14, 2000
- MURR Site Emergency Procedures and Facility Emergency Procedures, Rev. 32, dated November 14, 2001
- Letter of Agreement with the City of Columbia
- offsite support
- 2002 emergency drill documentation and critique

b. Observations and Findings

The inspectors reviewed the Emergency Plan (E-Plan) in use at the reactor and satellite emergency facilities. The E-Plan was reviewed annually as required. The Site Emergency Procedures and Facility Emergency Procedures (E-Plan implementing procedures) were reviewed and revised as needed to ensure effective implementation of 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 with support groups were acceptable and had been periodically tested.

The inspectors determined that a 2002 emergency drill had been conducted and off-site support organization participation was as required by the E-Plan. A critique was held

following the drill to discuss the strengths and weaknesses identified during the exercise and to develop possible solutions to the problems identified.

c. Conclusions

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

11. EXIT INTERVIEW

The inspection scope and results were summarized on November 21 and 25, 2002, with members of licensee management and staff. The inspectors 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 inspectors.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

C. Anderson, Lead Senior Reactor Operator
B. Brocker, Lead Senior Reactor Operator
A. Coria, MURR Training Coordinator
M. Dixon, Assistant Reactor Manager - Operations
R. Dobby, Health Physics Manager
J. Ernst, Associate Director, Regulatory Assurance Group
L. Foyto, Assistant Reactor Manager - Engineering
J. Fruits, Work Control Manager
A. Gaddy, Document Control Coordinator
P. Hobbs, Reactor Manager
R. Hudson, Lead Senior Reactor Operator and Operations Training Coordinator
K. Kutikkad, Assistant Reactor Manager - Physics
W. Meyer, Interim Chief Operations Officer
A. Saale, Lead Senior Reactor Operator
M. Wallis, Lead Senior Reactor Operator

Other Personnel

D. Wood, Safety Coordinator, University Hospital, University of Missouri-Columbia

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 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 69003 Class I Non-Power Reactor Operator Licenses, Requalification, and Medical Activities
IP 69005 Class I Non-Power Reactor Experiments
IP 82745 Class I Non-Power Reactor Emergency Preparedness

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-186/2002-202-01 NCV Fuel misalignment problem review, reporting, and corrective actions.

Closed

50-186/2002-202-01 NCV Fuel misalignment problem review, reporting, and corrective actions.

LIST OF ACRONYMS USED

CFR	Code of Federal Regulations
COO	Chief Operating Officer
CP	Compliance Procedure
E-Plan	Emergency Plan
ECP	Estimated Critical Position
IP	Inspection Procedure
IR	Inspection Report
LSRO	Lead Senior Reactor Operator
MIT	MURR Improvement Team
MSOC	MURR Safety Oversight Committee
MURR	University of Missouri-Columbia Research Reactor
MW	Megawatt
NCV	Non-Cited Violation
NRC	Nuclear Regulatory Commission
PDR	Public Document Room
RAC	Reactor Advisory Committee
Rev.	Revision
RTR	Research and Test Reactor
SCWE	Safety Conscious Work Environment
SOP	Standard Operating Procedure
TRTR	Test, Research, and Training Reactor (Organization)
TS	Technical Specification
WCM	Work Control Manager