

U.S. NUCLEAR REGULATORY COMMISSION

Docket No: 50-186
License No: R-103
Report No: 50-186/98201
Licensee: University of Missouri at Columbia
Facility Name: University of Missouri at Columbia Research Reactor
Location: Columbia, Missouri
Dates: January 12-15, 1998
Inspectors: T. M. Burdick
Approved by: Seymour H. Weiss, Director
Non-Power Reactor and Decommissioning
Project Directorate

9802060050 980202
PDR ADOCK 05000186
G PDR

Executive Summary

University of Missouri at Columbia Research Reactor (MURR)
Report No. 50-186/98201 (DRPM)

This routine, announced inspection included aspects of organization, operations and maintenance activities (39745); review, audit, and design change functions (40745); reactor operator requalification and medicals (69003); procedures (42745); fuel movement (60745); surveillance (61745); experiments (69005); emergency preparedness (82745); and event follow-up (92700).

Organization

The licensee met the requirements for staffing the reactor.

Operator Requalification

One violation of the licensee's program was identified by the inspector.

Operations, Maintenance, Review, Audit, and Design Change, Procedures, Fuel Handling, Experiments, and Emergency Preparedness

The inspected activities were conducted in accordance with license requirements.

Surveillance

The licensee identified, immediately corrected, and promptly reported a violation of a Technical Specifications (TS) requirement for reactor protection channel operability, that met the NRC Enforcement Policy criteria to be non-cited.

Event Follow-Up

The reactor underwent an unexplained positive reactivity addition followed by a high power reactor scram on December 9, 1997. The licensee took acceptable action to report the event and examined possible causes before returning the reactor to operation. No TS limits were exceeded.

DETAILS

Summary of Plant Status

The MURR reactor facility has been operating the past year without interruption other than for planned maintenance and refueling periods. The new Director has been at the facility since early December 1997. The reactor experienced one unexplained positive reactivity addition terminated by a high power reactor scram which is discussed in Section 9.0 of this report.

1.0 Organization, Operations and Maintenance

a. Inspection Scope (39745)

The inspector reviewed the facility organization and operations and maintenance activities to verify that they were maintained as required by the TS.

b. Observations and Findings

Dr. Edward A. Deutsch became the new Director for the facility in December. Operational staffing has been stable with little turnover. All but one member of the shift staffing had a senior reactor operator's license.

The inspector reviewed operations and maintenance logs and records. The Beryllium reflector replacement was a major task that was completed without incident.

During a reactor startup the inspector observed operators, engineers, and technicians troubleshoot a micro switch associated with rod control. Their techniques were methodical and safety oriented.

One unscheduled shutdown due to an unexplained positive reactivity addition was reviewed by the inspector and discussed in the Event Follow-Up Section 9.0.

c. Conclusions

The licensee met the requirements for staffing and operating and maintaining the reactor.

2.0 Review and Audit, and Design Change

a. Inspection Scope (40745)

The inspector reviewed the facility review and audit, and design change activities to verify they were consistent with the technical specifications.

b. Observations and Findings

Committees responsible for reviewing licensee activities were scheduled and attended by a quorum as required. The topics and activities were reviewed in accordance with the technical specifications.

The licensee obtained committee approval to install a new power range channel, which would be assigned the high power reactor trip function currently assigned to the Wide Range Monitor, channel 4. This may solve a problem with frequent spurious trips caused by channel 4 which will be retained for regulating rod control and indication only. Installation was being delayed until the arrival of a new recorder.

The licensee completed design, review, and installation of a new rod position indication system. The system appeared to work properly.

c. Conclusions

The licensee review and audit, and design change activities were consistent with the framework of their license requirements.

3.0 Operator Requalification Program

a. Inspection Scope (69003)

The inspector investigated whether the licensed operators had current licenses and physical examinations, and had completed the requirements of the requalification program as approved by the NRC.

b. Observations and Findings

The requalification program was submitted by the licensee on January 7, 1997, and was approved by the NRC on February 19, 1997. It required that each licensed operator be administered an annual operating test by designated individuals. Section 2.4 specifically delegated the Reactor Manager, Operations Engineer, Training Coordinator, and Shift Supervisors to administer the tests. The inspector determined that the tests administered throughout 1997 to the four Shift Supervisors, Training Coordinator, Operations Engineer, and one senior operator were conducted either entirely or partially by senior reactor operators that either reported to them or were their coworkers. This is a violation of the requalification program requirements (50-186/98201-01).

The licensee acknowledged that the evaluations should have been administered by only those designated and will readminister tests to the affected operators within 30 days following this inspection. The cause appeared to have been a misinterpretation of the requirements by the licensee's staff, since every licensed senior reactor operator staff member had the ability to perform shift supervisor duties and had the technical competence to have evaluated performance.

The inspector verified the licensee grading of biennial written examinations and found that they were scored accurately.

A sampling of licensed operators on-shift found that they had current licenses and medical examinations.

(Closed) Follow-Up Item 96001-01: The inspector verified that the licensee implemented corrective actions in the revised NRC approved requalification program which required all licensed operators to be administered a biennial written examination that they were not involved in developing.

c. Conclusion

The requalification program was implemented in accordance with the requalification plan with one exception as described.

4.0 **Procedures**

a. Inspection Scope(42745)

The inspector investigated whether the licensee's administrative controls were consistent with requirements; procedures met TS and administrative requirements; procedures were used as required; and procedures in use were current, reviewed, and approved as required.

b. Observations and Findings

Procedures Review Subcommittee minutes and recent procedure revisions were reviewed. The inspector made observations of procedure use in the control room. No concerns were identified.

c. Conclusions

Procedures were reviewed, approved, and used as required.

5.0 **Fuel Movement**

a. Inspection Scope (60745)

The inspector investigated whether procedures were adequate, TS were met, and problems were resolved.

b. Observations and Findings

A sampling of fuel movements were reviewed and no concerns were identified.

c. Conclusion

The fuel movements reviewed met all requirements.

6.0 Surveillance

a. Inspection Scope (61745)

The inspector investigated whether procedures met the requirements; surveillances were performed as required; and records and logs of safety parameters were consistent with surveillance results.

b. Observations and Findings

The inspector noted that the Rod C monthly drop time had increased since last November from about 520 to 620 milliseconds although it was still within the specification of 700 milliseconds.

The licensee was aware of the change which occurred after the rod assembly was refurbished in November. They plan to remove the rod and attempt to identify and correct the cause of the change by the end of January 1998.

The licensee notified the NRC by telephone on January 29, 1998 that the control rod C problem had been corrected by replacing the offset mechanism and that the rod drop time had returned to normal.

A failure to meet TS requirements for one channel of low primary flow reactor trip protection was discovered by the licensee during routine annual surveillance on June 16, 1997. The channel was set 25 gallons per minute (gpm) below the Limiting Safety System Setting of 1600 gpm. The channel was reset and retested with acceptable results each following week until a replacement was installed on July 14, 1997.

The licensee reported this event to the NRC as required.

This nonrepetitive licensee-identified and corrected violation is being treated as a Non-Cited Violation, consistent with Section VII.B.1. of the NRC Enforcement Policy.

c. Conclusion

The licensee's surveillance program acceptably met NRC requirements and Enforcement Policy standards.

7.0 Experiments

a. Inspection Scope (69005)

The inspector investigated whether experiments were handled in accordance with the licensee's requirements and limits.

b. Observations and Findings

The inspector observed licensee staff loading and documenting sample movement within the center flux trap holder. The operator was then observed while making entries in the sample log book. No concerns were identified.

c. Conclusion

The licensee had explicit instructions and procedures for handling experiments which the staff followed.

8.0 **Emergency Preparedness**

a. Inspection Scope (82745)

The inspector investigated whether emergency plan changes were in accordance with regulations and administrative controls; implementation procedures were consistent with the program; key response personnel were able to implement the plan; offsite support was capable of assistance; and drills, exercises and training were conducted.

b. Observations and Findings

The licensee modified their implementing procedures to correct some minor problems identified in the annual drill. Offsite organizations were involved extensively with the drill. Documented self evaluation was thorough and objective. Annual training included procedure corrections.

c. Conclusion

The licensee's emergency plan was effectively implemented as required.

9.0 **Event Follow-Up**

a. Inspection Scope (92700)

The inspector investigated the details of the event and its impact on safety, possible causes, and licensee actions taken or planned.

b. Observations and Findings

The licensee reported to the NRC by telephone, and in writing within 30 days (on January 8, 1998) as required that they experienced an unexplained reactor high power trip on December 9, 1997. The event occurred about 18 hours after returning the reactor to full power following a refueling and maintenance period on December 8, 1997.

The reactor scrammed when Wide Range Monitor channel 4 reached 118 percent. Power channel 6, close to channel 4 yet further from the core, indicated a rod run-in set point had been reached and had a slightly lower peak on its recorder trace than channel 4. Power channel 5, located some distance from channels 4 and 6 and reading the lowest before the event, did not indicate any power increase during the event, because of a sticking pen in the channel 5 chart recorder. The protective functions of channel 5 were operational, but were not reached during the event. The event was also detected by the channels 2 and 3 (intermediate range).

Nuclear channel 5 recorder pen had not indicated a sudden power increase like the other channels had during the trip event. The licensee suspected the pen had become stuck but could not reproduce the problem during testing. The inspector reviewed the pen trace from the previous day's reactor startup and discovered the pen had been stuck for a period of time. This information supported the licensee's theory that the channel 5 pen had been stuck during the event.

The Technical Specification limiting safety system setting for power was 125 percent. The licensee was operating at slightly less than 10 megawatts which was the license limit. The three nuclear channels that provide high power trips were all reading at or above 100 percent indicated power although the hourly primary cooling loop calorimetric readings and a pool heat balance calculation verified that power was less than the license limit 15 minutes before the event.

The licensee stated that the three channels were allowed to remain above 100 percent during the typical week-long run because as fission product poisons built up, fuel depleted, and rods withdrew, the shadowing effect on the nuclear instruments was continuously increasing and would otherwise have required constant adjustment to the instruments. At the time of the event channels 3 and 4 indicated 104 percent while channel 5 was at 100 percent. Operators confirmed that they were instructed to maintain the three affected channels within a range of about 100 to 105 percent at full power. Daily heat balance calculations were used to confirm the hourly calorimetric readings. The inspector verified daily heat balance calculations using logged parameters and verified that trip settings on all three channels were set below the 125 percent limit.

A review of the licensee's Hazard Summary Report (HSR) and applicable addendums that discussed reactivity insertions and limits confirmed that the licensee's assumptions and estimates of the amount of reactivity added were consistent with those predicted for similar scenarios.

Discussions with the operators on duty during the event as well as records and log reviews led the inspector to conclude that operations before and during the occurrence appeared to be within license limits and administrative guidelines. Scram settings prevented the reactor from exceeding safety limits and limiting safety system settings.

The licensee investigated the possibility that fuel movement caused the event. The licensee surveyed the operating crews involved in the December 8, 1997, refueling and concluded that the core had been reloaded as planned with all fuel elements seated in their appropriate positions. The fuel elements were also subject to downward forces due to primary cooling flow which had exceeded the amount necessary to seat fuel in the core. Licensee calculations indicated that, with the dimensional tolerances for fuel movement, it would have required all eight fuel elements to have moved to cause the reactivity event. It was unlikely that fuel movement in the core at power had contributed to this event.

The central flux trap and the samples it contained were also considered by the licensee as a possible source of positive reactivity that may have caused the high power transient. Operators that installed the sample holder confirmed to the licensee that the device was latched in place as required.

A review of the contents and a physical inspection of the samples in the trap during the event revealed nothing unusual. Vacuum testing and heat testing for leaking samples revealed nothing with any source of reactivity that was plausible.

After consulting with the Reactor Action Subcommittee, on December 10, 1997, the licensee started the reactor without the samples in the flux trap and compared the results during a second startup with the samples in place and accounted for the predictable reactivity differences.

The inspector observed the operators loading the flux trap holder with samples, verifying that it was full, and returning the holder to its latched position. With the apparent rigorous procedure compliance, second verification and the positive locking system for the holder, it was unlikely that it could have contributed to this event.

The inspector reviewed records of maintenance activities preceding the event to identify any potential precursors. Recent maintenance on the Uninterruptible Power Supply was reviewed. All nuclear instrumentation channels were either directly or indirectly powered from that source. Nothing was apparent that may have had any affect on the event.

The licensee hypothesized that a release of gas from the graphite reflector material could have caused a positive reactivity addition and may also separately have caused an increased neutron flux in the area of the channel 4 and 6 nuclear detectors. Both of these effects would have caused a higher power indication on those channels as a result. The licensee observed bubbles coming from the graphite in the vicinity of the channel 4 nuclear detector during startups after the event. The licensee's HSR predicted that a voiding of the rod gap would cause positive reactivity as would voiding in the flux trap. They supported this theory with the results from modeling data. The graphite segments were Helium filled in aluminum cladding. The total voiding of the rod gaps would not result in a prompt critical condition however according to the HSR Section 13.2.3.

This theory appears plausible and was a possible cause of the event although there was no means of verifying it.

The licensee also hypothesized that the boron control blades may have contributed to the event by releasing helium trapped within them. They plan to inspect the blades during outages in January and February 1998. They indicated to the inspector that this schedule may be extended except that C rod will be removed for inspection as discussed in Section 6.0.

c. Conclusion

Although the licensee had not been able to definitively state what caused the positive reactivity resulting in the high power scram, their efforts to identify and characterize the magnitude of positive reactivity and plausible sources were comprehensive. No safety limits or limiting safety system settings appeared to have been exceeded. No similar event had ever occurred before. Although a possible recurrence cannot be discounted, the potential magnitude of another transient, although uncertain, would likely be less than a prompt critical condition as described in the HSR for rod gap voiding and based upon limits associated with reactivity worths permitted in the core region.

10.0 **Miscellaneous**

a. Inspection Scope (86740)

The inspector investigated contact dose readings on a shipping container to determine whether the container was within dose limits for transportation as an empty package, exempt quantity.

b. Observations and Findings

(Closed) Follow-Up Item 97201-03: The licensee had shipped a depleted uranium shielded container to a licensee in New York state in 1996 as an empty package, exempt quantity. The recipient measured contact readings on the package and had concluded that it exceeded the limit of 0.5 mrem/hr. The inspector verified the container was the same one that had been shipped to New York state in 1996 and measured the container using a Victoreen 471 calibrated in September 1997. All contact readings were within the 0.5 mrem/hr limit established by the Department of Transportation for empty packaging, exempt quantities.

c. Conclusion

No further action required.

11.0 Exit Meeting Summary

The inspector presented the inspection results to members of the licensee management at an exit meeting on January 15, 1998. The licensee acknowledged the findings presented. The inspectors asked the licensee whether any material examined during the inspection should be considered proprietary. No proprietary information was identified.

Partial List of Persons Contacted

Edward Deutsch*	MURR	Director
Charles McKibben*	MURR	Assoc. Director
Walt Meyer*	MURR	Reactor Manager
Tony Schoone*	MURR	Operations Eng.

* Denotes those attending the exit meeting on January 15, 1998

Inspection Procedures Used

IP 39745	Organization and Operations and Maintenance
IP 40745	Review and Audit and Design Change
IP 69003	Reactor Operator Requalification
IP 42745	Procedures
IP 60745	Fuel Movement
IP 61745	Surveillance
IP 69005	Experiments
IP 82745	Emergency Preparedness
IP 92700	Follow-Up of Non-routine Events

Items Opened and Closed

Opened

50-186/98201-01	VIO	Failure to conduct annual operating tests by authorized individuals.
-----------------	-----	--

Closed

50-186/96001-01	IFI	Requalification written examination.
50-186/97201-03	IFI	Proper labeling for empty packaging.

List of Documents Reviewed

Hazard Summary Report	Operating Procedures
Reactor Operating License	Training Records
Technical Specifications	Maintenance Records
Administrative Procedures	Various Reports
Surveillance Procedures	

List of Acronyms Used

CFR	Code of Federal Regulations
HSR	Hazard Summary Report
mrem	millirem
MURR	Research Reactor Facility
NRC	Nuclear Regulatory Commission
PDR	Public Document Room
TS	Technical Specifications

U.S. Nuclear Regulatory Commission

INSPECTOR FOLLOWUP SYSTEM (IFS)
POWER REACTOR DATA ENTRY FORM

OPEN NEW ITEMS ONLY - (non escalated, including EEIs)

SITE NAME: UNIVERSITY OF MISSOURI AT COLUMBIA

SUBMITTED BY: T BURDICK DATE: 1/ /98

REPORT NO.:

REVIEWED BY: S WEISS DATE: _____

UNIT	DOCKET NO.:
1	50-186
2	
3	

Report Transmittal Date: _____

Lead Responsible Inspector
Last Name: T BURDICK RITS Initials: T T B

Responsible Org. Code: _____

Event Date (LER Only): _____

Item Seq. No.: 01

Item Type: V I O

Severity Level: I V

Supplement No.: I

EA NO. _____

ITEM STATUS: 0

Unit 1: _____ Unit 2: _____ Unit 3: _____

(Fill in the EA NO. if opening an 'EEI' item. The EA NO. can be obtained from EICS)

Title: FAILURE TO COMPLY WITH REQUALIFICATION PROGRAM REQUIREMENTS

(64 Characters Max)

Inspection Procedure Number: 69003

SALP Functional Area: _____

Cause Code: _____

Closeout Org. Code: _____

Closeout Employee Last Name & RITS Initials: BURDICK, TIB

NGV Summary/Comments: THE LICENSEE FAILED TO ENSURE THAT ANNUAL OPERATING TESTS WERE

DESIGNATED INDIVIDUALS AUTHORIZED.

This to 12th floor (B. Jones)

19.2

**INSPECTION FOLLOWUP SYSTEM (IFS)
SPEED CLOSEOUT / UPDATE FORM**

DOCKET NUMBERS		5	0	-	1	8	6	RESPONSIBLE INDIVIDUAL: T BURDICK			
AFFECTED UNITS (1/2/3)								FACILITY: UNIVERSITY OF MISSOURI AT COLUMBIA (MURR)			
AFFECTED UNITS (1/2/3)	ITEM TYPE*	ITEM REPORT NUMBER	SEQ. NO.	CLOSE/UPDATE REPORT NO.	INSPECTION ISSUE DATE	ITEM STATUS*					
1	I F I	9 6 0 0 1	0 1	9 8 2 0 1	2 / 98	C					
1	I F I	9 7 2 0 1	0 3	9 8 2 0 1	2 / 98	C					

(FOR ESCALATED ITEMS ONLY)

AFFECTED UNITS (1/2/3)	ITEM TYPE	EA NUMBER	NOV ID NUMBER	CLOSEOUT REPORT NO.	INSP. ISSUE DATE	ITEM STATUS*
	VIO					