

May 27, 2008

Dr. John A. Bernard, Jr.
Director of Reactor Operations
Massachusetts Institute of Technology
Research Reactor
MITNRL-NW 12
138 Albany Street
Cambridge, MA 02139

SUBJECT: NRC INSPECTION REPORT NO. 50-020/2008-201

Dear Dr. Bernard:

This letter refers to the inspection conducted on April 28 to May 1, 2008, at your research reactor facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of that inspection.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations of activities in progress. Based on the results of this inspection, no safety concern or noncompliance with NRC requirements was identified. No response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

If you have any questions concerning this inspection, please contact Marcus H. Voth at 301-415-1210.

Sincerely,

/RA/

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

Docket No.: 50-020
License No.: R-37

Enclosure: NRC Inspection Report No. 50-020/2008-201

cc: See next page

Massachusetts Institute of Technology

Docket No. 50-20

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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.: 50-020

License No.: R-37

Report No.: 50-020/2008-201

Licensee: Massachusetts Institute of Technology (MIT)

Facility: MIT Research Reactor

Location: Cambridge, Massachusetts

Dates: April 28 to May 1, 2008

Inspectors: Marcus H. Voth, Lead
Patrick J. Isaac
Linh Tran

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

EXECUTIVE SUMMARY

Massachusetts Institute of Technology
Research Reactor Facility
NRC Inspection Report No.: 50-020/2008-201

The primary focus of this routine, announced operations inspection was the onsite review of selected aspects and activities at the Massachusetts Institute of Technology related to operation of the five megawatt Class 1 research reactor. It included a review of the licensee's safety programs including: organization and operation and maintenance activities; experiments; surveillance; fuel movement; operator licensing, requalification, and medical activities; emergency preparedness; transportation; and follow-up on a previous special inspection of an unplanned exposure event. The licensee's programs were found to be acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

Organization and Operations and Maintenance Activities

- The licensee's organization and the conduct of operations and maintenance remained in compliance with the Technical Specifications (TS). The cause of the observed control blade binding was determined and corrected and the inspector followup item was closed.

Experiments

- Conduct and control of experiments met the requirements of regulations, the MIT Technical Specifications, and the applicable facility procedures.

Surveillance

- The system for tracking and completing surveillance checks and verifying compliance with limiting conditions for operation was well maintained. Maintenance records, performance, and reviews satisfied TS and procedure requirements.

Fuel Movement

- Fuel movements were performed in accordance with approved procedures and TS requirements.

Operator Licensing, Requalification and Medical Activities

- Operator requalification was up-to-date and was being performed as required by the MIT Reactor Operator Requalification Program.

Emergency Preparedness

- Emergency preparedness provisions for the licensee's facility were found to be in accordance with TS requirements and Emergency Plan commitments.

Transportation

- The licensee was observed to be performing shipments of radioactive material in accordance with regulatory requirements.

Follow-up of Special Inspection 50-020/2007-203, Higher than Expected Exposure Event

- The licensee's response to the two violations associated with the higher than expected exposure event were found adequate and they were closed. Additional enhancements will continue to be tracked with an inspector follow-up item that remains open.

REPORT DETAILS

Summary of Facility Status

The licensee's five megawatt Massachusetts Institute of Technology Reactor - II (MITR-II) routinely operated 24 hours a day, 7 days a week, for 3 month cycles in support of educational experiments, research and service irradiations, reactor operator training, and periodic equipment surveillances. At the end of each of the first two months of a cycle the reactor was shutdown for a short outage to perform surveillance testing. At the end of every third month the reactor was shut down for approximately a week for maintenance, refueling, and surveillance testing. During the inspection, the reactor was operating continuously.

1. Organization and Operations and Maintenance Activities

a. Inspection Scope (Inspection Procedures (IP) 69006 and 92701)

The inspectors reviewed the following regarding the licensee's organization and staffing to ensure that the requirements of Section 7 of the Technical Specifications (TS), Administrative Controls, were being met:

- MIT Nuclear Reactor Laboratory Organization Chart, April 30, 2008
- Reactor Logbook #113, August 5, 2007 to December 1, 2007
- Reactor Logbook #114, December 1, 2007 to April 5, 2008
- MIT Research Reactor Annual Report to the U.S. Nuclear Regulatory Commission for the Period July 1, 2006 to June 30, 2007, submitted October 11, 2007
- MITR-II Job Workbook
- New Insight into Shim Blade #1 Failure, Memorandum to File from E. Lau completing control blade investigation, March 31, 2008

b. Observations and Findings

Through discussions with licensee representatives and review of the reactor logbook, the inspectors determined that the minimum staffing requirements had been met. The organization was the same as in the previous inspection with the exception of minor variations among student reactor operators.

The inspectors reviewed the Annual Report submitted by the licensee pursuant to TS Section 7.13.5 and generally found it in general conformance with the stated requirements. However, the inspectors noted that it was not submitted within the specified 60-day interval following the end of the reporting year. The licensee acknowledged the deadline, expressed difficulty in gathering information in a timely manner every year because of summer vacation schedules, and stated that if necessary, they may consider requesting an increased.

The inspectors reviewed a recent reactor logbook and found operations to be conducted in accordance with TS requirements. In addition, they reviewed the Job Workbook, a record for staff members, primarily reactor operators, to

document and inform management of anomalies found during their watch. The inspectors found that items of concern were given appropriate, timely attention.

The inspectors reviewed progress on Inspector Followup Item (IFI) 50-020/2007-201-01, resolution of control blade bulging. Recent observations, combined with a review of prior observations, indicated that the observed hesitation during control blade drop tests was the result of mechanical interference associated with the alignment of the blade, not bulging or warping of the blade tip as was hypothesized as a likely cause. While some deformation of the blade tips was observed at the end of life of all control blades, the data did not correlate with the drop time performance. On the basis of drop time testing results and alignment adjustments done in March of 2008, the staff concluded that the observed behaviors, including 2007 observations, were related to alignment which was corrected. Therefore, IFI 50-020/2007-201-01 was closed.

c. Conclusions

The licensee's organization and the conduct of operations and maintenance remained in compliance with the TS. The cause of the observed control blade binding was determined and corrected and the inspector followup item was closed.

2. Experiments

a. Inspection Scope (IP 69005)

To verify compliance with the licensee's procedures, TS Sections 6.1, General Experiment Criteria, 7.9, Experiment Approval Procedures, and 7.5.1, Safety in Reactor Operations, and 10 CFR 50.59, the inspector reviewed:

- Reactor Logbook #113, August 5, 2007 to December 1, 2007
- Reactor Logbook #114, December 1, 2007 to April 5, 2008
- MIT Procedure Manual 1.4, Review and Approval of Plans, Procedures and Facility Equipment and Changes Thereto
- MIT Procedure Manual 1.10, Experiment Review and Approval
- MIT Procedure Manual 1.10.2, MIT Reactor Safeguards Committee
- MIT Procedure Manual 1.10.3, MITR Operations
- MIT Procedure Manual 1.10.7, Records
- MIT Part I, Irradiation Request Form
- MIT Part II, Neutron Activation Analysis Form
- Safety Review Forms for selected recent experiments
- Minutes – Meeting on Predicative methods for Silicon, April 16, 2008
- MIT Reactor Safeguards Committee (RSC) – Draft Minutes of Committee Meeting #96 held on December 14, 2007
- MIT RSC – Minutes of Committee Meeting #95, June 6, 2007
- Procedure for Verifying Operation of Advanced Clad Irradiation
- MIT – Nuclear Reactor Laboratory Silicon Program Procedure # 7.5.5-1, Rev. 6, General Radiological Guidelines, November 18, 2007

b. Observations and Findings

The inspector observed work being performed on the silicon radiation facilities. Particular attention was given to personnel safety and contamination control for personnel. Work was found to be executed in a safe and professional manner. Reviews by the Safeguards Committee were recorded in meeting minutes. Reviews and approval of experiments were documented on the Part I and Part II Review Forms. Criteria required by TS 6.1 to be considered in the safety review appeared on review forms.

c. Conclusions

Conduct and control of experiments met the requirements of regulations, the MIT TS, and the applicable facility procedures.

3. Surveillance

a. Inspection Scope (IP 69010)

To verify that the licensee was meeting the surveillance requirements of their TS, the inspector reviewed selected aspects of:

- Reactor Logbook #113, August 5, 2007 to December 1, 2007
- Reactor Logbook #114, December 1, 2007 to April 5, 2008
- MIT Procedure Manual 6.1.1 to 6.1.5.5, System Tests and Calibrations Vol. 1 of 3
- MIT Procedure Manual 6.2.1 to 6.4.2.4, System Tests and Calibrations Vol. 2 of 3
- MIT Procedure Manual 6.5.1 to 7.4.4.2, System Tests and Calibrations Vol. 3 of 3
- MIT Procedural Manual 6.0, Test and Calibration Procedures
- Surveillance activities and equipment maintenance documented in 2007 Test and Calibration Tracker
- Surveillance activities and equipment maintenance documented in 2008 Test and Calibration Tracker
- MIT Daily Operations Schedule

b. Observations and Findings

The inspector performed spot checks which in all cases verified that TS surveillance requirements were completed on their specific schedule as required by TS and in accordance with licensee procedures. A Test and Calibration Tracker system was used to track completion of the various required surveillance and LCO verifications. Checklists for surveillance activities were completed and filed to document the date those activities were completed and by whom. These checklists and associated forms provided acceptable documentation of the results and proper control of reactor operational tests and surveillance.

c. Conclusions

The system for tracking and completing surveillance checks and verifying compliance with limiting conditions for operation was well maintained. Maintenance records, performance, and reviews satisfied TS and procedure requirements.

4. Fuel Movement

a. Inspection Scope (IP 69009)

To ensure that the licensee was following the requirements of TS Section 3.10, Fuel Element and Core Component Handling and Storage, the inspectors reviewed selected aspects of the following:

- Reactor Logbook #114, December 1, 2007 to April 5, 2008
- Core Configuration No. 182 approved packet, including:
 - Fuel Loading Permission, February 29, 2008
 - Fuel Removal Permission, February 29, 2008
 - Transfer Schedule, February 29, 2008
 - Core Configuration, March 5, 2008
 - Safety and Operating Limits for Core No. 182, no date
 - Elements with a 30% Excess Loading over 20-22" for Core No. 182, no date
 - Elements with a 30% Excess Loading over 2-4" for Core No. 182, no date
 - Fuel Loading Verification, April 22, 2008

b. Observations and Findings

The inspectors reviewed in depth the preparations and followup to the refueling recorded in the reactor logbook on March 2, 2008, designated as Core Number 182. The new core design and fuel moves to achieve the new configuration were developed in a systematic manner. The design packet was approved and subsequently used by reactor operators, in addition to the routine approved procedures, for performing the fuel moves. Fuel removed from the core was placed in specified locations meeting the requirements of TS 3.10.3.

Simultaneous with this NRC inspection of operations, the inspectors performed an inspection of physical security which including special nuclear material control and accountability activities. Inspection Report Number 50-020/2008-202 indicated that the licensee was acceptably controlling and tracking the use and location of material pursuant to 10 CFR Part 74.

c. Conclusions

Fuel movements were performed in accordance with approved procedures and TS requirements.

5. Operator Licensing, Requalification and Medical Activities

a. Inspection Scope (IP 69003)

To verify that the licensee was complying with the requirements of 10 CFR Part 55 and licensee's operator requalification program, the inspectors reviewed selected aspects of:

- MIT Procedure Manual 1.16.1, Requalification Program for Licensed Personnel, March 11, 1988
- MIT Procedure Manual 1.16.2, MITR Operator Qualification Program for Senior Reactor Operators/Shift Supervisors, May 6, 2004
- MIT Procedure Manual 1.16.3, MITR Operator Qualification Program for Operators, May 6, 2004
- MIT Procedure Manual 1.16.4, Operator and Senior Operator Review Board Evaluations, September 1979
- MIT 2007 Requalification Examination
- Reactor Logbook #113, August 5, 2007 to December 1, 2007
- Reactor Logbook #114, December 1, 2007 to April 5, 2008
- List of individuals holding current NRC operator and senior operator licenses
- Reactor operator files maintained in the Operations Office
- On-the-Job-Training Records maintained in Control Room binders

b. Observation and Findings

The requalification program was maintained up-to-date and Reactor Operator and Senior Reactor Operator licenses were current. A review of the logs and records showed that training was being conducted in accordance with the requalification and training program. Attendance at training sessions and records indicating the completion of the annual operations tests and the biennial written examinations were maintained as required. A random check of the records of reactor operations and other operations activities determined that operators were spending at least the minimum required time at the controls of the reactor. The inspectors also noted that operators were receiving the required biennial medical examinations.

c. Conclusions

Operator requalification was up-to-date and was being performed as required by the MIT Reactor Operator Requalification Program.

6. Emergency Preparedness

a. Inspection Scope (IP 69011)

The inspectors reviewed selected aspects of the following to verify compliance with TS Sections 7.8.1.i and 7.8.4 and the licensee's Emergency Plan and Procedures:

- MITR Emergency Plan and Procedures, April 30, 1997

- 2007 Medical Emergency Plan Drill, August 27, 2007
- 2007 Radiological Emergency Exercise, March 11, 2008
- 2008 Medical Emergency Drill, March 31, 2008
- Emergency Plan and Test and Calibration Procedure 6.6.1.1, Reactor Operations

b. Observation and Findings

The inspectors verified compliance with the TS Section 7.8.4 requirement for annual Emergency Plan drills. The licensee met this requirement by conducting radiological emergency and medical emergency drills on alternate years. Following each drill a critique was conducted, identifying areas of strength and weakness with action plans to address weaknesses. Drills and critiques were documented in writing as referenced above. MIT police officers played a role in both types of drills. In radiological emergencies they performed environmental radiation sampling in areas designated by the Drill Supervisor who remained in the control room during emergencies. For medical emergencies MIT police officers were the first responders, assisting with first aid and initial decontamination. They also communicated the need for emergency resources such as the Student Emergency Medical Services, Cambridge Fire and Hazmat Department, or backup emergency resources.

Police officers were required to attend 2 hours of training plus a reactor tour annually; newly hired officers were given the same training at the time of hiring. Officers made rounds at the reactor each shift which helped maintain their familiarity with the facility and staff.

In early March the Nuclear Preparedness Manager of the Massachusetts Emergency Management Agency requested of the NRC that he observe an NRC inspection of emergency preparedness at a Massachusetts research reactor, the April MIT inspection being the next one scheduled. He was invited pursuant to the Policy Statement and Protocol Agreement for State Observation of NRC Inspections (Federal Register, Volume 57, Number 37, February 25, 1992, page 6465.) He attended a round table discussion of emergency capability and interfaces with representatives of MIT Reactor Operations, MIT Environmental Health and Safety, Cambridge Fire and Hazmat, and the NRC inspectors. He also accompanied the NRC inspectors and licensee representatives for an inspection of the MIT Medical Center emergency receiving room for contaminated victims. The inspectors found the designated radiation survey instruments in place with operating instructions and current calibration labels. Other decontamination and medical supplies were available per the Emergency Plan. Personnel at the Medical Center were knowledgeable of the procedures for receiving, assessing, and treating victims of radioactive contamination.

c. Conclusions

Emergency preparedness provisions for the licensee's facility were found to be in accordance with Technical Specification requirements and Emergency Plan commitments.

7. Transportation

a. Inspection Scope (IP 86740)

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

- Shipping Papers for Implant Science Yttrium Foils, April 4, 2007
- Shipping Papers for Best Medical Industries Gold Seeds, February 13, 2008
- File of Annual QA [Quality Assurance] Audits of Shipping Containers for Radioactive Material Shipments
- Addendum to 2006 QA Audit, G. Wallace, May 4, 2007
- Addendum to 2007 QA Audit, E. Lau, April 21, 2008
- Approved Highway Route for Transport of Spent Nuclear Fuel, R. Caldwell (USNRC), July 16, 2007
- MIT Shipment Transportation Plan – 2007 Shipment, July 31, 2007
- MIT to Savannah River Site, 2007 Shipment Security Plan, July 31, 2007
- Driver Instructions, MIT to Westinghouse – Savannah River Site, August 2007
- Checklist for Fuel Shipment #MIT-0701, August 8, 2007
- Radiation and Contamination Survey Form, August 14, 2007

b. Observation and Findings

The inspectors reviewed shipping papers for radioactive materials shipped by the licensee under the MITR operating license. The two shipments referenced above, randomly selected from shipments for 2007 and 2008, were reviewed in detail; no inconsistencies with regulatory or procedural requirements were identified. The licensee performed annual audits of shipping containers as an internal quality assurance requirement. The inspectors noted that each year the auditors found paperwork to be in proper order.

The inspectors also reviewed a past shipment of spent reactor fuel elements per the special requirements of 10 CFR 73.37. The licensee maintained on file documents indicating compliance with requirements for the preparation and proper execution of the shipment.

c. Conclusions

The licensee was observed to be performing shipments of radioactive material in accordance with regulatory requirements.

8. Special Inspection 50-020/2007-203, Higher than Expected Exposure Event

a. Inspection Scope (IP 92701)

To verify that appropriate action was taken in response to two Violations (VIO), VIO 50-020/2007-203-02 and VIO 50-020/2007-203-04, and one Inspector Follow-up Item, IFI 50-020/2007-203-01, as identified in NRC Special Inspection Report No. 50-020/2007-203 issued on December 19, 2007, the inspector reviewed:

- MIT Response to NRC Inspection Report No. 50-020/2007-203 and Notice of Violation EA-06-113, January 15, 2008
- MIT Procedure Manual 1.10, Experiment Review and Approval
- Safety Review Forms for Silicon experiments
- Landauer Radiation Dosimetry Report for 2007
- Landauer Radiation Dosimetry Report for 1st Quarter 2008
- Training Records for Silicon Operators
- Memorandum on Formation of ALARA [As Low As Reasonably Achievable] Committee, March 10, 2008
- Minutes – Meeting on Predicative methods for Silicon, April 16, 2008
- MIT RSC – Draft Minutes of Committee Meeting #96 held on December 14, 2007

b. Observation and Findings

- 1) VIO 50-020/2007-203-02 (Closed): Follow-up on the licensee's commitment to conduct adequate surveys

The inspectors interviewed licensee personnel and observed work being performed on the silicon radiation facilities. Particular attention was given to personnel safety and contamination and exposure control for personnel. Work was found to be executed in a safe and professional manner. The inspectors also verified that all the corrective actions that the licensee committed to in their response to the NRC Special Inspection Report were being implemented or had been completed.

- 2) VIO 50-020/2007-203-04 (Closed): Follow-up on the licensee's commitment to provide workers adequate training in health protection problems

The inspectors performed a random check of the training records of MIT personnel who were issued dosimetry and verified that the corrective actions to which the licensee committed in their response to the NRC Special Inspection Report were being implemented or had been completed.

- 3) IFI 50-020/2007-203-01 (Discussed but not closed): Follow-up on the licensee's corrective actions yet to be taken in response to the incident

The licensee initiated numerous pro-active follow-on measures to enhance safety and ALARA as a result of the findings of their internal analysis of the incident and the NRC Special Inspection Report. Numerous initiatives were underway but not completed at the time of the inspection. Examples included improved integration and communication between reactor operations and health physics, review of the experiment review process when experiments evolve into major productions, and effective use of electronic dosimetry for ALARA purposes. These will be reviewed in future inspections so IFI 50-020/203-01 will therefore remain open.

c. Conclusions

The licensee's response to the two violations associated with the higher than expected exposure event were found adequate and were closed. Additional enhancements will continue to be tracked with an inspector follow-up item that remains open.

9. Exit Briefing

The inspection scope and results were summarized on May 1, 2008, with members of licensee management. The inspectors described the areas inspected and discussed the preliminary inspection findings. The licensee did not state any dissenting opinions or identify any information to be withheld from public disclosure.

PARTIAL LIST OF PERSONS CONTACTED

Licensee:

J. Bernard	Director of Reactor Operations
E. Block	Maintenance Supervisor
L. DiBerardinis	Director of Environmental Health and Safety (EHS)
D. Carlson	Captain, MIT Police Department
D. Diamond	MIT Medical, Associate Medical Director
P. Drooff	Assistant Health Physicist
M. Gulanck	Campus Radiation Protection Officer and Deputy Director, EHS
L-W. Hu	Associate Director, Research Development and Utilization
D. Lamay	[SNM Accountability] Officer, EHS
E. Lau	Superintendent for Reactor Operations
F. McWilliams	Reactor Radiation Protection Officer and Deputy Director, EHS
D. Moncton	Director of the MIT Nuclear Reactor Laboratory
T. Newton	Associate Director, Reactor Engineering
S. Tucker	Quality Assurance Supervisor

Other Personnel:

J. Giarrusso, Jr.	Nuclear Preparedness Manager, Massachusetts Emergency Management Agency
G. Reardan	Chief, Cambridge Fire Department
R. Rossi	Cambridge Fire Department Hazmat

INSPECTION PROCEDURES USED

IP 69003	Class 1 Research and Test Reactor Operator Licenses, Requalification, and Medical Examinations
IP 69005	Class 1 Research and Test Reactor Experiments
IP 69006	Class 1 Research and Test Reactors Organization and Operations and Maintenance Activities
IP 69009	Class 1 Research and Test Reactor Fuel Movement
IP 69010	Class 1 Research and Test Reactor Surveillance
IP 69011	Class 1 Research and Test Reactor Emergency Preparedness
IP 86740	Inspection of Transportation Activities
IP 92701	Follow-up

ITEMS OPENED, CLOSED, AND DISCUSSED

OPENED:

None

DISCUSSED:

50-020/2007-203-01 IFI Follow-up on the licensee's corrective actions that are yet to be taken in response to the higher than expected exposure event.

CLOSED:

50-020/2007-201-01 IFI Resolution of control blade bulging

50-020/2007-203-02 VIO Failure to conduct adequate surveys of the work area as required by 10 CFR 20.1501.

50-020/2007-203-04 VIO Failure to provide the worker involved adequate training in health protection problems associated with exposure to radiation and/or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices as required by 10 CFR 19.12

LIST OF ACRONYMS USED

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Reasonably Achievable
CFR	<i>Code of Federal Regulations</i>
CIP	Continuous Improvement Program
EHS	Environmental Safety and Health
IFI	Inspector Follow-up Item
IP	Inspection Procedure
MIT	Massachusetts Institute of Technology
MITR	Massachusetts Institute of Technology Reactor
No.	Number
NRC	Nuclear Regulatory Commission
PARS	Publicly Available Records
QA	Quality Assurance
Rev.	Revision
RSC	Reactor Safeguards Committee
TS	Technical Specification
VIO	Violation
Vol.	Volume