

January 17, 2012

Dr. Thomas H. Newton
Director of Reactor Operations
Massachusetts Institute of Technology
Research Reactor
MITNRL-NW 12
138 Albany Street
Cambridge, MA 02139

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – NRC NON-ROUTINE
INSPECTION REPORT NO. 50-020/2011-205

Dear Dr. Newton:

On December 19-21, 2011, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted an inspection at the Massachusetts Institute of Technology Research Reactor facility (Inspection Report No. 50-020/2011-205). The enclosed report documents the inspection results, which were discussed on December 21, 2011, with you, other members of your staff, and Dr. David Moncton, Director, Nuclear Reactor Laboratory.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records, observed activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, and requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Should you have any questions concerning this inspection, please contact Craig Bassett at (301) 466-4495 or by electronic mail at Craig.Bassett@nrc.gov.

Sincerely,

/RA/

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

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

Enclosure: NRC Inspection Report No. 50-020/2011-205
cc: See next page

Massachusetts Institute of Technology

Docket No. 50-020

cc:

City Manager
City Hall
Cambridge, MA 02139

Department of Environmental Protection
One Winter Street
Boston, MA 02108

Mr. Robert Gallagher, Acting Director
Radiation Control Program
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Charlestown, MA 02129

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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ACCESSION NO.: ML120120011

*** concurrence via e-mail**

TEMPLATE #: NRC-002

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

Docket No.: 50-020

License No.: R-37

Report No.: 50-020/2011-205

Licensee: Massachusetts Institute of Technology

Facility: Nuclear Reactor Laboratory

Location: Cambridge, Massachusetts

Dates: December 19-21, 2011

Inspector: Craig Bassett

Accompanied by: Al Adams, Project Manager
Taylor Lichatz, Inspector Trainee

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

EXECUTIVE SUMMARY

Massachusetts Institute of Technology
Nuclear Reactor Laboratory
NRC Inspection Report No.: 50-020/2011-205

The primary focus of this non-routine, announced inspection was the onsite review of various events that have occurred at the Massachusetts Institute of Technology (the licensee's) Class I six megawatt (MW) research and test reactor safety program since the last routine U.S. Nuclear Regulatory Commission (NRC) inspection in May. The events were identified by the licensee and corrective actions were initiated as a result.

Reactor Operations – Occurrence Corrective Action Follow-up

- Following various occurrences in 2011, MIT research reactor staff developed, implemented, and completed corrective actions for each.

Reactor Operations – Safety Conscious Work Environment

- There appeared to be an appropriate Safety Conscious Work Environment at the MIT facility.

Maintenance and Surveillance

- The licensee continued to make use of the program that is in place to track to completion maintenance and repair work activities to include the use of the Job Work Book.

REPORT DETAILS

Summary of Facility Status

The Massachusetts Institute of Technology (MIT, the licensee) Nuclear Reactor Laboratory (NRL) six megawatt (MW) research and test reactor continued to be operated in support of experiments, research and service irradiations, reactor operator training, and periodic equipment maintenance and surveillance activities. The reactor is typically operated approximately 300 days per year with operations running 24 hours a day, 7 days a week, for about four weeks followed by a shutdown varying from 8 hours to two weeks in length. During the inspection, the reactor was operated at varying power levels to support on-going experiments and for silicon irradiation.

1. Reactor Operations – Occurrence Corrective Actions Follow-up

a. Inspection Scope (Inspection Procedure (IP) 69006, 69008, 92701)

To determine whether the licensee was conducting reactor operations in accordance with the Massachusetts Institute of Technology Reactor (MITR) Technical Specification (TS) and procedural requirements and implementing corrective actions following occurrences, the inspector reviewed selected portions of the following:

- Reactor Logbook #124, July 6, 2011 to present
- TS for the Massachusetts Institute of Technology, Revision (Rev.) 6, implemented through renewed Facility Operating License R-37, issued November 1, 2010
- Procedure Manual (PM) Section 5, “Abnormal Operating Procedures,” which included Abnormal Operating Procedure (AOP) 5.4.14, “Loss of City Water Pressure,” last revision dated July 8, 2011
- Unusual Occurrence Report - 2011-3, “Loss of City Water Pressure,” date of occurrence June 4, 2011
- Reportable Occurrence Report – 2011-3, “Operation with Fewer than the Required Number of Nuclear Safety Channel Level Scrams,” report submitted to the NRC on July 28, 2011
- Unusual Occurrence Report – 2011-4, “Release of Fission Products from HYFI Experiment,” report dated June 26, 2011
- Independent Auditor Report entitled, “MITR Evaluation of Recent Reportable and Unusual Occurrences,” Final Report, Revision (Rev.) 1, dated November 22, 2011

b. Observations and Findings

(1) Loss of City Water Pressure Occurrence

On June 4, 2011, the MIT research reactor was operated for more than 5 minutes at a power level greater than 100 kilowatts following the receipt of a “Loss of City Water Pressure” alarm which resulted in a minor violation involving failure to follow procedure. Abnormal Operating

Procedure 5.4.14 required that the reactor not be operated above 100 kilowatts (kW) for more than 5 minutes following loss of city water pressure.

The licensee initiated a review of the event and concluded that the procedure was not clearly written and did not reflect the requirement stipulated in the TS. Also, the perceived need to minimize the thermal stress on the in-core experiments resulted in the Reactor Supervisor (RS) taking the actions he did. An Unusual Occurrence Report (UOR) was written to document this event and corrective actions were identified. To correct this problem, AOP 5.4.14 was rewritten to clarify the immediate actions and to require the reactor to be scrammed with a continuous loss of city water pressure of greater than three minutes. In addition, a reactor scram was added to the scram circuitry to initiate an automatic scram upon a three minute loss of city water. It was also stipulated that the UOR was required reading for all operations personnel.

The inspector reviewed the corrective actions taken by the licensee. Through interviews with personnel and review of various records, the inspector verified that the actions had been completed. This included revising and issuing the AOP 5.4.14.

(2) Operation of the Reactor with Fewer than the Required Number of Nuclear Safety Channel Level Scrams Occurrence.

On July 18, 2011, the MIT research reactor was started up with only one operable nuclear safety channel level scram (two are required by Technical Specification Section 3.2.3). This resulted in a Non-Cited Violation because the problem had been identified and reviewed by the licensee, reported to the NRC, and corrective actions had been taken.

As a result of this event the licensee took various corrective actions as follows: 1) All period and level Channel's cables were labeled at all connection locations. 2) Channel Number (No.) 6 was recalibrated and verified to be operable. 3) Retraining sessions were required for licensed and maintenance personnel to highlight the importance of proper communication with the Control Room Reactor Operator (RO), as well as the important role of proper documentation and attention to detail.

The inspector reviewed the event and the corrective actions taken by the licensee. Through interviews and review of the Reactor Console Logbook and training records, the inspector verified that the actions had been completed. This included retraining all licensed and maintenance personnel.

(3) Release of Fission Products from the Hydride Fuel Experiment

The licensee uses the research reactor to conduct various types of experiments including the Hydride Fuel (HYFI) experiment. This involves

irradiating three hydride fuel sample capsules in the reactor over a period of time to assess how such capsules will react in such an environment.

During routine gas sampling of the three installed HYFI sample capsules on June 21, 2011, the fission product gas levels were found to be within normal baseline values. On June 26, during a period of low power operation for operator training, contamination was found in the reactor building and on personnel exiting the containment building. This led to the discovery of elevated dose rates at the HYFI gas sampling manifold on the reactor top. The gas supply to the HYFI sample capsules was secured and the reactor was shut down. Following decontamination efforts, the contamination levels in the containment building were found to be normal on June 27 but dose rates remained elevated at the gas sampling manifold. The Capsule 2 gas system was found to have caused the problem and the system was purged. It was surmised that the primary containment barrier of Capsule 2 had apparently failed allowing the fission product gases into the sampling system. The sampling system had leaked releasing fission product gases into the containment building. It was noted that the fission gases did not get out of the containment building into the environment.

Modifications to the sample manifold system were proposed, reviewed, and implemented to preclude the release of contamination into the containment building. Corrective actions included replacing the sampling lines and establishing a detailed weekly leak detection procedure. Modifications to the high radiation detection systems surrounding the experiment were also made. Capsule 2 was removed from the experiment and testing of the two remaining HYFI sample capsules was resumed. Later it was determined that the primary containment of a second HYFI sample capsule had failed and fission product gases had been detected in the sampling system. However, because of the modifications to the sample manifold, no contamination was released into the containment building. The second HYFI sample capsule was removed and testing of the remaining capsule was resumed.

The inspector and Project Manager discussed the issue of the failure of the primary containment of two HYFI sample capsules with the licensee. Because this was an experiment involving fuel, the NRC questioned why the experiment was continued without determining why the primary containment of two of the three capsules had failed. The licensee indicated that the capsules would need to be sent to the Idaho National Laboratory to be inspected before a definitive failure mechanism could be determined. The licensee agreed to conduct a detailed review of the experiment before any more capsules were introduced into the reactor. The licensee was informed that the issue of reviewing the HYFI sample capsule experiment would be considered by the NRC as an Inspector Follow-up Item (IFI) and would be reviewed during a future inspection (IFI 50-020/2011-205-01).

c. Conclusion

Corrective actions had been taken and completed following occurrences at the facility. One Inspector Follow-up Item was identified involving review of the Hydride Fuel Experiment following fission product leakage from two of the three sample capsules contained in the experiment.

2. Reactor Operations – Safety Conscious Work Environment

a. Inspection Scope (IP 69006)

To assess the status of the facility's safety culture with respect to the NRC Policy Statement issued on June 14, 2011, the inspector interviewed numerous staff members and reviewed selected aspects of:

- Notice posted on the Main Bulletin Board entitled, "Your Rights Under The Energy Reorganization Act"
- Copies of NRC Form 3 posted on various bulletin boards throughout the facility
-

b. Observations and Findings

On June 14, 2011, the NRC issued a Final Safety Culture Policy Statement in the Federal Register. The Statement of Policy was issued to set for the Commission's expectation that individuals and organizations establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions. In order to assess the safety culture at the MIT Research Reactor facility, the inspector interviewed nearly all full-time management and staff members at the facility, as well as the Chair of the Reactor Safeguards Committee and the Director, Environment, Health, and Safety (EH&S) Office for MIT.

It was noted that all those interviewed felt that a safety conscious work environment (SCWE) existed at the facility and that they could raise a safety concern without fear of retaliation. Some individuals indicated that there was still room for improvement. Most people felt that there was an appropriate emphasis on safety and safety training. Although no formal safety policy existed at the facility, the Director of the Nuclear Reactor Laboratory indicated that that was an issue that he and the Reactor Safeguards Committee would look into.

c. Conclusion

There appeared to be an appropriate safety culture at the facility.

3. Maintenance and Surveillance

a. Inspection Scope (IP 69006, 69010, 92701)

To verify that the licensee was meeting the surveillance requirements specified in TS Section 4 and that maintenance was being conducted, the inspector reviewed selected aspects of:

- MITR-II Job Workbook
- Reactor Logbook #124, July 6, 2011 to present
- TS for the Massachusetts Institute of Technology, Revision (Rev.) 6, implemented through renewed Facility Operating License R-37, issued November 1, 2010

b. Observations and Findings

During an inspection in August 2011, the inspector inquired about the condition of all the nuclear safety channels. The licensee indicated that, although they had sufficient to operate safety, about half were out of commission (OOC) or in need of some type of maintenance. The inspector then reviewed the program the licensee used to track and complete maintenance activities and needed repair work. One aspect of the system involved the use of the Job Work Book. It was maintained in the Control Room so that anyone who found an item of equipment that was OOC or other problem could enter that data in the Job Work Book to be tracked until the needed repairs were completed. Following that inspection, the licensee was informed that the issue of effectively using the Job Work Book would be considered by the NRC as an IFI and would be reviewed during a future inspection.

During the current inspection, the inspector again reviewed the Job Work Book for references to the various safety channels. It was noted that staff members appeared to be using the book appropriately. This item will remain open until it can be determined that the Job Work Book is consistently being used to track items that have been taken out of service until the items are properly repaired and all associated checks and/or calibrations have been completed.

c. Conclusion

One IFI involving the use of the Job Work Book noted during a previous inspection remained open.

4. Exit Interview

The inspection scope and results were summarized on December 21, 2011, with members of licensee management. The inspector described the areas inspected and discussed the preliminary inspection findings. The licensee did not offer any dissenting opinions or identify any information to be withheld from public disclosure.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel:

J. Bernard	
E. Block	Maintenance Supervisor
T. Bork	Experiment Coordinator
L. Calderon	Reactor Supervisor and Operator Coordinator
D. Cormier	Senior Technician, Reactor Radiation Protection Office, Environment, Health, and Safety Office
J. Diciaccio	Technician
J. Foster	Superintendent of Reactor Operations
S. Hanvy	Reactor Instrumentation Technician
L.-W. Hu	Associate Director, Research Development and Utilization
D. Kelly	Reactor Supervisor – Night Shift
E. Lau	Associate Director, Reactor Operations and Requalification Program Coordinator
H. Lee	Reactor Operator
W. McCarthy	Reactor Radiation Protection Officer and Deputy Director, Environment, Health, and Safety Office
P. Menadier	Project Specialist
D. Moncton	Director, Nuclear Reactor Laboratory
P. Nawazelski	Reactor Operator
T. Newton	Director of Reactor Operations
J. Quattrochi	Staff Officer, Reactor Radiation Protection Office, Environment, Health, and Safety Office
P. Same	Reactor Supervisor and Silicon Irradiation Coordinator
S. Tucker	Quality Assurance Supervisor
F. Warmasley	Assistant Superintendent of Operations and Training Supervisor

Other Personnel

L. DiBerardinis	Director, Environment, Health, and Safety (EHS) Office
J. Litster	Chair, Reactor Safeguards Committee

INSPECTION PROCEDURES USED

IP 69006	Class 1 Research and Test Reactors Organization and Operations and Maintenance Activities
IP 69008	Class 1 Research and Test Reactors Procedures
IP 69010	Class 1 Research and Test Reactors Surveillance
IP 92701	Follow-up on Open Items

ITEMS OPENED, CLOSED, AND DISCUSSED

OPENED:

50-020/2011-201-02 IFI Follow-up on the licensee review of the Hydride Fuel Experiment following fission product leakage from two of the three sample capsules contained in the experiment.

CLOSED:

None

REVIEWED

50-020/2011-201-02 IFI Follow-up on the licensee's making effective using the Job Work Book to track and close-out maintenance items and items needing repair.

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
AOP	Abnormal Operating Procedure
HYFI	Hydride Fuel
IFI	Inspector Follow-up Item
IP	Inspection Procedure
MIT	Massachusetts Institute of Technology
MITR-II	Massachusetts Institute of Technology Reactor
No.	Number
NRC	U. S. Nuclear Regulatory Commission
NRL	Nuclear Reactor Laboratory
OOC	Out of commission
PM	Procedure Manual
Rev.	Revision
RO	Reactor Operator
TS	Technical Specification
UOR	Unusual Occurrence Report