

July 27, 2017

Mr. Al Queirolo, Director
of Reactor Operations
Massachusetts Institute of Technology
Nuclear Reactor Laboratory
Research Reactor
138 Albany Street, MS NW12-116A
Cambridge, MA 02139

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – U.S. NUCLEAR
REGULATORY COMMISSION ROUTINE INSPECTION REPORT
NO. 50-020/2017-201

Dear Dr. Queirolo:

From April 25-27, 2017, the U.S. Nuclear Regulatory Commission (NRC or Commission) conducted an inspection at the Massachusetts Institute of Technology Research Reactor facility. The enclosed report documents the inspection results, which were discussed on April 27, 2017, with you and members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with 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, 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 Mr. Johnny H. Eads at (301) 415-0136 or by electronic mail at Johnny.Eads@nrc.gov.

Sincerely,

/RA/

Anthony J. Mendiola, 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:
As stated

cc: See next page

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – U.S. NUCLEAR
REGULATORY COMMISSION ROUTINE INSPECTION REPORT
NO. 50-020/2017-201 DATED: JULY 27, 2017

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| DATE | 7/24/17 | 7/21/17 | 7/27/17 |

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Massachusetts Institute of Technology

Docket No. 50-020

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Ms. Sarah M. Don, Reactor Superintendent
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U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No. 50-020

License No. R-37

Report No. 50-020/2017-201

Licensee: Massachusetts Institute of Technology

Facility: Nuclear Reactor Laboratory

Location: Cambridge, Massachusetts

Dates: April 25-27, 2017

Inspector: Johnny Eads

Approved by: Anthony J. Mendiola, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

Massachusetts Institute of Technology
Nuclear Reactor Laboratory
NRC Inspection Report No. 50-020/2017-201

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the Massachusetts Institute of Technology (the licensee's) Class I six megawatt research reactor safety program including: (1) organization and staffing, (2) reactor operations, (3) operator requalification, (4) maintenance and surveillance, (5) fuel handling, (6) experiments, (7) procedures, and (8) emergency preparedness since the last U.S. Nuclear Regulatory Commission (NRC) inspection of these areas. The licensee's program was acceptably directed toward the protection of public health and safety and in compliance with NRC requirements.

Organization and staffing

- Organizational structure and staffing were consistent with technical specification (TS) requirements.

Reactor Operations

- Reactor operations were conducted in accordance with procedure and the appropriate logs were being maintained.

Operator Requalification

- Operator requalification was conducted as required by the Requalification Program and the program was being maintained up-to-date.
- Operators were receiving biennial medical examinations as required.

Maintenance and Surveillance

- The system for tracking and completing maintenance items and surveillance checks and calibrations was adequate and was being maintained as required.
- Maintenance and surveillance records, performance, and reviews satisfied TS and procedure requirements.

Fuel Handling

- Fuel was being controlled as required and fuel movements were conducted in accordance with TS and procedural requirements.

Experiments

- The program for reviewing and conducting experiments satisfied procedural and TS requirements.

Procedures

- The procedure review, revision, control, and implementation program satisfied TS requirements.

Emergency Preparedness

- The emergency preparedness program was conducted in accordance with the Emergency Plan (E-Plan).
- Emergency response equipment was being maintained and inventoried as required.
- Emergency drills were being conducted annually as required by the E-Plan.
- Emergency preparedness training for licensed operators and personnel from various support organizations was being completed as required.

REPORT DETAILS

Summary of Facility Status

The Massachusetts Institute of Technology (MIT or the licensee) Nuclear Reactor Laboratory (NRL) six megawatt research and test reactor continued to be operated 24 hours a day, 7 days a week in support of educational experiments, research and service irradiations, and reactor operator training. During the inspection, the reactor was shutdown for maintenance.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure (IP) 69006)

The inspector reviewed the Massachusetts Institute of Technology Reactor (designated as MITR-II) organization and staffing to ensure that the requirements of technical specification (TS) 7.1, implemented through Renewed Facility Operating License R-37, Amendment 40 issued August 13, 2015, were being met regarding the following:

- Management responsibilities
- Qualifications of facility operations personnel
- MIT NRL Organization Chart, dated April 12, 2017
- Reactor Digital Logbook covering the period from March 2016 to present
- Staffing requirements for reactor operation stated in TS 7.1.3
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2016, to December 31, 2016."

b. Observations and Findings

The inspector noted that the Director of Reactor Operations continued to report to the Director of the MIT NRL, who in turn reported to the President of the university through the Vice President for Research. This organization was consistent with that specified in the TS. The organizational structure and the responsibilities of the reactor staff had not changed since the last inspection.

Staffing levels remained consistent with those noted during the last inspection of the facility. The current reactor operations organization consisted of the Director of Reactor Operations, the Deputy Director of Reactor Operations, the Assistant Director of Operations, the Superintendent of Operations, the Training Coordinator, a Quality Assurance Supervisor, and various reactor supervisors, and reactor operators (ROs). The Deputy Director of Reactor Operations, the Assistant Director of Reactor Operations, the Superintendent of Operations, the Quality Assurance Supervisor, the Training Coordinator, and the majority of the reactor supervisors were licensed senior reactor operators (SROs). In addition to the operations staff, there were various support groups, including a research staff, a research development group, a reactor engineering staff, maintenance personnel, and a reactor radiation protection group. Through a review of reactor

operations logs for the period from March 2016 through the present, and through interviews with operations personnel, the inspector determined that the licensee normally operated 24 hours a day with three crews and no shift rotation. Each operating crew was staffed with various personnel (with at least two licensed operators on duty at the MITR-II per shift). Operations shifts were scheduled for a period of 8 hours. The review of the reactor (console) logbooks and associated records confirmed that shift staffing during reactor operations met the minimum requirements for duty and on-call personnel specified in TS 7.1.3.

c. Conclusion

The licensee's organization and staffing were in compliance with the requirements specified in TS 7.1.

2. Reactor Operations

a. Inspection Scope (IP 69006)

To verify that the licensee was conducting reactor operations in accordance with TS Sections 2 and 3 and procedural requirements, the inspector reviewed selected portions of the following:

- Reactor Digital Logbook covering the period from March 2016 to present
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2016, to December 31, 2016."

b. Observations and Findings

(1) Reactor Operation

The inspector observed facility activities on various occasions during the week including routine reactor operations and updating the console logs while the reactor was shutdown for maintenance. Written procedures and checklists were used for each activity as required. It was noted that the reactor operators followed the appropriate procedures, were knowledgeable of the required actions, and professional in the conduct of their duties.

(2) Staff Communication

During the inspection, the inspector observed reactor operator turnover activities during the shift. The status of the reactor and the facility was discussed on each occasion as required. The oncoming personnel were briefed on the upcoming activities and scheduled events before assuming the operations duty. Through direct observation and records review, the inspector verified that the content of turnover briefings was appropriate

and that shift activities and plant conditions were discussed in sufficient detail.

c. Conclusion

MITR-II reactor operations, as well as turnovers and operator cognizance of facility conditions during routine operations, were acceptable.

3. Operator Requalification

a. Inspection Scope (IP 69003)

To verify that the licensee was complying with the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 55 and TS 7.2.3.3 (b) and conforming to Chapter 12, Sections 12.1 and 12.10 of the facility safety analysis report, the inspector reviewed selected aspects of the following:

- Current status of operator licenses
- Reactor Digital Logbook covering the period from March 2016 to present
- Results of the annual written examinations completed in 2016
- Medical examination records for selected operators for the past 2 years
- Procedure Manual (PM) 1.16, "Requalification and Qualification," latest revision dated February 20, 2013.

b. Observations and Findings

There were 21 individuals licensed to operate the reactor at MIT. Of those personnel, 15 were qualified SROs and 6 were ROs. A review of various Requalification Program records indicated that the program was maintained up-to-date and that SRO and RO licenses were current. MITR-II operator files and reactor logs also showed that all operators maintained active duty status with the exception of one SRO who was designated as inactive by the facility. A review of the MITR Safety Committee (MITRSC) meeting minutes and independent audit results indicated that the program was being audited annually as required by TS 7.2.3.3.(b).

A review of the pertinent logs and records also showed that training was being conducted in accordance with the licensee's requalification and training program. A series of lectures were given to operators during the 2 year training and requalification cycle. Information regarding facility changes, procedure changes, and other relevant information was routinely routed to all licensed operators for their review. The inspector verified that the required reactor operations, reactivity manipulations, other operations activities, and reactor supervisor activities were being completed and the appropriate records were being maintained. The inspector also noted that all operators were receiving biennial medical examinations within the time frame allowed as required by the program.

c. Conclusion

Operator requalification was up-to-date and being completed as required by the MITR-II Operator Requalification Program. Operators were receiving biennial medical examinations as required.

4. Maintenance and Surveillance

a. Inspection Scope (IPs 69006 and 69010)

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 the following:

- MITR-II Job Workbook
- MITR-II Daily Operations Schedule
- Reactor Digital Logbook covering the period from March 2016 to present
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2016, to December 31, 2016."

b. Observations and Findings

(1) Maintenance

The inspector reviewed the system that the licensee had developed to track and complete maintenance activities. The system was designed to ensure that all maintenance activities were planned and completed as scheduled, that post maintenance testing was conducted, and that the entire process was documented appropriately. The licensee used a locally developed system called the "Test and Calibration Tracker" which listed nearly all the tests, checks, and calibrations that were due on a monthly basis, as well as MITR-II "Systems, Tests, and Calibrations" notebooks to document completion of the various periodic maintenance and surveillance activities. The inspector noted that all such tasks were tracked through this system. The program appeared to be effective.

(2) Surveillance

Various periodic surveillance verifications and calibration records of equipment, including the testing of various reactor systems, instrumentation, and auxiliary systems were reviewed by the inspector. TS surveillance items were completed on schedule as required by TS and in accordance with licensee procedures. The results of selected tests, checks, and calibrations reviewed by the inspector were noted to be within the TS and procedurally prescribed parameters.

c. Conclusion

The system for tracking and completing maintenance items and surveillance checks and calibrations was adequate and was being maintained as required. Maintenance and surveillance records, performance, and reviews satisfied TS and procedure requirements.

5. Fuel Handling

a. Inspection Scope (IP 69009)

To ensure that the licensee was following the requirements of TSs 3.1.4, 3.1.6, 4.1.5, and 5.4, the inspector reviewed selected aspects of the following:

- Reactor Digital Logbook covering the period from March 2016 to present
- Approved packets for core configurations completed in 2016 and 2017, including:
 - “Fuel Loading Permission” Form (form revision dated February 20, 2013), completed for fuel element transfers in 2016 and 2017 to date

b. Observations and Findings

The inspector reviewed the fuel movement process and verified that fuel moves were conducted according to established procedure and documented on specific fuel movement sheets developed by the Reactor Engineer. The inspector reviewed selected fuel movement sheets for 2016 and to date in 2017. They had been developed and used for each specific core refueling as required.

c. Conclusion

Fuel was being controlled as required and fuel movements were performed in accordance with approved procedures and TS requirements.

6. Experiments

a. Inspection Scope (IP 69005)

To verify compliance with the licensee’s procedures, TSs 6, 7.5, and 10 CFR 50.59 the inspector reviewed the following:

- Reactor Digital Logbook covering the period from March 2016 to present
- Experiment Review Process documented in PM 1.10, “Experiment Review and Approval,” latest revision dated February 20, 2013.

b. Observations and Findings

The inspector reviewed the experimental review and approval process described in PM 1.10. The inspector reviewed selected safety review forms and irradiation

request forms for experiments that were currently active. The experimental facilities and/or equipment had been evaluated in accordance with TS requirements and the associated data sheets indicated that the experiments would be within the specified limits. The analysis for each had been performed and the reviews and approvals completed. The appropriate reviews and approvals had also been completed for the samples and/or materials to be irradiated and the experiments were conducted under the cognizance of the reactor supervisor and in accordance with the specified requirements.

c. Conclusion

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

7. Procedures

a. Inspection Scope (IP 69008)

To verify that the licensee was meeting the requirements of TS 7.4, the inspectors reviewed selected aspects of the following:

- PM 1.4, "Review and Approval of Plans, Procedures and Facility Equipment and Changes Thereto," which included:
 - PM 1.4.1, "Plan, Procedure, and Equipment Change Classification," latest revision dated February 20, 2013
 - PM 1.4.2, "Class C Review and Approval," latest revision dated February 20, 2013
 - PM 1.4.3, "Class B Review and Approval," latest revision dated February 20, 2013
 - PM 1.4.4, "Class A Review and Approval," latest revision dated February 20, 2013
 - PM 1.4.5, "Safety Review Form," latest revision dated February 20, 2013
 - PM 1.4.6, "Procedure Manuals," latest revision dated February 20, 2013
- PM 1.5, "Procedure Adherence and Temporary Change Method," latest revision dated February 20, 2013

b. Observations and Findings

The inspector noted that procedures had been developed for reactor operations and safety as required by the TS 7.4. The licensee's procedures were found to be acceptable for the current facility status and staffing level. The inspector noted that the administrative procedure specified the responsibilities of the various positions and for the MITRSC.

Operations procedures were typically reviewed by operators and support personnel prior to being used/implemented and were revised as needed. The inspector noted that abnormal and emergency procedures were reviewed annually by all licensed operators as required and revised when needed. Major procedure revisions were reviewed and approved by the Director of Reactor Operations and submitted to the MITRSC for review. All procedure changes were routinely routed to all operators for review as well.

It was also noted that management and supervisory oversight was focused on proper implementation and adherence to procedures. Through observation of various activities in progress during the inspection, the inspector noted that adherence to procedures was adequate.

c. Conclusion

Procedures were properly prepared and implemented in compliance with license requirements.

8. Emergency Preparedness

a. Inspection Scope (IP 69011)

The inspector reviewed selected aspects to verify compliance with TS 7.2.3.d and the licensee's Emergency Plan and associated procedures of the following:

- Training records for MITR Support Personnel
- Review and Critique of the 2016 Emergency Exercise conducted on August 16, 2016
- Review and Critique of the 2016 actual medical emergencies which occurred on February 13, 2016 and July 6, 2016
- PM 4.0, "MITR-II Emergency Plan and Procedures," revision dated June 20, 2013
- PM 4.4.4, "Emergency Operating Procedures"

b. Observations and Findings

The inspector reviewed the Emergency Plan (EP) and implementing procedures in use at the reactor and verified that the procedures were reviewed annually by all licensed operators in accordance with the Operator Requalification Program.

Through records reviews and interviews with facility emergency personnel (i.e., licensed operators or emergency responders), the inspector determined that they were knowledgeable of the proper actions to take in case of an emergency. Training for staff members had been conducted annually as required and documented acceptably.

Emergency training for MIT Police Department personnel was required to be conducted annually by EP Section 4.10.1.1. The inspector reviewed the training records and noted that the most recent training had been completed as required.

The inspector verified that letters of agreement with various emergency support organizations were on file and being maintained.

Communications capabilities with support groups were acceptable and were verified annually through a communications check with the various organizations. Emergency call lists had been revised and updated as needed and were available in various areas of the facility, including in controlled copies of the Emergency Procedures Manuals. The inspector also verified that emergency equipment was being inventoried quarterly as required.

The inspector verified compliance with the EP requirement for annual emergency plan drills. The licensee met this requirement by conducting radiological emergency and medical emergency drills each year or by taking credit for an actual emergency. Following each drill, a critique was conducted to identify areas of strength and weakness. Drills and critiques were documented in writing as referenced above. The drills appeared to be challenging and provided a good indication of each organization's responsiveness and capabilities.

c. Conclusion

The licensee was maintaining acceptable emergency preparedness in accordance with TS and E-Plan requirements.

9. Exit Interview

The inspection scope and results were summarized on April 27, 2017, with members of licensee management. The inspector described the areas inspected and discussed the preliminary inspection findings. The licensee acknowledged the results of the inspection and did not identify as proprietary any of the material provided to or reviewed during the inspection.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel:

| | |
|-------------|---|
| J. Bernard | Senior Advisor, Research Staff |
| S. Don | Superintendent Operations |
| J. Foster | Deputy Director of Reactor Operations |
| E. Lau | Assistant Director of Reactor Operations |
| W. McCarthy | Reactor Radiation Protection Officer and Deputy Director, MIT Environment, Health, and Safety Office |
| A. Queirolo | Director of Reactor Operations |
| S. Tucker | Quality Assurance Supervisor |

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 69008 | Class 1 Procedures |
| 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 |

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened:

None

Closed:

None

LIST OF ACRONYMS USED

| | |
|--------|--|
| CFR | <i>Code of Federal Regulations</i> |
| EP | Emergency Plan |
| IP | Inspection Procedure |
| MIT | Massachusetts Institute of Technology |
| MITR | Massachusetts Institute of Technology Reactor |
| MITRSC | Massachusetts Institute of Technology Reactor Safety Committee |
| NRC | U.S. Nuclear Regulatory Commission |
| NRL | Nuclear Reactor Laboratory |
| PM | Procedure Manual |
| RO | Reactor Operator |
| SRO | Senior Reactor Operator |
| TS | Technical Specification |