



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

May 2, 2018

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

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – NUCLEAR  
REGULATORY COMMISSION ROUTINE INSPECTION REPORT  
NO. 50-020/2017-202

Dear Mr. Queirolo:

From December 11-14, 2017, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at your Massachusetts Institute of Technology Research Reactor. The enclosed report presents the results of that inspection, which were discussed on December 14, 2017, with members of your staff.

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 selective procedures and records, observed various 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 Publicly Available Records component of 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).

A. Queirolo

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Should you have any questions concerning this inspection, please contact Mr. Johnny Eads at (301) 415-0136 or by electronic mail at [Johnny.Eads@nrc.gov](mailto:Johnny.Eads@nrc.gov).

Sincerely,

*/RA/*

Anthony J. Mendiola, Chief  
Research and Test Reactors Oversight Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

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

Enclosure:  
As stated

cc: See next page

Massachusetts Institute of Technology

Docket No. 50-020

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SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – NUCLEAR  
REGULATORY COMMISSION ROUTINE INSPECTION REPORT  
NO. 50-020/2017-202 DATED MAY 2, 2018

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<b>DATE</b>	4/28/2018	4/27/2018	5/2/2018

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

Docket No. 50-020

License No. R-37

Report No. 50-020/2017-202

Licensee: Massachusetts Institute of Technology

Facility: Nuclear Reactor Laboratory

Location: Cambridge, Massachusetts

Dates: December 11-14, 2017

Inspector: Johnny Eads

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

Enclosure

## EXECUTIVE SUMMARY

Massachusetts Institute of Technology  
Nuclear Reactor Laboratory  
NRC Inspection Report No. 50-020/2017-202

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the Massachusetts Institute of Technology (MIT or the licensee's) Class I six megawatt research reactor safety program, including: (1) organization and staffing, (2) review and audit and design change functions, (3) radiation protection, (4) effluent and environmental monitoring, and (5) transportation of radioactive materials 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 was in compliance with NRC requirements.

### Organization and Staffing

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

### Review and Audit and Design Change Functions

- The MIT Reactor Safeguards Committee (RSC) was meeting as required and reviewing the topics outlined in the TS.
- Quarterly and annual audits of facility programs were generally conducted as required.
- The design change program satisfied NRC requirements.

### Radiation Protection

- Surveys were completed and documented as required.
- Postings and notices met regulatory requirements.
- Staff personnel were wearing dosimetry as required and recorded doses were within the NRC's regulatory limits.
- Radiation survey and monitoring equipment was being maintained and calibrated as required.
- Radiation protection training was being conducted as required and was acceptable.
- The radiation protection and as low as reasonably achievable (ALARA) programs satisfied regulatory requirements.

### Effluent and Environmental Monitoring

- Effluent monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and TS limits.

### Transportation of Radioactive Materials

- The licensee continued to ship radioactive material in accordance with regulatory requirements.

## REPORT DETAILS

### Summary of Facility Status

The MIT's Nuclear Reactor Laboratory (NRL) 6-megawatt research 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. The licensee's programs were acceptably directed toward the protection of public health and safety, and were in compliance with NRC requirements.

#### 1. Organization and Staffing

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

The inspector reviewed the following regarding the MIT Reactor (designated as MITR-II) organization, staffing, and management responsibilities to ensure that the requirements of TS Section 7, Revision (Rev.) 6, dated November 1, 2010, were being met:

- Management responsibilities
- Qualifications of facility radiation protection personnel
- MIT NRL organization chart, dated December 7, 2017
- Staffing requirements for operation of the research reactor
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Annual Report to U.S. Nuclear Regulatory Commission for the Period January 1, 2016 to December 31, 2016," submitted March 30, 2017

##### b. Observations and Findings

The inspector noted that the Director of Reactor Operations was responsible for the safe operation of the facility and reported to the Director of the MIT NRL. The Director, of MIT NRL in turn reported to the President of the University through the Vice President for Research. The inspector also noted that the MITR-II Radiation Protection Officer (RPO) was responsible for radiation protection and advised the Director of Reactor Operations in all matters pertaining to radiation protection. This organization was consistent with that specified in the TS. The organizational structure and the responsibilities of the reactor staff and the radiation protection staff had not changed since the last inspection.

The radiation protection organization staffing levels at the facility remained consistent with those noted during the last inspection of this facility. The current reactor radiation protection organization consisted of the RPO, two Environment, Health, and Safety (EH&S) Officers, a project technician, three part-time EH&S technicians and an administrative assistant. The RPO, who also had the title of Deputy Director, EH&S, reported to the MIT Director of the EH&S Office. The RPO was also a member of the facility RSC. It was noted that the reactor radiation protection personnel provided assistance and job coverage for work done by Operations Group personnel.

c. Conclusion

The licensee's organization and staffing were in compliance with the requirements specified in TS Section 7.

**2. Review and Audit and Design Change Functions**

a. Inspection Scope (IP 69007)

To verify compliance with TS Section 7.2.1, TS Section 7.2.2 and Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.59, the following documents were reviewed:

- Minutes of the MIT RSC, Meeting No. 109, held December 9, 2016
- 10 CFR Section 50.59 evaluations completed since the last inspection in December 2016
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Annual Report to U.S. Nuclear Regulatory Commission for the Period January 1, 2016 to December 31, 2016," submitted March 30, 2017

b. Observations and Findings

(1) Review and Audit Functions

The inspector reviewed the revised RSC charter and minutes of the MIT RSC and the minutes of selected special subcommittees for the past year to verify compliance with TS requirements. Members were appointed and designated in writing as stipulated in the TS. A quorum was present for the various meetings and the meeting minutes indicated that a thorough review of the appropriate topics was conducted. The RSC appeared to be appropriately focused on performing both routine reviews and promptly attending to non-routine emerging issues.

As part of its safety oversight program, the licensee and an outside contractor performed audits of the operations and the radiation protection programs. The inspector reviewed the report of recent internal audits and the report of the external audit. No significant problems were identified, although various findings and recommendations were noted. The licensee's response to the findings and recommendations appeared to be appropriate.

(2) Design Change Functions

The licensee has an established design change review function. It includes the screening and safety review of changes, tests, or experiments to determine if, pursuant to 10 CFR Section 50.59, a change required NRC approval prior to being implemented. The inspector found procedures in place to control the review process and evidence of adherence to the procedures.

The inspector reviewed 10 CFR Section 50.59 evaluations completed since the last inspection in 2016. The licensee's 10 CFR Section 50.59 reviews concluded that the changes could be implemented at the facility without prior NRC approval. In each case, the required safety review forms were completed and approved in accordance with facility procedures.

c. Conclusion

The review and audit program was being conducted in compliance with the TS. The design change evaluation program was being implemented in accordance with the TS requirements and NRC regulations.

**3. Radiation Protection**

a. Inspection Scope (IP 69012)

To ensure that the licensee was following the requirements of TS Section 7.3 and 10 CFR Part 19 and 10 CFR Part 20, the inspector reviewed selected aspects of the following:

- Quarterly Landauer dosimetry reports for fourth quarter 2016, and to date in 2017
- Observations of facilities, equipment, operations, and postings during facility tours
- Reportable Occurrence Reports, Unusual Occurrence Reports, and Operator Lessons Learned Reports related to radiation protection for the past year
- MIT EH&S Reactor Radiation Protection Procedure 3001, "Radiological Surveys," Rev. 5, dated March 2003
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Annual Report to U.S. Nuclear Regulatory Commission for the Period January 1, 2016 to December 31, 2016," submitted March 30, 2017

b. Observations and Findings

(1) Surveys

Daily, weekly, monthly, and other periodic contamination and radiation surveys, outlined in the licensee's procedures, were generally completed in a timely manner by radiation protection staff members. Any contamination detected in concentrations above established action levels was noted and the area or item was generally decontaminated. Those that were not immediately decontaminated were located in areas that were established as contaminated areas where work was in progress.

Surveys were completed and documented acceptably to permit evaluation of the radiation hazards present.

(2) Postings and Notices

The inspector observed the copies of the notices to workers that were posted in various areas in the facility. The forms were posted on the main bulletin board, in the main hallways, and at the entrance to the reactor building. The inspector determined that radiological signs and, as noted above, survey maps were typically posted at the entrances to controlled areas. Other postings also showed the industrial hygiene hazards that were present in various areas as well.

(3) Dosimetry Use and Results

Through direct observation the inspector determined that dosimetry was acceptably used by facility and contractor personnel. The inspector determined that the licensee used optically stimulated luminescent (OSL) dosimetry for whole body monitoring and thermoluminescent dosimeters in the form of finger rings for extremity monitoring. The dosimetry was supplied and processed by a National Voluntary Laboratory Accreditation Program accredited vendor (Landauer).

An examination of the OSL results indicating radiological exposures at the facility for the past year showed that the highest occupational doses, as well as doses to the public, were within 10 CFR Part 20 limits. The records showed that approximately half of the facility personnel received occupational exposures of zero to only a few millirem above background.

(4) Radiation Monitoring Equipment

Examination of selected radiation monitoring equipment indicated that the instruments had the acceptable up-to-date calibration sticker attached. The instrument calibration records indicated that the calibration of certain portable survey meters was typically completed by licensee staff personnel. In the event that an instrument could not be calibrated by the licensee, it was taken out of service. Calibration frequency met procedural requirements and records were maintained as required. Licensee records for calibration and tracking were comprehensive and well maintained.

(5) Radiation Protection Training

The inspector reviewed the general employee radiation training given to MIT staff members, to those authorized to use the experimental facilities of the reactor, to students, and to visitors. It was noted that the training was available online through the EH&S website and reinforced with hands on, practical training. The training satisfied the requirements of 10 CFR Part 19 and the training program was acceptable. The inspector also noted that any specialized training, including Radiation Worker I and Radiation Worker II training, was provided on an individual basis by the RPO for those who needed it. No problems were noted. The inspector observed one of the refresher courses that are given annually so that current topics could be brought up and discussed by staff members. The

refresher training given included topics such as the facility ALARA program results, safety culture, emergency response, and new equipment and systems.

(6) ALARA Program

The MITR management ALARA efforts were well organized and continued to produce dose reduction results. ALARA goals were set and performance indicators were established. Each group in the MITR organization had an established ALARA goal for the year and the facility dose was tracked by group, as well as for each individual.

The facility is proactively taking action to reduce doses to workers through system modifications and radioactive material/waste shipments. The inspector notes that some additional dose will be received in the near term due to making modifications or preparing the material/waste shipments; however, in the long term, an overall reduction in dose should be realized.

The dose goal for 2016 was 2.0 person-rem. The cumulative dose for 2016 was less than the goal. The goal for 2017 is 2.0 person-rem for the facility.

(7) Facility Tours

The inspector toured the reactor containment, the reactor control room, and selected support laboratories and maintenance areas with licensee representatives on various occasions. The inspector noted that facility radioactive material storage areas were properly posted. Radiation and high radiation areas were posted as required and properly controlled.

c. Conclusion

The inspector determined that the Radiation Protection and ALARA Programs, as implemented by the licensee, satisfied regulatory requirements based on the following: (1) surveys were completed and documented acceptably to permit evaluation of the radiation hazards present, (2) postings met regulatory requirements, (3) personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits, (4) radiation survey and monitoring equipment was being maintained and calibrated as required, and (5) the radiation protection training program was acceptable.

**4. Effluent and Environmental Monitoring**

a. Inspection Scope (IP 69004)

The inspector interviewed licensee representatives and reviewed the following to verify compliance with the requirements pertaining to discharges from the facility and environmental surveys pursuant to TS 7.7.1:

- Facility records of measurements and analysis of effluent samples
- MIT EH&S Reactor Radiation Protection Procedure 3010, "Conduct of Environmental Radiological Surveys," Rev. 1, dated May 2000
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Annual Report to U.S. Nuclear Regulatory Commission for the Period January 1, 2016 to December 31, 2016," submitted March 30, 2017

b. Observations and Findings

The inspector determined that releases continued to be monitored as required in accordance with TS 3.7.2 and were acceptably analyzed. These results were documented in the annual operating reports in accordance with TS 7.7.1.

Airborne concentrations of gaseous releases, principally Argon-41, were well within the concentrations stipulated in 10 CFR Part 20, Appendix B, Table 2, and TS limits.

The licensee reported the annual total activity of liquid released from the facility to the sanitary sewer. The total activity was reported in terms of tritium and all other activity less tritium. The total activity monitored and analyzed by the licensee for calendar year 2016 was 63 millicuries of tritium and 10 microcuries of all other isotopes. The concentration was below the 10 CFR 20.2003 limit with no credit for dilution due to other MIT waste streams. There were two solid waste shipments to a licensed, offsite disposal facility.

There were no investigative studies or human therapy exposures during the year to be reported pursuant to TS 7.7.1.9.

The licensee recorded data throughout the year from five radiation monitors mounted within a quarter mile of the reactor. The predominant source of exposure was noted to be Argon-41. All doses were well within all regulatory limits.

c. Conclusion

Effluent release measurements and analyses and environmental monitor measurements demonstrated compliance with regulatory requirements.

**5. Transportation of Radioactive Materials**

a. Inspection Scope (IP 86740)

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

- Various completed forms for 2017, including:
  - Hazardous Goods Declaration forms
  - Bill of Lading forms
  - Surveys
  - MIT sample irradiation forms

- “2015 DOT Shipping Audit,” completed by a senior reactor operator
- “MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Annual Report to U.S. Nuclear Regulatory Commission for the Period January 1, 2016 to December 31, 2016,” submitted March 30, 2017

b. Observations and Findings

Through records review and discussions with licensee personnel, the inspector determined that the licensee had shipped radioactive waste and other types of radioactive material since the previous inspection in this area. The records of these shipments indicated that the radioisotope types and quantities were calculated and dose rates measured as required. The radioactive material shipment records of these materials had been completed in accordance with Department of Transportation (DOT) and NRC regulations. It was noted that the Operations Group complete the majority of the shipments. The training of the staff members responsible for shipping the material was also reviewed. The inspector verified that the individual staff members designated as “shippers” had received training in accordance with the requirements of the DOT.

c. Conclusion

The licensee continued to ship radioactive material in accordance with regulatory requirements.

**6. Exit Interview**

The inspection scope and results were summarized on December 14, 2017, with members of licensee management. The inspector described the areas inspected and discussed the preliminary inspection findings. The licensee acknowledged the inspection findings and did not identify any information to be withheld from public disclosure.

## PARTIAL LIST OF PERSONS CONTACTED

### Licensee Personnel

J. Bernard	Senior Advisor
T. Bork	Irradiation Service Coordinator
S. Don	Superintendent of Reactor Operations
E. Lau	Associate Director, Reactor Operations
M. Mahowald	Radiation Protection Program Officer, EH&S
W. McCarthy	Reactor Radiation Protection Officer and Deputy Director, Environment, Health, and Safety Office, MIT
D. Moncton	Director, Nuclear Reactor Laboratory
J. Quattrochi	Radiation Protection Program Officer, EH&S
P. Same	Reactor Supervisor
S. Tucker	Quality Assurance Supervisor

## INSPECTION PROCEDURES USED

IP 69004	Class 1 Research and Test Reactor Effluent and Environmental Monitoring
IP 69006	Class 1 Research and Test Reactors Organization and Operations and Maintenance Activities
IP 69007	Class 1 Research and Test Reactors Review and Audit and Design Change Functions
IP 69012	Class 1 Research and Test Reactor Radiation Protection
IP 86740	Transportation of Radioactive Materials

## ITEMS OPENED, CLOSED, AND DISCUSSED

### Opened:

None

### Closed:

None

## LIST OF ACRONYMS USED

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ALARA	As Low As Reasonably Achievable
DOT	Department of Transportation
EH&S	Environmental Health and Safety
IP	Inspection Procedure
MIT	Massachusetts Institute of Technology
MITR	Massachusetts Institute of Technology Reactor
NRC	U.S. Nuclear Regulatory Commission
NRL	Nuclear Reactor Laboratory
OSL	Optically Stimulated Luminescent
Rev.	Revision
RPO	Radiation Protection Officer
RSC	Reactor Safeguards Committee
TS	Technical Specification