November 19, 2012

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

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY - NRC ROUTINE INSPECTION REPORT NO. 50-020/2012-202 AND NOTICE OF VIOLATION

Dear Dr. Newton:

From October 22 to 25, 2012, the U.S. Nuclear Regulatory Commission (NRC or the Commission) conducted an inspection at the Massachusetts Institute of Technology Research Reactor facility (Inspection Report No. 50-020/2012-202). The enclosed report documents the inspection results, which were discussed on October 25, 2012, with you; Professor David Moncton, Director, Nuclear Reactor Laboratory; Mitch Galanek, Assistant Director, Environment, Health, and Safety Office and Campus Radiation Safety Officer; and various other members of the reactor facility 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 selected procedures and records, observed activities, and interviewed personnel.

Based on the results of this inspection, the NRC has determined that a Severity Level IV violation of NRC requirements occurred. The violation was evaluated in accordance with the NRC Enforcement Policy included on the NRC's Web site at www.nrc.gov; select **What We Do, Enforcement,** then **Enforcement Policy**. The violation is cited in the enclosed Notice of Violation (Notice) and the circumstances surrounding it are described in detail in the subject inspection report. The violation is being cited in the Notice because it constitutes a failure to meet regulatory requirements that has more than minor safety significance and the licensee failed to identify the violation.

The NRC has concluded that information regarding the reason for the violation and the corrective actions taken and planned to correct the violation and prevent recurrence were adequately addressed during the inspection and documented in this inspection report. Therefore, you are not required to respond to this letter unless the description herein does not accurately reflect your corrective actions or your position. In that case, or if you choose to provide additional information, you should follow the instructions specified in the enclosed Notice. 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 and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Document Access 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 Johnny Eads at (919) 219-9128 or by electronic mail at Johnny.Eads@nrc.gov.

Sincerely,

/RA/

Gregory T. Bowman, 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

Enclosures:
1. Notice of Violation
2. NRC Inspection Report No. 50-020/2012-202

cc w/encls: Please see next page

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
Department of Public Health
Schrafft Center, Suite 1M2A
529 Main Street
Charlestown, MA 02129

Nuclear Preparedness Manager
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

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

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ACCESSION NO.: ML12320A397 *** concurrence via e-mail** **TEMPLATE #: NRC-002**

OFFICE	PROB:RI *	PRPB:LA	PROB:BC
NAME	JEads	GLappert	GBowman
DATE	11/15/2012	11/15/2012	11/19/2012

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NOTICE OF VIOLATION

Massachusetts Institute of Technology
Nuclear Reactor Laboratory

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

During a U.S. Nuclear Regulatory Commission (NRC) inspection conducted from October 22 to 25, 2012, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 20.1003 defines a high radiation area as an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.

10 CFR 20.1601(a) states that each licensee shall ensure that each entrance or access point to a high radiation area has one or more of the following features: (1) a control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a deep-dose equivalent of 0.1 rem in 1 hours at 30 centimeters from the radiation source or from any surface that the radiation penetrates; (2) a control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or, (3) entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry. 10 CFR 20.1601(b) states that in the place of the controls required by 10 CFR 20.1601(a), a licensee may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

Contrary to 10 CFR 20.1601, the licensee failed to ensure that each entrance or access point to a high radiation area had one or more of the features required by 10 CFR 20.1601(a) or that the entrance or access point was under direct surveillance, as allowed by 10 CFR 20.1601(b). Specifically, the licensee did not maintain control of access to a high radiation area in that, on October 23, 2012, the gate to the entrance of a posted high radiation area, with radioactive material inside the posted area reading 500 millirem on contact and in excess of 0.1 rem per hour at 30 centimeters from the material, was not locked. None of the other control features described in 10 CFR 20.1601(a) was in place and the area was not under direct or electronic surveillance.

This has been determined to be a Severity Level IV violation (Section 6.7).

The NRC has concluded that information regarding the reason for the violation and the corrective actions planned and taken to correct the violation and prevent recurrence were adequately addressed during the inspection and documented in this inspection report. Therefore, you are not required to respond to this letter unless the description herein does not accurately reflect your corrective actions or your position. In that case, or if you choose to respond, clearly mark your response as a “Reply to a Notice of Violation,” include the violation

number, and send it to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Director, Office of Nuclear Reactor Regulation, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001. Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated this 19th day of November, 2012

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

Docket No.:	50-020
License No.:	R-37
Report No.:	50-020/2012-202
Licensee:	Massachusetts Institute of Technology
Facility:	Nuclear Reactor Laboratory
Location:	Cambridge, Massachusetts
Dates:	October 22-25, 2012
Inspectors:	Johnny Eads Craig Bassett
Approved by:	Gregory T. Bowman, 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.: 50-020/2012-202

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 five megawatt research and test reactor safety program including: (1) organization and staffing, (2) review and audit and design change functions, (3) radiation protection; (4) environmental monitoring, (5) procedures, and (6) 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 in compliance with NRC requirements. One cited violation was identified.

Organization and Staffing

- Organizational structure and staffing were consistent with Technical Specification (TS) requirements.

Review and Audit and Design Change Functions

- The Massachusetts Institute of Technology Reactor Safeguards Committee was meeting as required and reviewing the topics outlined in the TS.
- Quarterly and annual audits of facility programs were conducted as required.
- The design change program satisfied NRC requirements.

Radiation Protection

- Surveys were completed and documented as outlined in the Annual Report.
- 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 and was acceptable.
- The Radiation Protection and As Low As Reasonably Achievable Programs satisfied regulatory requirements.
- One violation was noted for failure to maintain control of the access to a high radiation area.

Effluent and Environmental Monitoring

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

Procedures

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

Transportation

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

REPORT DETAILS

Summary of Facility Status

The Massachusetts Institute of Technology (MIT's or the licensee's) Nuclear Reactor Laboratory (NRL) five megawatt research and test reactor continued to be operated 24 hours a day, 7 days a week, for 3-month cycles in support of educational experiments, research and service irradiations, and reactor operator training. At the end of each of the first 2 months of a cycle, the reactor was shut down for a short outage to perform surveillance testing and periodic equipment surveillances. At the end of every third month of the cycle, the reactor was shut down for approximately 1 week for maintenance, refueling, and periodic equipment surveillances. During the inspection, the reactor was in an extended shut down.

1. Organization and Staffing

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

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

- Management responsibilities
- Qualifications of facility radiation protection personnel
- MIT NRL Organization Chart, dated October 17, 2012
- Staffing requirements for operation of the research reactor
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2011 to December 31, 2011," submitted March 29, 2012

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, 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. In addition, 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, a staff Officer, an

Assistant Officer, a Project Technician, and an Administrative Assistant. The RPO, who also had the title of Deputy Director, Environment, Health, and Safety (EH&S), reported to the MIT Director of the Environment, Health, and Safety Office. The RPO was also a member of the facility Reactor Safeguards Committee. 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 Sections 7.5.1 and 7.5.2 and Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.59, the following documents were reviewed:

- Minutes of the MIT Reactor Safeguards Committee, meeting No. 101, held January 19, 2011
- Minutes of the MIT Reactor Safeguards Committee, meeting No. 102, held September 30, 2011
- Minutes of the Special Standing Subcommittee of the MIT Reactor Safeguards Committee, meeting held January 18, 2012
- Minutes of the MIT Reactor Safeguards Committee Special Subcommittee for In-Core Experiments held January 18, 2012
- MIT Administrative Procedure 1.4, "Review and Approval of Plans, Procedures, and Facility Equipment and Changes Thereto," latest revision dated June 22, 1988, with the associated Safety Review Form, latest for revision dated May 6, 2008
- MIT Administrative Procedure 1.18, "Audits," latest revision dated January 10, 1986
- Administrative Audit for the Calendar Months of October, November, and December 2011, completed March 14, 2012
- Administrative Audit for the Calendar Months of January, February, and March 2012, completed June 15, 2012
- Administrative Audit for the Calendar Months of April, May, and June 2012, completed August 20, 2012
- MITR Annual Independent Audit Report for CY 2011 dated June 28, 2012, conducted by W. Gunther on June 13-14, 2012
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2010 to December 31, 2010," submitted March 31, 2011
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory

Commission for the Period January 1, 2011 to December 31, 2011," submitted March 29, 2012

b. Observations and Findings

(1) Review and Audit Functions

The inspector reviewed the revised Reactor Safeguards Committee (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. Meeting frequency met the minimum requirements; the last full committee meeting was completed on September 30, 2011, approximately 13 months ago, which is within the grace period of the required annual frequency of the Technical Specifications.

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

No design changes or changes to equipment related to radiation protection had been made recently. However, the inspector noted that the licensee had established a design change review function. It included the screening and safety review of changes, tests, or experiments to determine if, pursuant to 10 CFR 50.59, a change required U.S. Nuclear Regulatory Commission (NRC) approval prior to being implemented. The inspector found procedures in place to control such a review process and evidence of adherence to the procedures.

The inspector reviewed the 10 CFR 50.59 evaluation (SR 0-12-21) recently completed for the analog displays on the console, which was approved on October 19, 2012. The inspector agreed with the overall conclusions of the evaluation and did not identify any violations of significance; however, the inspector identified issues related to increases in the probability of a malfunction of safety-related equipment and to the timing of the approval of the 10 CFR 50.59 evaluation and the installation work schedule. These issues did not change the overall conclusion of the 10 CFR 50.59 evaluation.

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 7.10, "Radiation Protection Program," and 10 CFR Parts 19 and 20, the inspector reviewed selected aspects of the following:

- Quarterly Landauer dosimetry reports for 2010, 2011, and to date in 2012
- Observations of facilities, equipment, operations, and postings during facility tours
- Memorandum from the RPO documenting the annual review of the radiation protection program for 2011, not dated
- Reportable Occurrence Reports, Unusual Occurrence Reports, and Operator Lessons Learned reports related to radiation protection for the past year
- MIT Administrative Procedure 1.11, "Radiation Protection Office," latest revision dated September 19, 1979
- MIT Administrative Procedure 1.12, "Radiological Training and Dosimetry Classification," latest revision dated November 9, 2004
- MIT EH&S Reactor Radiation Protection Procedure 0150, "Personnel Contamination Monitoring and Decontamination," Rev. 5, dated December 2005
- MIT EH&S Reactor Radiation Protection Procedure 0600, "Use of Protective Clothing," Rev. 5, dated December 2005
- MIT EH&S Reactor Radiation Protection Procedure 3001, "Radiological Surveys," Rev. 5, dated March 2003
- MIT EH&S Reactor Radiation Protection Procedure 3005, "Neutron Gamma Survey," Rev. 2, dated April 2000
- MIT EH&S Reactor Radiation Protection Procedure 4203, "Quarterly Operational Check of Hand and Foot Monitoring Equipment," Rev. 4, dated June 2001
- MIT EH&S Reactor Radiation Protection Procedure 4802, "Calibration Procedure for the Eberline RO-2 and RO2A Ion Chambers," Rev. 4, dated November 2002
- MIT EH&S Reactor Radiation Protection Procedure 4805, "Calibration Procedure for the Ludlum Model 2 and 3 GM Meters," Rev. 4, dated April 2002
- MIT EH&S Reactor Radiation Protection Procedure 4806, "Calibration Procedure for the Bicron RSO-5 and RSO-50 Ion Chambers," Rev. 4, dated November 2002
- MIT EH&S Reactor Radiation Protection Procedure 4814, "Calibration Procedure for the Ludlum Model 14C GM Survey Meter," Rev. 2, dated

June 2001

- MIT EH&S Reactor Radiation Protection Procedure 5002, "Primary Water Sampling and Analysis Procedure," Rev. 5, dated June 2007
- MIT EH&S Reactor Radiation Protection Procedure 6006, "Breathing Zone Air (BZA) Sampling," Rev. 1, dated February 2000
- MIT EH&S Reactor Radiation Protection Procedure 8010, "Respiratory Protection Training," Rev. 1, dated September 2000
- MIT Standard Operating Procedure 2.6, "Radiation Protection Program for the MIT Reactor and Associated Projects," latest revision dated November 7, 2011
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2010 to December 31, 2010," submitted March 31, 2011
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2011 to December 31, 2011," submitted March 29, 2012

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. Results of the surveys were typically documented on survey maps and posted at the entrances of the various areas surveyed so that facility workers and visitors would be aware of the radiological conditions that existed therein.

The inspector accompanied a radiation protection technician during completion of the daily radiation surveys. Appropriate survey techniques were used and no problems were noted.

(2) Postings and Notices

The inspector observed the copies of the notices to workers that were posted in various areas in the facility. One of the copies of NRC Form 3 posted in the facility was noted to be out of date. When this was brought to the attention of the licensee, the current version of NRC Form 3 was downloaded from the NRC website and posted as required by 10 CFR Part 19. 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 2 years 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 (mr) above background. The highest annual whole body exposure received by a single individual for 2010 was 464 mr deep dose equivalent (DDE). The highest annual extremity exposure for 2010 was 750 mr and the highest shallow dose equivalent (SDE) was 522 mr. The highest annual whole body exposure received by a single individual for 2011 was 479 mr DDE. The highest annual extremity exposure for 2011 was 1160 mr and the highest SDE was 531 mr. The highest annual whole body exposure received by a single individual for 2012, through the third quarter of the year, was 362 mr DDE. The highest annual extremity exposure through the second quarter of 2012 was 700 mr and the highest SDE was 363 mr.

The facility also collected and analyzed urine samples for Tritium (H-3) bioassay purposes. The highest attributable dose in 2010 from H-3 was 4.1 mr committed effective dose equivalent (CEDE). The highest H-3 attributable dose in 2011 was calculated to be 9.6 mr CEDE.

(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. Certain instruments were shipped to a vendor for calibration. Calibration frequency met procedural requirements and records were maintained as required. Area radiation monitors and stack monitors were also being calibrated as required. These monitors were typically calibrated by licensee staff personnel. 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 licensee indicated that a refresher course was required every 2 years. However, the training was actually given annually so that current topics could be brought up and discussed by staff members. Through records review the inspector found that the refresher training given during the first part of 2012 included topics such as the use of new equipment and the proper reporting of personal contamination.

(6) MIT As Low As Reasonably Achievable (ALARA) Program

Following a higher than expected exposure event in 2007, MITR management recognized that improvements could be made in the area of dose reduction. Consequently, greater emphasis was placed on keeping exposures ALARA. An ALARA enhancement program was initiated and an ALARA policy was formulated. A formal ALARA committee for the reactor was organized as well. ALARA goals were set and performance indicators were established. Each group in the MITR organization established an ALARA goal for the year and the facility dose was then tracked by group, as well as for each individual.

With emphasis placed on achieving the various groups' ALARA goals, the facility dose has been reduced. In 2006, the calendar year facility dose was 6.3 rem. In 2007, the yearly facility dose was 9.2 rem. In 2008, due to the establishment of aggressive ALARA goals, continued efforts on dose reduction, worker awareness, and various other improvements, the facility dose was 4.3 rem. The facility dose for 2009 was 3.1 rem. The dose for 2010 was 3.6 rem; this was due to an extended maintenance outage. Due to the success of the primary system improvements and cleanup during the outage in 2010 and the resulting dose for 2011 was 2.7 rem. The goal for 2012 has been established at 3.0 rem.

(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 (HRAs) were posted as required and properly controlled, except as noted below.

(8) Unlocked Gate to a High Radiation Area

10 CFR 20.1003 defines an HRA as an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.

10 CFR 20.1601(a) states that each licensee shall ensure that each entrance or access point to an HRA has one or more of the following features: (1) a control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a deep-dose equivalent of 0.1 rem in 1 hours at 30 centimeters from the radiation source or from any surface that the radiation penetrates; (2) a control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the HRA and the supervisor of the activity are made aware of the entry; or, (3) entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry. 10 CFR 20.1601(b) states that in the place of the controls required by 10 CFR 20.1601(a), a licensee may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

During the inspection, the inspector accompanied a senior radiation protection technician as she conducted a radiation and contamination survey of various areas around the facility. While inside the reactor containment area, the inspector noted that one area was posted as an HRA. The area was surrounded by concrete blocks about 6 feet in height that formed a wall around the area except for the entrance. An “accordion” style metal gate was located at the entrance to the area. It was also noted that a movable lead shield was located in front of the entrance to the HRA to further reduce the radiation levels coming from inside.

A survey at the entrance/gate of the HRA indicated radiation levels between 15 and 20 millirem per hour (mr/hr). While surveying this area, the inspector noted that the access to this HRA was not controlled properly, i.e., a padlock used to ensure the gate remained closed, so that no one inadvertently entered the area, was not fastened. Instead it was lying on a ledge of the concrete block wall surrounding the HRA. When this condition was pointed out to the senior technician, she immediately secured the area by locking the padlock. (Along with the immediate corrective action mentioned, it was noted that the licensee also checked all the other HRAs to ensure that they were all locked and/or alarmed as required.)

This situation was reported to licensee management and the inspector asked the licensee to determine how long the gate had been unlocked. The licensee conducted an investigation of this event and determined that the gate had apparently been unlocked since September 27, 2012. On that date, radioactive material in a barrel had been moved into the HRA and other containers inside the HRA had been moved within the area. At least one of the barrels/containers had a contact dose rate of 500 mr/hr and a reading of greater than 100 mr/hr (0.1 rem) at 30 centimeters. After the work inside the HRA was completed, no one remembered to lock the padlock so the gate could not be opened.

Following the investigation, the licensee decided to take various corrective actions to prevent recurrence, including:

- The entrance to this HRA is to be equipped with an infrared sensor that energizes a conspicuous audible alarm signal so that the individual entering the high radiation area is made aware of the entry, similar to those devices used at the entrances to other HRAs in the facility. The sensor will also activate an alarm in the Control Room.
- When the gate is unlocked, the padlock will be required to be left in the locking eyebolt such that it obstructs the complete closure of the gate.
- All HRAs in the facility will be added to a checklist to be completed by either Operations or RPO personnel each day. Each HRA will be checked to ensure that it is secured properly.
- All Radiation Protection personnel providing coverage for work in an HRA will be required to confirm that the HRA is secured properly following any activity in that area.
- Reactor Operations and Radiation Protection personnel will jointly re-assess all HRAs for improvements that can be made in maintaining the areas locked and ensuring that alarm mechanisms are working properly.

These corrective actions appeared to be appropriate and will be reviewed during a future NRC inspection. The licensee was informed that failure to maintain control of access to a high radiation area was a violation (VIO) of 10 CFR 20.1601 (VIO 50-020/2012-202-01).

c. Conclusion

The inspector determined that the Radiation Protection and ALARA Programs, as implemented by the licensee, generally satisfied regulatory requirements because: (1) surveys were generally 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. One violation was noted for failure to maintain control of the access to a high radiation area.

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 7.13.5.f and h:

- 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 EH&S Reactor Radiation Protection Procedure 4001, "Calibration and Source Check of Environmental Monitors," Rev.4, dated April 2001
- MIT EH&S Reactor Radiation Protection Procedure 4011, "Effluent and Process Radiation Monitoring System – Quarterly Calibrations," Rev.4, revision dated April 2007
- MIT EH&S Reactor Radiation Protection Procedure 4012, "Effluent and Process Radiation Monitoring System – Annual Calibrations," Rev.3, issued April 4, 2007
- MIT EH&S Reactor Radiation Protection Procedure 4201, "Annual Ar-41 Calibration," Rev.5, dated December 2002
- MIT EH&S Reactor Radiation Protection Procedure 5001, "Cooling Tower Sampling and Analysis Procedure," Rev.5, dated June 2007
- MIT EH&S Reactor Radiation Protection Procedure 6001, "Air Particulate Sampling," Rev.5, dated April 2007
- MIT EH&S Reactor Radiation Protection Procedure 6002, "Air Gas Sampling – Argon-41," Rev.5, dated December 2002
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2010 to December 31, 2010," submitted March 31, 2011
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2011 to December 31, 2011," submitted March 29, 2012

b. Observations and Findings

The inspector determined that gaseous releases continued to be monitored as required, were acceptably analyzed, and were documented in the annual operating reports in accordance with TS 7.13.5. Airborne concentrations of gaseous releases, principally Argon-41, were well within the concentrations stipulated in 10 CFR 20, Appendix B, Table 2, and TS limits. The dose rate to the public, as a result of the gaseous releases, was below the dose constraint specified in 10 CFR 20.1101(d) of 10 millirem per year. COMPLY code results indicated a calendar year (CY) annual dose to the public of 0.3 mr for 2011.

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 CY 2011 was 132 millicuries (mCi) of tritium and 0.53 mCi of all other isotopes. The predominant source was acknowledged to be the cooling tower blowdown. The concentration was below the 10 CFR 20.2003 limit with no credit for dilution due to other MIT waste streams (estimated at 2.7 million gallons per day).

Solid waste and tritiated liquid waste was shipped to a licensed, offsite disposal facility. There were no investigative studies or human therapy exposures during the year to be reported pursuant to TS 7.13.5.i.

The licensee recorded data throughout the year from five radiation monitors mounted within a quarter mile of the reactor. The data indicated that the average exposure to anyone in that area was approximately 0.1 mr for CY 2010 and 0.3 mr for CY 2011. The predominant source of that exposure was noted to be Argon-41.

c. Conclusion

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

5. Procedures

a. Inspection Scope (IP 69008)

To verify that the MIT EH&S procedures were being reviewed as required and approved as needed, the inspector reviewed selected aspects of various radiation protection procedures.

b. Observations and Findings

The inspector noted that an individual in the Reactor Radiation Protection group had been assigned the task of compiling a list of radiation protection procedures in use at the facility. The individual had completed that task and was now focused on reviewing and revising those procedures so that they reflected current implemented conditions. Management and supervisory oversight was focused on proper implementation and adherence to procedures. The inspector observed that procedures were being followed as required.

c. Conclusion

Procedures were being listed and revised as needed and implemented in compliance with license requirements.

6. Transportation

a. Inspection Scope (IP 86740)

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

- Various completed forms, including NRC Form 540, "Uniform Low Level Radioactive Waste Manifest," for 2010 and 2011
- Various completed forms associated with the spent fuel shipment that occurred during the week of the inspection, including: radiation and contamination surveys, supervisory checklist, Loading of the BRR [BEA Research Reactor] Cask form, Fuel Element Transfers from Spent Fuel Pool to BRR Cask with the associated transfer documentation, BRR Cask Vacuum Drying and Helium Leak Test with BRR Package data sheet, and documentation of the BRR gasket certification
- MIT Administrative Procedure 1.19, "Receiving, Storing, and Issuing of NRL Materials," latest revision dated May 20, 2004
- MIT EH&S Reactor Radiation Protection Procedure 1101, "Receipt of Radioactive Material," Rev. 5, dated November 2002
- MIT EH&S Reactor Radiation Protection Procedure 1102, "Receipt and Handling of New Fuel," Rev. 5, latest revision dated November 2002
- MIT EH&S Radiation Protection Program, Required Procedures for Radiation Protection Procedure, Section III-H, "Transportation of Radioactive Material," Seventh Edition (interim), latest revision dated January 2006
- MIT Standard Operating Procedure 2.7, "Fuel Handling," latest revision dated November 7, 2011
- "2011 DOT Shipping Audit," completed by a Senior Reactor Operator on March 6, 2012
- MITR Annual Independent Audit Report for CY 2011, dated June 28, 2012
- Certificate of Compliance for Radioactive Material Package, Certificate Number 9341, Rev. 2, dated August 22, 2011, Docket No. 71-9341, Package Identification Number USA/9341/B(U)F-96
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2010 to December 31, 2010," submitted March 31, 2011
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period January 1, 2011 to December 31, 2011," submitted March 29, 2012

b. Observations and Findings

On Tuesday and Wednesday of the week of the inspection, the inspector observed the preparations for, and the shipment of, spent nuclear fuel from the facility. Through direct observation and review of shipping records, the inspector

determined that all required actions were completed in accordance with licensee's procedures and the regulations. The spent fuel was placed in the BRR shipping cask and the cask was vacuum-dried, surveyed, and leak tested. The leak testing was conducted by personnel from the Idaho National Laboratory. The cask was then fitted with the impact limiters and transferred to the Tri-State Motor Transit (TSMT) truck trailer. Following the required truck and cask surveys, the shipping papers were filled out with the required information. The appropriate labels were affixed to the cask and the proper placards were placed on the trailer. As the TSMT tractor and trailer left the licensee's parking lot, personnel from the Cambridge Police Department, the Cambridge Fire Department, and Massachusetts State SWAT and Police provided escort and traffic control for the shipment. All these activities were well coordinated through the licensee with assistance from a representative of Secured Transportation Service. No problems were noted.

In addition to the spent fuel shipment, through records review and discussions with licensee personnel, the inspector determined that the licensee had also 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. Like the spent fuel shipment documents, the radioactive material shipment records of these other materials had been completed in accordance with Department of Transportation (DOT) and NRC regulations. It was noted that the Operations Group completed the majority of the shipments but that no formal procedure existed for making shipments.

The inspector also verified that the licensee maintained copies of consignees' licenses to possess radioactive material as required and that the licenses were verified to be current prior to initiating a shipment. 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. Generally all the training was current.

c. Conclusion

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

7. Exit Briefing

The inspection scope and results were summarized on October 25, 2012, 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
D. Cormier	Senior Technician, Reactor Radiation Protection Office, EH&S
J. Foster	Superintendent of Reactor Operations
E. Lau	Associate Director, Reactor Operations
W. McCarthy	Reactor Radiation Protection Officer and Deputy Director, Environment, Health, and Safety Office, MIT
D. Moncton	Director, Nuclear Reactor Laboratory
T. Newton	Director of Reactor Operations
J. Quattrochi	Staff Officer, Reactor Radiation Protection Office, EH&S
P. Same	Reactor Supervsor
S. Tucker	Quality Assurance Supervisor
M. Young	Administrative Officer

Other Personnel

F. Burress	Driver, Tri-State Motor Transit Company
L. Burress	Driver, Tri-State Motor Transit Company
M. Galanek	MIT Campus Radiation Safety Officer and Assistant Director, EH&S Office
T. Rossi	NDE Leak Tester, Idaho National Laboratory
G. Selders	Quality Inspector, Idaho National Laboratory

INSPECTION PROCEDURES USED

IP 69004	Class 1 Research and Test Reactor Effluent and Environmental Monitoring
IP 69005	Class 1 Research and Test Reactors Experiments
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 69008	Class 1 Research and Test Reactor Procedures
IP 69012	Class 1 Research and Test Reactor Radiation Protection
IP 86740	Transportation of Radioactive Materials

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened:

50-020/2012-202-01	VIO	Failure to maintain control of access to a high radiation area as required by 10 CFR 20.1601.

Closed:

None

LIST OF ACRONYMS USED

10 CFR	Title 10 of the *Code of Federal Regulations*
ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Reasonably Achievable
BRR	BEA Research Reactor
CEDE	Committed effective dose equivalent
CY	Calendar Year
DDE	Deep dose equivalent
DOT	Department of Transportation
EH&S	Environmental Health and Safety
HRA	High Radiation Area
IP	Inspection Procedure
mCi	Millicurie
MIT	Massachusetts Institute of Technology
MITR	Massachusetts Institute of Technology Reactor
mr	Millirem
mr/hr	Millirem per hour
No.	Number
NRC	U.S. Nuclear Regulatory Commission
NRL	Nuclear Reactor Laboratory
OSL	Optically stimulated luminescent
PARS	Publicly Available Records
Rev.	Revision
RPO	Radiation Protection Officer
RSC	Reactor Safeguards Committee
SDE	Shallow dose equivalent
TS	Technical Specification
TSMT	Tri-State Motor Transit
VIO	Violation