

March 26, 2012

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

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – NRC ROUTINE
INSPECTION REPORT NO. 50-020/2012-201

Dear Dr. Newton:

On March 12-15, 2012, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted an inspection at the Massachusetts Institute of Technology Research Reactor facility (Inspection Report No. 50-020/2012-201). The enclosed report documents the inspection results, which were discussed on March 15, 2012, with you and other 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 selected procedures and records, observed activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

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

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

Sincerely,
/ Plsaac for RA/

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

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

Enclosure: NRC Inspection Report No. 50-020/2012-201
cc: See next page

Massachusetts Institute of Technology

Docket No. 50-020

cc:

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City Hall
Cambridge, MA 02139

Department of Environmental Protection
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Boston, MA 02108

Mr. Robert Gallagher, Acting Director
Radiation Control Program
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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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*** concurrence via e-mail**

TEMPLATE #: NRC-002

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| DATE | 3/22/2012 | 3/22/2012 | 3/26/2012 |

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

Docket No.: 50-020

License No.: R-37

Report No.: 50-020/2012-201

Licensee: Massachusetts Institute of Technology

Facility: Nuclear Reactor Laboratory

Location: Cambridge, Massachusetts

Dates: March 12-15, 2012

Inspector: Craig Bassett

Accompanied by: Jonathan Fiske, NSPDP Program Assignee

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

EXECUTIVE SUMMARY

Massachusetts Institute of Technology
Nuclear Reactor Laboratory
NRC Inspection Report No.: 50-020/2012-201

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 and test reactor safety program including: 1) organization and staffing, 2) review and audit and design change functions, 3) reactor operations, 4) operator requalification, 5) maintenance and surveillance, 6) fuel handling, 7) experiments, 8) procedures and procedural control, and 9) 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.

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 being completed as required.
- The design change program satisfied NRC requirements

Reactor Operations

- Reactor operations were conducted in accordance with procedure and the appropriate logs were being maintained.
- Various daily and weekly meetings were held to ensure proper communication of, and planning and preparation for, operations activities.

Operator Requalification

- Operator requalification was conducted as required by the Requalification Program and the program was generally 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 appeared to be 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.
- Emergency response equipment was being maintained and inventoried as required.
- The Letters of Agreement between the licensee and the City of Cambridge Fire, Police, and Emergency Management Departments, as well as between the licensee and the Massachusetts General Hospital, were being maintained.
- Emergency drills were being conducted annually as required by the Emergency 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, the licensee) Nuclear Reactor Laboratory (NRL) six megawatt (MW) research and test reactor continued to be operated in support of experiments, research and service irradiations, reactor operator training, and periodic equipment maintenance and surveillance activities. The reactor is typically operated approximately 300 days per year with operations running 24 hours a day, 7 days a week, for about four weeks followed by a shutdown varying from 8 hours to two weeks in length. During the inspection, the reactor was operated continuously to support ongoing experiments and material irradiation.

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 and staffing to ensure that the requirements of Technical Specification (TS) Section 7.1, "Organization," Revision (Rev.) 6, implemented through renewed Facility Operating License R-37, issued November 1, 2010, were being met:

- Management responsibilities
- Qualifications of facility operations personnel
- MIT NRL Organization Chart, dated March 2012
- Reactor Logbook #123, February 22, 2011, to July 6, 2011
- Reactor Logbook #124, July 6, 2011 to November 29, 2011
- Reactor Logbook #125, November 29, 2011 to the present
- Staffing requirements for reactor operation stated in TS Section 7.1.3
- Procedure Manual (PM) 1.1, "Organization," which included:
 - PM 1.1.2, "Reactor Division," latest revision dated January 30, 1984
 - Table 1.1.2-1, "Reactor Division," latest revision dated April 13, 2009
- "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 to the NRC on March 31, 2011

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 Assistant Director of Operations and Requalification Program Coordinator, the Superintendent of Operations, an Assistant Superintendent of Operations and Training Supervisor, a Quality Assurance Supervisor, and various Reactor Supervisors, and Reactor Operators (ROs). The Director of Reactor Operations, the Assistant Director of Reactor Operations, the Superintendent of Operations, the Assistant Superintendent, the Quality Assurance Supervisor, the Training Coordinator, and the majority of the Reactor Supervisors were qualified Senior Reactor Operators (SROs). It was noted that about one-half of the Reactor Supervisor and one-third RO positions were full-time while the others were part-time positions (mostly students). 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 February 2011 through the present, and through interviews with operations personnel, the inspector determined that the licensee continued to operate 24/7 with three crews and no shift rotation. There were also those personnel who worked primarily on the weekends. 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 Section 7.1.3.

c. Conclusion

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

2. Review and Audit and Design Change Functions

a. Inspection Scope (IP 69007)

To verify that the required reviews and audits were being completed by the MIT Reactor Safeguards Committee as required by TS Sections 7.2.2 and 7.2.3 and to ensure that facility changes were reviewed and approved as required by TS Section 7.2.2 and in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.59, the inspector reviewed selected aspects of:

- Annual Independent Audits conducted in 2010 and 2011
- Administrative Audits for the Calendar Months of January, February, and March; April, May and June; July, August, and September 2011; and, October, November, and December 2011
- MIT Reactor Safeguards Committee meeting minutes for 2010 through the present

- Meeting minutes for 2010 through the present of the MIT Reactor Safeguards Committee Standing and Special Subcommittees (including the Special Subcommittee for In-Core Experiments, the Special Subcommittee for Security, and the Special Subcommittee for LEU Conversion)
- PM 1.1, "Organization," which included Section 1.1.1 "MIT Administration and Committees," latest revision dated March 18, 1991
- PM 1.4, "Review and Approval of Plans, Procedures and Facility Equipment and Changes Thereto," which included an example of the Safety Review Form, latest revision dated May 6, 2008
- PM 1.10, "Experiment Review and Approval," which included Section 1.10.2, "MIT Reactor Safeguards Committee," latest revision dated March 11, 1988
- PM 1.18, "Audits," which included:
 - Section 1.18.1, "Internal Audits," latest revision dated January 10, 1986
 - Section 1.18.2, "Independent Audits," latest revision dated September 18, 1984
- Safety Review Form No. M-11-5, "Pressure Relief System Upgrade," dated October 7, 2011
- Safety Review Form No. O-02-8, "Annular Fuel Irradiation Experiment," dated February 27, 2004
- Safety Review Form No. O-10-7, "New License Compliance – PM 2.1 through 2.8, Standard Operating Procedures," dated December 19, 2011
- Safety Review Form No. O-11-7, "Loss of City Water Pressure Alarm and Scram," dated July 28, 2011
- "Summary Report for the HYdride Fuel Irradiation (HYFI) Experiment in the MITR-II," dated September 2010, which indicated that the HYFI experiment was within the envelope of the Advanced (*sic*) Fuel Irradiation (AFI) experiment dated 2004
- "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 to the NRC on March 31, 2011

b. Observations and Findings

(1) Review and Audit Functions

The composition of the MIT Reactor Safeguards Committee (MITRSC) and qualifications of MITRSC members were as specified in TS 7.2.1.1. Minutes of MITRSC meetings and those of the MITRSC Standing and Special Subcommittees demonstrated that the committee typically met more often than the frequency required by the TS. Through records review the inspector determined that safety reviews were conducted by the MITRSC or by designated Subcommittee representatives as specified in TS 7.2.2. Topics of those reviews were as required by the TS and

provided sufficient guidance, direction, and oversight to ensure acceptable use of the reactor.

Quarterly Administrative Audits and Annual Independent Audits were conducted by management and independent auditors respectively. The inspector noted that the quarterly audits for 2011 and the annual independent audits for Fiscal Year (FY) 2010 and Calendar Year (CY) 2010 were adequate and audited the activities specified in TS 7.2.3 including various aspects of the reactor facility operations and programs. It was noted that the audits had been completed by qualified individuals as required. The audits appeared to be adequate and included recommendations concerning potential improvements to the program. The licensee responded to each audit, if required, and took corrective actions as needed.

(2) Design Change Functions

To satisfy the regulatory requirements stipulated in 10 CFR 50.59, "Changes, tests, and experiments," the licensee had implemented facility procedure, PM 1.4, "Review and Approval of Plans, Procedures, and Facility Equipment and Changes Thereto." The inspector verified that the procedure adequately incorporated criteria provided by the regulations with additional requirements mandated by local conditions.

The inspector noted that all proposed facility plans, procedures, and equipment changes were classified into three categories, Class A, Class B, or Class C. Class C changes were those of less significance and were required to be reviewed and approved by Senior Shift Supervisors and a Group Supervisor. Class B changes were those that required the review and approval of two licensed SROs and the Director of Reactor Operations before implementation. Depending upon the nature of the change or modification, Class B changes might also require a review by the Radiation Protection group and were typically submitted to the MITRSC for information. Class A changes were significant/major changes involving procedures and/or equipment related to the reactor and related systems, the Emergency Plan, the Operator Requalification Program, or the security system. They typically required a review by the Radiation Protection group, as well as all the reviews and approvals noted above. In addition, these types of changes also required the review and approval of the MITRSC before implementation. Class A changes also included those that required a change to the license or TS, and thus, would require review and approval by the NRC.

The inspector reviewed selected Safety Review Forms and the associated safety evaluation documents of reviews conducted in 2004 through 2011. The completed forms showed that the proposals were acceptably reviewed in accordance with the procedure. It was noted that none of the recent proposals were designated as Class A and therefore did not require formal MITRSC approval. Also, none of the changes was

determined to constitute a safety question or concern and none required a license or TS amendment.

c. Conclusion

The MITRSC was meeting as required and reviewing the topics outlined in the TS. Quarterly and annual audits of facility programs were conducted as required. The facility design change program satisfied NRC requirements.

3. 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 Logbook #123, February 22, 2011, to July 6, 2011
- Reactor Logbook #124, July 6, 2011 to November 29, 2011
- Reactor Logbook #125, November 29, 2011 to the present
- PM 1.7, "Shift and Relief Turnover," latest revision dated September 19, 1979
- PM 1.8, "Reactor Operating Logs," latest revision dated January 31, 1985
- PM 2.3, "Reactor Startup Procedure," which included PM 2.3.1, "Normal Reactor Startup," latest revision dated November 7, 2011
- PM 2.4, "Continuous Power Operation," which included PM 2.4.1, "Full-Power Operation," latest revision dated November 7, 2011
- PM 2.5, "Reactor Shutdown Procedure," which included PM 2.5.1, "Normal Reactor Shutdown Procedure," latest revision dated November 7, 2011
- PM 3.1, "Startup Checklists," which included:
 - PM 3.1.1, "Full Power Start-up Checklist," latest revision dated July 7, 2011
 - PM 3.1.6, "Restart Following an Unanticipated or Brief Scheduled Shutdown," latest revision date June 27, 2011
 - PM 3.1.1.4, "Surveillance- Two Loop Restart Incorporating Monthly Startup Surveillance," dated June 24, 2011
- PM 3.2, "Shutdown Checklists," which included PM 3.2.1, "Shutdown from Operations at Power," latest revision dated June 22, 2011
- PM 3.5, "Daily Surveillance Check," latest revision dated February 8, 2011
- PM 5.0, "Abnormal Operating Procedures," latest revision dated December 8, 2011
- "MIT Reactor Operating Data Log," latest revision March 20, 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 to the NRC on March 31, 2011

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 (“taking logs”). 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 attended operations crew shift turnover meetings on Tuesday and Wednesday evening. The status of the reactor and the facility was discussed on each occasion as required. The Reactor Supervisors of the relief shifts were briefed on the upcoming shift activities and scheduled events before assuming the operations duty. Through direct observation and records review, the inspector verified that the content of shift turnover briefings held during each shift change was appropriate and that shift activities and plant conditions were discussed in sufficient detail.

c. Conclusion

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

4. Operator Licensing, Requalification and Medical Activities

a. Inspection Scope (IP 69003)

To verify that the licensee was complying with the requirements of 10 CFR Part 55, TS Section 7.2.3.b), and Chapter 12, Sections 12.1 and 12.10 of the facility Safety Analysis Report, the inspector reviewed selected aspects of:

- Current status of operator licenses
- Reactor Logbook #123, February 22, 2011, to July 6, 2011
- Reactor Logbook #124, July 6, 2011 to November 29, 2011
- Reactor Logbook #125, November 29, 2011 to the present
- Results of the 2010 and 2011 Annual Written Examinations
- Reactor operator files maintained in the Operations Office
- Medical examination records for selected operators for the past three years
- “On-the-Job-Training Notebook, Book 1,” documenting reactivity manipulations completed by those operators whose last names began with A through Le

- “On-the-Job-Training Notebook, Book 2,” documenting reactivity manipulations completed by those operators whose last names began with Lu through Y
- PM 1.16, “Requalification and Qualification,” which included:
 - Section 1.16.1, “Requalification Program for Licensed Personnel,” latest revision dated March 11, 1988
 - Section 1.16.2, “MITR Operations Qualification Program for Senior Reactor Operators/Shift Supervisors,” latest revision dated May 6, 2004
 - Section 1.16.3, “MITR Operations Qualification Program for Operators,” latest revision dated May 6, 2004

b. Observation and Findings

There were 27 individuals licensed to operate the reactor at MIT. Of those personnel, 15 were qualified SROs and 12 were ROs. A review of various Requalification Program records indicated that the program was maintained up-to-date and that RO and SRO licenses were current. MITR-II operator files and Reactor Logbooks also showed that 24 of the 27 operators maintained active duty status. A review of the MITRSC meeting minutes and independent audit results indicated that the program was being audited annually as required by TS Section 7.2.3.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 two 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. Records indicating the completion of annual supervisory observations and evaluations for each operator were also maintained. The inspector also noted that all operators were receiving biennial medical examinations within the time frame allowed as required by the program.

As indicated above, three SROs’ licenses were “inactive.” This was due to the fact that those individuals had limited time to complete the reactivity manipulations and other required activities or, in one case, the individual was not currently being on site. However, one of the operators who was onsite was still completing the annual written exams and having biennial medical examinations as required. By completing the written exams and by having the biennial medical examinations, the person’s license could be reinstated to “active” if needed. This reactivation would be accomplished by requiring that the operator complete any training that they had missed and conduct the required number of manipulations and other activities under the supervision and observation of a Reactor Supervisor.

c. Conclusion

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

5. Maintenance and Surveillance

a. Inspection Scope (IP 69006, 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:

- MITR-II Job Workbook
- MITR-II Daily Operations Schedule
- Reactor Logbook #123, February 22, 2011, to July 6, 2011
- Reactor Logbook #124, July 6, 2011 to November 29, 2011
- Reactor Logbook #125, November 29, 2011 to the present
- MITR-II Notebook, "Systems, Tests, and Calibrations, Volume 1 of 3," containing documentation of tests and/or calibrations associated with PM 6.1.1 through PM 6.1.5.5
- MITR-II Notebook, "System Tests and Calibrations, Volume 2 of 3," containing documentation of tests and/or calibrations associated with PM 6.2.1 through PM 6.4.2.4,
- MITR-II Notebook, "System Tests and Calibrations, Volume 3 of 3," containing documentation of tests and/or calibrations associated with PM 6.5.1 through PM 7.4.4.2
- PM 6.1, "Technical Specification Tests," which included PM 6.1.1, "Emergency Cooling System," latest revision dated September 21, 2011
- PM 6.1.3, "Calibrations," which included: PM 6.1.3.6, "Building Overpressure Scram," latest revision dated September 21, 2011
- PM 6.6, "Radiological Emergency Exercise," which included PM 6.6.2.4, "Inventory of Emergency Supplies and Equipment," April 13, 1999
- Surveillance activities and equipment maintenance documented on the 2010 Test and Calibration Tracker forms, the 2011 Test and Calibration Tracker forms, and the 2012 Test and Calibration Tracker forms
- "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 to the NRC on March 31, 2011

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. Also, all these activities were discussed and coordinated through the morning meeting held each day during outages when most of the maintenance was performed. 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. As noted above, the "Test and Calibration Tracker" system was used to track completion of a majority of the required surveillances and verifications. The inspector noted that completion of these surveillance activities outlined in the "Tracker" system was documented in one of the three MITR-II "Systems, Tests, and Calibrations" notebooks. These notebooks listed who completed the surveillances and could be used to reference the checklists and associated forms used for the reactor operational tests and surveillances. Other forms were used to document those surveillances that were not in the "Tracker" system. 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 appeared to be adequate and was being maintained as required. Maintenance and surveillance records, performance, and reviews satisfied TS and procedure requirements.

6. Fuel Movement and Handling

a. Inspection Scope (IP 69009)

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

- Reactor Logbook #123, February 22, 2011, to July 6, 2011
- Reactor Logbook #124, July 6, 2011 to November 29, 2011
- Reactor Logbook #125, November 29, 2011 to the present

- PM 1.15 “Refueling,” which included PM 1.15.1 “Removal of Spent Fuel,” latest revision dated October 27, 1989
- PM 3.3, “Movement of Fuel,” which included PM 3.3.1, “General Conduct of Refueling Operations,” latest revision dated January 10, 1994
- PM 3.3.1, “General Conduct of Refueling Operations,” which included PM 3.3.1.1, “Fuel Element Transfers: Core/Storage Ring/Vault,” latest revision dated April 22, 1980
- PM 3.3.2, “General Conduct of Removal of Spent Fuel,” which included PM 3.3.2.1, “Fuel Element Transfers: Storage Ring/Storage Vault,” latest revision dated July 28, 1981
- Approved packets for Core Configuration Nos. 204, 204i1, 204i2, 205, and 205A, including:
 - “Fuel Loading Permission” Form (form revision dated September 19, 1979) – completed for fuel element transfers on January 5, January 30, February 2, and February 7, 2011
 - “Fuel Removal Permission” Form (form revision dated July 21, 1981) – completed for the fuel element transfers associated with Core No. 204
 - “Transfer Schedule” Form (form revision dated September 19, 1979) – completed for the fuel element transfers associated with Core Nos. 204, 204i1, 204i2, 205, and 205A
 - “Core Configuration” Form (form revision dated October 27, 1989) – completed for Core Nos. 204, 204i1, 204i2, 205, and 205A
 - “Fuel Loading Verification” Form (form revision dated September 19, 1979) – completed for Core No. 205A
 - “Safety and Operating Limits for Core No. 198,” no date listed
 - “Elements with a 30% Excess Loading over 20-22 inches” for Core Nos. 204 and 205A
 - “Elements with a 30% Excess Loading over 2-4 inches” for Core Nos. 204 and 205A
 - “Reactivity Change for Core No.205A” Form (form revision dated September 19, 1979) – completed February 10, 2011

b. Observations and Findings

The inspector reviewed the fuel movement process and verified that fuel moves were designed according to established procedure and documented on specific fuel movement sheets developed by the Interim Director of Reactor Operations. The inspector reviewed selected fuel movement sheets for 2011 and to date in 2012. They had been developed and used for each specific core refueling as required.

The inspector reviewed the preparations for, and follow-up to, the refueling activities recorded in the reactor logbook that occurred during January and February 2011. The resultant final “new” core was designated as Core No. 205A. The core design and fuel moves to achieve the new configuration were developed in a systematic manner using an approved computer code. The core configuration package was approved and subsequently used by reactor operators, in addition to the routine procedures, for completing the fuel moves.

The inspector noted that fuel moves had been completed as specified and that fuel removed from the core was placed in specified locations meeting the requirements of TS 3.1.4. The inspector also compared the location of fuel elements in the reactor core as indicated on the fuel movement/transfer forms for the latest core with the information maintained on the MITR-II Fuel Status/Location Board in the Control Room. No problems or anomalies were noted.

c. Conclusion

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

7. Experiments

a. Inspection Scope (IP 69005)

To verify compliance with the licensee's procedures, TS Sections 6 and 7.5, and 10 CFR 50.59, the inspector reviewed:

- Reactor Logbook #123, February 22, 2011, to July 6, 2011
- Reactor Logbook #124, July 6, 2011 to November 29, 2011
- Reactor Logbook #125, November 29, 2011 to the present
- Experiment Review Process documented in PM 1.10, "Experiment Review and Approval," which included PM 1.10.7, "Records," latest revision dated March 11, 1988, including:
 - "MIT Part I – Irradiation Request Form"
 - "MIT Part II – Irradiation Information Form"
- Quality Assurance Process documented in PM 1.13, "Quality Assurance Program," latest revision dated January 31, 1985
- MIT Part I – Irradiation Request Form, MITR Reference (Ref.) No. 128-2, concerning irradiation of Teflon samples and Fly Ash in quartz vials and examples of the associated MIT Part II – Irradiation Information Forms for irradiations completed during December, 2011
- MIT Part I – Irradiation Request Form, MITR Ref. No. 132-1, concerning irradiation of gold seeds encapsulated in platinum and examples of the associated MIT Part II – Irradiation Information Forms for irradiations completed from August through September, 2011
- MIT Part I – Irradiation Request Form, MITR Ref. No. 71-3, concerning irradiation of metal pellets in a polyethylene bag and vial and examples of the associated MIT Part II – Irradiation Information Forms for irradiations completed during September, 2011
- MIT Part I – Irradiation Request Form, MITR Ref. No. 55-28, concerning irradiation of cerium oxide powder samples in quartz vials and examples of the associated MIT Part II – Irradiation Information Forms for irradiations completed during September, 2011
- Safety Review Form No. M-09-2, concerning "High Temperature Sample Capsules for Use in the In-Core Sample Assembly (ICSA)," dated

December 11, 2009, and approved by the MIT In-Core Experiment Subcommittee, dated September 22, 2009

- Safety Review Form No. O-11-4A, concerning "Procedure HYFI-4, Hydride Fuel Irradiation Experiment Gas Sampling Procedures," dated July 18, 2011, and approval dated July 19, 2011

b. Observations and Findings

The inspector noted that the review and approval process described in PM 1.10 referred to experimental facilities and equipment installed in the reactor. This was an extensive process and typically involved the completion of a Safety Review Form with accompanying documentation. These Safety Review Forms were reviewed by Reactor Operations personnel (typically the Superintendent of Reactor Operations) and by the Reactor Radiation Protection Officer and ultimately submitted to the MITRSC for review and approval. The review and approval of samples of material to be irradiated using these facilities or equipment were required to be completed by the Reactor Supervisor and the Reactor Radiation Protection Officer. These reviews were documented on the MIT Part I – Irradiation Request Forms (IRFs). Typically the Superintendent of Reactor Operations also reviewed these forms. MIT Part II forms were used to document the irradiation data such as length of irradiation, etc.

The inspector reviewed selected Safety Review Forms and IRFs 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.

8. Procedures

a. Inspection Scope (IP 69008)

To verify that the licensee was meeting the requirements of TS Section 7.4, "Procedures," the inspector reviewed selected aspects of:

- PM 1.1, "Organization," which included PM 1.1.1, "MIT Administration and Committees," latest revision dated March 18, 1991
- PM 1.1.2, "Reactor Division," latest revision dated January 30, 1984, which included PM 1.1.2.7, "Reactor Utilization Supervisor," latest

- revision dated January 1, 1982
- 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 September 3, 1998
 - PM 1.4.5, "Safety Review Form," latest revision dated June 22, 1988
 - PM 1.4.6, "Procedure Manuals," latest revision dated June 22, 1988
- PM 1.5, "Procedure Adherence and Temporary Change Method," latest revision dated September 19, 1979

b. Observations and Findings

The inspector noted that procedures had been developed for reactor operations and safety as required by the TS Section 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 noted that all the Abnormal Operating Procedures had recently been reviewed and updated.

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 being developed, revised, and implemented in compliance with license requirements.

9. Emergency Preparedness

a. Inspection Scope (IP 69011)

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

- Training records for MITR Support Personnel
- Review and Critique of the 2010 Medical Emergency Drill conducted August 20, 2010 (actual event)

- Review and Critique of the 2010 Radiological Emergency Exercise conducted August 19, 2010
- Review and Critique of the 2011 Medical Emergency Drill conducted January 6, 2012 (actual event)
- Review and Critique of the 2011 Radiological Emergency Exercise conducted December 21, 2011
- PM 4.0, "MITR-II Emergency Plan and Procedures," which included:
 - PM 4.3, "Organizations and Responses," latest revision dated January 31, 2006
 - PM 4.4, "Emergency Classification System," latest revision dated April 30, 1997
 - PM 4.5, "Emergency Action Levels," latest revision dated April 30, 1997
 - PM 4.6, "Emergency Planning Zone," latest revision dated April 30, 1997
 - PM 4.7, "Emergency Response," latest revision dated January 31, 2006
 - PM 4.8, "Emergency Facilities and Equipment," latest revision dated April 30, 1997
 - PM 4.9, "Recovery," latest revision dated April 30, 1997
 - PM 4.10, "Maintenance of Emergency Preparedness," latest revision dated April 30, 1997
 - PM 4.0, "MITR-II Emergency Plan and Procedures," Appendix A, "Agreements with Civil Authorities and Hospitals," letters dated June 3, 2011
- PM 4.4.4, "Emergency Operating Procedures," which included:
 - PM 4.4.4.10, "Medical Emergency," latest revision dated July 27, 1984
 - PM 4.4.4.11, "NW12 Evacuation," latest revision dated April 30, 1997
 - PM 4.4.4.12, "Reactor Containment Evacuation," latest revision dated September 30, 1998
 - PM 4.4.4.13, "Reactor Reentry," latest revision dated November 29, 1993
 - PM 4.4.4.14, "Excess Radiation at the Exclusion Area (Site) Boundary Resulting from a Contained Source," latest revision dated April 30, 1997
 - PM 4.4.4.15, "Escape of Airborne Radioactive Material from the Containment Building," latest revision dated April 30, 1997
 - PM 4.4.4.16, "Instructions to the MIT Campus Police During MIT Reactor Radiological Emergencies," latest revision dated April 4, 1994
- PM 4.4.4.14, "Excess Radiation at the Exclusion Area (Site) Boundary Resulting from a Contained Source," which included the "MIT Reactor Emergency Notification List," latest revision dated September 29, 2011
- PM 6.6.1, "Emergency Plan Exercises, Drills, and Tests," which included
 - PM 6.6.1.1, "Radiological Emergency Exercise," latest revision dated October 11, 1984

- PM 6.6.1.3, "Medical Emergency Drill," latest revision dated January 9, 1984
- PM 6.6.1.4, "Communication Link Test," latest revision dated January 9, 1984
- PM 6.6.2, "Emergency Plan Maintenance," which included
 - PM 6.6.2.1, "Fire Extinguishers," latest revision dated January 26, 2000
 - PM 6.6.2.2, "Self-Contained Breathing Devices," latest revision dated February 19, 1987
 - PM 6.6.2.3, "Calibration of Portable Health Physics Instruments and Dosimeters," latest revision dated January 9, 1984
 - PM 6.6.2.4, "Inventory of Emergency Supplies and Equipment," latest revision dated April 13, 1999

b. Observation and Findings

The inspector reviewed the Emergency Plan (E-Plan) and Implementing (also known as Emergency) 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. It was noted that the licensee was in the process of revising the E-Plan and the Implementing/Emergency Procedures so that changes necessitated by the new TS could be incorporated.

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. Training for City of Cambridge Fire Department (CCFD) personnel was completed periodically with the last training conducted in September 2011.

Emergency training for MIT Police Department (PD) personnel was required to be conducted annually by E-Plan Section 4.10.1.1. When the inspector reviewed the training, it was noted that the most recent training had been completed on various days during September 2011.

The inspector verified that Letters of Agreement (LOA) with the City of Cambridge Fire Department and Police Department, as well as the LOA with the Massachusetts General Hospital, were on file and being maintained. It was noted that the agreements with the Fire Department and Police Department were signed in January and February of 2011 respectively. The LOA with the hospital had been updated and signed on June 3, 2011.

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 generally being inventoried quarterly as required.

The inspector verified compliance with the E-Plan 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.

The inspector, the MITR Assistant Director of Operations, and the MITR Quality Assurance Supervisor visited one of the CCFD fire stations, met with various personnel there, and observed some of the equipment that would be used in response to an emergency at the MITR facility. During the tour of the fire station, it was noted that the CCFD maintained more than a sufficient amount of equipment to respond to any fire emergency at the MITR. It was noted that there appeared to be a good working relationship between licensee and CCFD personnel.

c. Conclusion

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

10. Follow-up on Previously Identified Items

a. Inspection Scope (IP 92701)

The inspector reviewed the actions taken by the licensee in response to various previously identified Inspector Follow-up Items (IFIs).

b. Observations and Findings

- (1) IFI 50-020/2011-201-01 - Follow-up on the issue of the licensee documenting the fact that Class A changes were submitted to the MITRSC prior to implementation.

During an inspection of the MITR-II facility in May 2011, the inspector reviewed the MITRSC review function per Section 7.2.2.1 of the TS and requested the licensee provide validation that Class A changes were submitted to the MITRSC for review prior to being initiated. The licensee indicated that this was done but it was not well documented. The licensee was informed that the issue of documenting the fact that Class A changes were submitted to the MITRSC prior to implementation would be considered by the NRC as an Inspector Follow-up Item (IFI) and would be reviewed during a future inspection.

During this inspection, the licensee provided the inspector with a memorandum to the MITRSC from the Director of Reactor Operations. The memo indicated that proposed changes that required an MITRSC

review were only those that involved equipment having safety significance as determined by the Safety Review process outlined in Section 12 of the facility Safety Analysis Report (SAR). In that process, changes identified as being outside the envelope of those previously approved would be reviewed by the MITRSC prior to implementation. Those changes identified as having safety significance but inside the envelope of previous approvals would be subsequently reviewed by the MITRSC as part of the annual report. It was also noted that those changes requiring MITRSC review prior to implementation were also identified in the Quarterly Audits conducted by Operations staff members. The inspector verified that the process was being followed as outlined. This IFI is considered closed.

- (2) IFI 50-020/2011-201-03 - Follow-up on the licensee's long term issue of determining the maximum concentration of hydrogen in the space above the core.

During the inspection of the MITR-II facility in May 2011, the inspector reviewed the licensee's corrective actions following a core purge blower problem. One corrective action taken in response to the problem had not been completed because it was a long-term item. At the time of that inspection the licensee was in the process of determining the possible maximum hydrogen concentration levels that could accumulate in the air space above the core under varying conditions. The long-term issue of determining the maximum concentration of hydrogen in the space above the core was identified by the NRC as an IFI.

During this inspection, the inspector discussed this issue with the licensee. It was noted that the licensee had made various attempts to determine the extent of hydrogen buildup in the core purge space but the process was very difficult because the core purge blower could not be isolated for a significant amount of time without violating the facility TS. In one test, the hydrogen concentration buildup in the core purge space was measured to be no more than two percent (2%) with the reactor power at 5.5 MW and the space isolated for approximately 16 minutes. However, the licensee was in the process of taking other measurements and no definitive conclusion had been reached. This IFI remains open.

- (3) IFI 50-020/2011-201-04 - Follow-up on the licensee's actions to implement the revised operator requalification program.

During the inspection in May 2011, it was also noted that the facility was issued a renewed Facility Operating License R-37, on November 1, 2010. The Operator Requalification Program was described in Chapter 12 of the accompanying Safety Analysis Report (SAR). That Chapter indicated that the program would consist of various portions including: 1) lectures and reviews, 2) on the job training (i.e., conduct of reactivity manipulations, participation in emergency drills and exercises, and emergency and abnormal procedures reviews), 3) a biennial written

examination, 4) an annual walk-through examination, and 5) a biennial medical examination.

During this inspection, the inspector noted that the licensee had taken various steps to fully implement the revised requalification program. The responsibility for tracking the completion of the various aspects of the program was assigned to the Assistant Director of Reactor Operations. In addition, various new forms had been developed to ensure that all licensed operators completed all aspects of the program. A thorough review of the current program indicated that adequate progress has been made and the program is being conducted as outlined. This IFI is considered closed.

c. Conclusion

As a result of the inspection, two IFIs were closed; one IFI remains open.

11. Exit Interview

The inspection scope and results were summarized on March 15, 2012, with members of licensee management. The inspector described the areas inspected and discussed the preliminary inspection findings. The licensee did not offer any dissenting opinions or identify any information to be withheld from public disclosure.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel:

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|-------------|---|
| J. Bernard | Senior Advisor, Research Staff |
| T. Bork | Irradiation Services Coordinator |
| E. Block | Engineering Supervisor |
| J. Foster | Superintendent of Operations |
| E. Lau | Assistant Director of Reactor Operations and Requalification Program Coordinator |
| W. McCarthy | Reactor Radiation Protection Officer and Deputy Director, MIT Environment, Health, and Safety Office |
| D. Moncton | Director, MIT Nuclear Reactor Laboratory |
| T. Newton | Interim Director of Reactor Operations and Associate Director, Reactor Engineering |
| S. Tucker | Quality Assurance Supervisor |

Other Personnel:

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| R. Rossi | Assistant Chief, City of Cambridge Fire Department |
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INSPECTION PROCEDURES USED

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| 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 69007 | Class 1 Research and Test Reactors Review and Audit and Design Change Functions |
| IP 69008 | Class 1 Research and Test Reactors 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 |
| IP 92701 | Follow-up on Previously Identified Items |

ITEMS OPENED, CLOSED, AND DISCUSSED

OPENED:

None

CLOSED:

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|--------------------|-----|--|
| 50-020/2011-201-01 | IFI | Follow-up on the issue of the licensee documenting the fact that Class A changes were submitted to the MITRSC prior to implementation. |
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50-020/2011-201-04 IFI Follow-up on the licensee's actions to implement the revised operator requalification program.

DISCUSSED:

50-020/2011-201-03 IFI Follow-up on the licensee's long term issue of determining the maximum concentration of hydrogen in the space above the core

LIST OF ACRONYMS USED

| | |
|---------|--|
| 10 CFR | Title 10 of the <i>Code of Federal Regulations</i> |
| ADAMS | Agencywide Documents Access and Management System |
| CCFD | Cambridge City Fire Department |
| CPM | counts per minute |
| E-Plan | Emergency Plan |
| EHS | Environmental Safety and Health |
| FY | Fiscal Year |
| IFI | Inspector Follow-up Item |
| IP | Inspection Procedure |
| IRF | Irradiation Request Form |
| MIT | Massachusetts Institute of Technology |
| MITR-II | Massachusetts Institute of Technology Reactor |
| MITRSC | Massachusetts Institute of Technology Reactor Safeguards Committee |
| No. | Number |
| NRC | U. S. Nuclear Regulatory Commission |
| NRL | Nuclear Reactor Laboratory |
| PD | Police Department |
| PM | Procedure Manual |
| Ref. | Reference |
| RO | Reactor Operator |
| RRPO | Reactor Radiation Protection Officer |
| RSC | Reactor Safeguards Committee |
| SRO | Senior Reactor Operator |
| TS | Technical Specification |
| Vol. | Volume |