

January 11, 2010

Dr. John A. Bernard, Jr.  
Director of Reactor Operations  
Massachusetts Institute of Technology  
Research Reactor  
MITNRL-NW 12  
138 Albany Street  
Cambridge, MA 02139

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY - NRC NON-ROUTINE  
INSPECTION REPORT NO. 50-020/2009-204

Dear Dr. Bernard:

On December 16, 2009, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted a non-routine inspection at the Massachusetts Institute of Technology Research Reactor facility (Inspection Report No. 50-020/2009-204). The enclosed report documents the results of this inspection.

The inspection examined the primary coolant leak identified in one of three heat exchangers (of which two are in operation) to the secondary side of the heat exchanger. The inspection examined activities, evaluated data, detectability methods and heat exchanger replacement plan 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 conducted interviews with 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 Jack Donohue at (301) 415-3163 or by electronic mail at [Jack.Donohue@nrc.gov](mailto:Jack.Donohue@nrc.gov).

Sincerely,

/RA/

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

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

Enclosure: NRC Inspection Report No. 50-020/2009-204  
cc: See next page

Massachusetts Institute of Technology

Docket No. 50-020

cc:

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**ACCESSION NO.:** ML100070299

\* concurrence via e-mail

**TEMPLATE #:** NRC-002

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NAME	JDonohue	GLappert	JEads
DATE	1/11/10	1/11/2010	1/11/10

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

Docket No.: 50-020

License No.: R-37

Report No.: 50-020/2009-204

Licensee: Massachusetts Institute of Technology

Facility: Nuclear Reactor Laboratory

Location: Cambridge, Massachusetts

Dates: December 16, 2009

Inspector: Jack Donohue

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

## EXECUTIVE SUMMARY

Massachusetts Institute of Technology  
Nuclear Reactor Laboratory  
NRC Inspection Report No.: 50-020/2009-204

The primary focus of this non-routine, announced inspection was the on-site review of selected aspects of the Massachusetts Institute of Technology (the licensee's) Class I five megawatt research and test reactor safety program including and activities of the licensee's response to a leak of slightly radioactive water from the one of the three primary to secondary heat exchangers and determine if the facility radiation detection program and effluent and environmental monitoring has been maintained in accordance with regulatory requirements and licensee commitments. The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with U. S. Nuclear Regulatory Commission (NRC) requirements.

### Observation of Primary Leakage Identification and Repair Activities

- Following the Primary to Secondary leak of the secondary heat exchanger, the inspector verified that the licensee was meeting all of the applicable requirements to ensure the public health and safety and the protection of the environment.

### 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 exit surveys were performed. Recorded doses were within the NRC's regulatory limits.
- Radiation survey and monitoring equipment was being maintained and calibrated as required.
- Radiation Protection Procedures are documented as required by Technical Specification (TS)
- Radiation protection training was being conducted and was acceptable.
- The Radiation Protection and As Low As Reasonably Achievable Programs satisfy regulatory requirements.

### Reactor Effluent and Environmental Monitoring

- Effluent reports indicate that a very low level of activity has been detected in the secondary coolant. This activity is stable, is closely monitored and well below the NRC's regulatory limit.

## REPORT DETAILS

### Summary of Facility Status

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

#### 1. Observation of Primary Leakage Identification and Repair Activities

##### a. Inspection Scope (IP 69012)

To ensure that the licensee was following the requirements of technical specification (TS) Section 7.10, Radiation Protection Program (RPP) and Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 19 and 20, the inspector reviewed selected aspects of the following:

- Quarterly Landauer dosimetry reports for 2009
- Observations of facilities, equipment, operations, and postings during facility tours
- 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 Reactor Radiation Protection Procedure 3001, "Radiological Surveys," Revision (Rev.) 4, latest revision dated October 2003
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period July 1, 2008 to June 30, 2009," submitted August 28, 2009
- Email "S. Tucker for J. Bernard dated December 13, 2009 Subject "Notification to MITSC" A very low level of activity (1000pci/l) has been detected in the secondary coolant".

##### b. Observations and Findings

On October 23, 2009 William McCarthy, Deputy Director- Reactor Radiation Protection Program informed Ed Lau, Reactor Supervisor that the gross beta and gamma counts have been increasing over the last month in the cooling tower. In early December the count rates were one at one cps above background and Sodium-24 (Na-24) has been identified and indicates a primary leak. The daily cooling tower gross beta activity trend indicates the monthly activity

concentration (MAC) is  $5 \times 10^{-4}$   $\mu\text{Ci/ml}$ . The cooling tower blowdown is to the sanitary sewer. Daily activity trend analysis was given to Senior Staff and their summary plan of action to operations personnel is as follows:

A very low level of activity (1000 pCi/liter) has been detected in the secondary coolant. This level is stable, it is closely monitored and it is orders of magnitude below the regulatory limit. This activity was found as a result of a review by the Reactor Radiation Protection Officer (RRPO) of past records and as part of an effort to identify the minimum detectable baseline activity. The leak started approximately August 13, 2009. Subsequent analysis ruled out contaminated glassware and calibration error of the detector. The isotope in question was Na-24 which is relatively short lived (15.99 hour half life). No Tritium was detected. The heat exchangers were isolated on December 4, 2009 during the scheduled shutdown. During testing one of the heat exchangers (HE-1B) elevated activity had been observed. HE-1B had been determined to be the cause of the leak. HE-1B is a lamella type heat exchanger and plugging is very difficult and time consuming in addition to requiring lengthy reactor shutdown. They have two replacement heat exchangers at MIT on site and ready for installation. All preliminary testing and pre-installation checks to the heat exchangers were completed.

There is a possibility that the installation can begin as early as February if the planning and material preparations (piping etc.) can support. The plan that has been agreed upon by the safety committee will be to continue reactor operations until all preparations are completed. The Inspector inquired about a 10 CFR 50.59 and the licensee confirmed that was going to be a part of the replacement preparations. The basis for the decision to continue reactor operations and not performing a shutdown is 1) that the activity level is low and well below regulatory limit and; 2) in-line water monitors (two of) would detect any increase in the activity of the secondary coolant (presently set to alarm at 50 percent of the allowed sewer effluent (Part 20 limit) and additionally daily analysis for activity is being performed to track the activity and a threshold for further evaluation has been established should the level arise.

The reactor operators have been briefed on the immediate actions of a high radiation monitor alarm procedure (Procedure Manual (PM) 5.6.2) and leak in the heat exchangers (PM 5.8.10) if this action is required and the standing order would include a call to operations and the NRC personnel. The City of Cambridge and the NRC were notified initially on December 10, 2009 and the State of Massachusetts was notified December 16, 2009.

The Inspector and the Project Manager will be informed if there was any indication that an increase in activity level is present.

c. Conclusions

The inspector determined that: 1) the daily cooling tower gross beta and gamma elevated counts were self identified and below the regulatory limit and the activity of the secondary coolant was determined to be within the Part 20 limits; 2) The source of the leak was identified and isolated; 3) The operators have been briefed on immediate actions of high radiation monitor alarm or leak in the heat exchangers and 4) A plan of action is in place for heat exchanger replacement. The above action is in accordance with regulatory and licensing requirements.

**2. Radiation Protection**

a. Inspection Scope (IP 69012)

To ensure the facility radiation program has been maintained in accordance with regulatory requirements and licensee commitments.

- Quarterly Landauer dosimetry reports for 2009
- Observations of facilities, equipment, operations, and postings during facility tours
- 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 Reactor Radiation Protection Procedure 3001, "Radiological Surveys," Revision (Rev.) 4, latest revision dated October 2003
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- Email "S. Tucker for J. Bernard dated December 13, 2009 Subject "Notification to MITSC" A very low level of activity (1000pci/l) has been detected in the secondary coolant".

b. Observations and Findings

(1) Surveys

Daily, monthly, and other periodic contamination and radiation surveys, outlined in MIT Reactor Radiation Protection Procedure 3001, were completed by HP staff members. The inspector reviewed monthly radiation and contamination surveys of the reactor building, which were conducted by the facility staff. The results were documented on the appropriate forms and reviewed by the RRPO 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.

(2) Postings and Notices

The inspector determined that radiological signs and survey maps were posted at the entrances to controlled areas. Copies of current notices to workers, NRC Form-3 were of the latest issue, as required by 10 CFR Part 19, and were posted in various areas throughout the facility such as on the main bulletin board, in main hallways, and at the entrance to the Reactor Building.

(3) Personnel Dosimeters

Through direct observation the inspector determined that the dosimetry program was effective, maintained and meets regulatory requirements and license commitments.

(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 (friskers) was typically completed by licensee staff personnel. The calibration records of portable survey meters, friskers, fixed radiation detectors, and air monitoring equipment in use at the facility were reviewed. Calibration frequency met the requirements established in TS 4.4 while records were being maintained as required.

(5) Radiation Protection Program

The licensee's RPP was established through the procedures. The RPP provides guidance for keeping doses ALARA and is consistent with the guidance in 10 CFR Part 20. The inspector verified that the RPP was being reviewed annually as required by 10 CFR 20.1101(c). No issues related to the RPP were identified in the review of the program.

(6) Personnel Training

The RPP requires that all personnel who work with radioactive materials receive training in radiation protection, policies, procedures, requirements, and the facilities prior to having unescorted access at the facility. The RRPO is responsible for conducting the training and all of the training is typically conducted both on a computer and with practical applications. A test is administered at the end of the training to verify that the individuals understood the material presented. The training covered the topics required to be taught in 10 CFR Part 19 and the review of

training materials and tests indicated that the staff were instructed on the appropriate subjects.

(7) Facility Tour

The inspector toured the reactor facility, counting laboratories and accompanying facilities. Control of radioactive material and control of access to radiation and high radiation areas were observed to be acceptable. The postings and signs for these areas were appropriate. Licensee personnel followed the indicated precautions for access to controlled areas.

c. Conclusions

The inspector determined that the immediate and subsequent actions as implemented by the licensee satisfied regulatory requirements because (1) surveys were being completed, documented and below limits, (2) postings met regulatory requirements, (3) personnel dosimetry was being worn and recorded doses were within the NRC's regulatory limits, (4) radiation monitoring equipment was being maintained and calibrated as required, (5) the RPP satisfied regulatory requirements, and (6) the radiation protection training program was being administered as required.

**3. Reactor Effluent and Environmental Monitoring**

a. Inspection Scope (IP69004)

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 Reactor Radiation Protection Procedure 3001, "Gamma Spectroscopy Utilizing Canberra Genie 2000," Rev. 2, latest revision dated December 2002
- MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology" Cooling Tower Sample Analysis gross beta/gamma counts activity trend August 1, 2009 thru December 17, 2009 "
- "MIT Research Reactor, Nuclear Reactor Laboratory, Massachusetts Institute of Technology Annual Report to the U.S. Nuclear Regulatory Commission for the Period July 1, 2008 to June 30, 2009," submitted August 28, 2009

b. Observations and Findings

(1) Effluent Reports

The effluent reports indicate the NA-24 activity concentrations that were released to the ambient air are below the regulatory requirements of Table 2 of Appendix B to 10 CFR Part 20 and below the regulations for the release of liquid effluents to the sanitary sewer per the regulatory limits per Table 3 of Appendix B to 10 CFR Part 20. The licensee submitted timely written annual reports to the NRC in accordance with TS 7.13.5 in which annual releases of gaseous, liquids, and solid effluents were reported.

(2) Effluent Control, Monitoring, and Records

The on-line water monitors of the secondary water system has been reset to alarm at 50% below the effluent sanitary sewer limit established in 10 CFR Part 20.

(3) Environmental Sampling

Several Optically Stimulated Luminescent Dosimeters (OSLDs) were placed around the inside walls of the reactor facility and minimal doses were recorded. Records (2009) show that there was minimal radiation exposure to the environment from the reactor during the previous year. There was no liquid effluent discharged from the reactor facility. The licensee indicated that gaseous effluents (Ar 41) from the reactor facility were 0.65 mrem/yr.

c. Conclusions

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

**4. Exit Briefing**

The inspection scope and results were summarized on December 16, 2009, with members of licensee management. The inspector described the areas inspected and discussed the preliminary inspection findings. The licensee did not present any dissenting opinions or identify any information to be withheld from public disclosure.

## **PARTIAL LIST OF PERSONS CONTACTED**

### Licensee Personnel

J. Bernard	Director of Reactor Operations
E. Lau	Superintendent for Reactor Operations
W. McCarthy	Reactor Radiation Protection Officer, RRPO, EHS
D. Moncton	Director, MIT Nuclear Reactor Laboratory
S. Tucker	Quality Assurance Supervisor

### Other Personnel

None

## **INSPECTION PROCEDURES USED**

IP 69012	Class I Research and Test Reactor Radiation Protection
IP 69004	Class I Research and Test Reactor Effluent and Environmental Monitoring

## **ITEMS OPENED, CLOSED, AND DISCUSSED**

### OPENED:

None

### DISCUSSED:

None.

### CLOSED:

None

**LIST OF ACRONYMS USED**

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Reasonably Achievable
CFR	<i>Code of Federal Regulations</i>
CPS	Counts Per Second
EHS	Environmental Health and Safety
IFI	Inspector Follow-up Item
IP	Inspection Procedure
LSA	Low Specific Activity
MAC	Monthly Activity Concentration
MIT	Massachusetts Institute of Technology
MITR	Massachusetts Institute of Technology Reactor
MITRSC	Massachusetts Institute of Technology Reactor Safeguards Committee
No.	Number
NRC	Nuclear Regulatory Commission
OSLD	Optically Stimulated Luminescent Dosimeters
PARS	Publicly Available Records
Rev.	Revision
RO	Reactor Operator
RRPO	Reactor Radiation Protection Officer
RSC	Reactor Safeguards Committee
TS	Technical Specification