U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report Nos.: 50-20/94-02 and 70-938/94-02

Docket Nos.: 50-20 and 70-938

License Nos.: R-37 and SNM-986

Licensee: Massachusetts Institute of Technology (MIT)
138 Albany Street
Cambridge, Massachusetts

Facility Name: MIT Research Reactor

Inspection At: Cambridge, Massachusetts

Inspection Conducted: April 4-8, 1994

Inspector: _____ 5/31/94
Thomas Dragoun, Project Scientist — Date
Effluents Radiation Protection Section (ERPS)
Facilities Radiological Safety
and Safeguards Branch (FRSSB)

Approved By: _____ 5-31-94
Acting Chief, ERPS, FRSSB — Date
Division of Radiation Safety and Safeguards

Areas Inspected: Status of previously identified items, use and control of special nuclear material, and the reactor radiation protection program.

Results: No safety concerns or violations of NRC requirements were observed.

DETAILS

1.0 Individuals Contacted

* M. Austin, Assistant Reactor Radiation Protection Officer
J. Bernard, Director of Reactor Operations
M. Galanek, Campus Radiation Protection Officer
* O. Harling, Director, Nuclear Reactor Laboratory
E. Lau, Assistant Operations Superintendent
\+ F. Massé, MIT Radiation Protection Officer
*+ F. McWilliams, Reactor Radiation Protection Officer
* T. Newton, Assistant Operations Superintendent

* Personnel present at the reactor program inspection Exit Interview on April 8, 1994.
\+ Personnel present at the special nuclear material program inspection Exit Interview on April 7, 1994.

Additional personnel were contacted or interviewed during the course of the inspection.

2.0 Status of Previously Identified Items

2.1 (Closed) Followup Item (50-20/92-02-01) Inconsistencies were noted in completed Irradiation Request Forms. Instructions were issued for use of part 1 of the form in April 1993. The licensee also added a new form which records the amount of radioactive material already in possession of the experimenter who requested the irradiation. This matter is closed.

2.2 (Closed) Followup Item (50-20/92-02-02) The 2.2 liter water jar standard for the counting laboratory could not be located. A new 0.3L standard was purchased. This counting geometry will be employed for future analyses. This matter is closed.

3.0 Special Nuclear Material (SNM) Program Oversight

The MIT Radiation Protection Officer (MIT-RPO) has overall responsibility for the safe use of SNM by MIT personnel. Reporting to the MIT-RPO are the Reactor RPO (RRPO) and the Campus RPO (CRPO). The RRPO has one Assistant RPO and two Technicians while the CRPO has six Assistant RPOs. The CRPO and the RRPO are responsible for the oversight within their respective facilities while the MIT-RPO is responsible for the two off-campus locations approved for SNM use (Bates Linear Accelerator and Lincoln Laboratory). Staffing levels and qualifications of the safety personnel appeared to be good.

4.0 Reactor Facility SNM Program

The inspector toured the areas of the reactor facility where SNM is used or stored and reviewed the performance of the safety program with respect to the license conditions and requirements in 10 CFR 20. The inspector noted that fission chambers are purchased under the SNM license for use in the reactor. License condition No. 11 does not authorize the insertion of licensed material into the reactor. However, in a telephone conference with personnel in the NRC Office of Nuclear Materials Safety and Safeguards/Licensing Branch, the licensee was informed that this license condition does not prohibit insertion of SNM into the reactor. The material may be used in the reactor after completion of the safety reviews specified by the reactor license. Experimenters obtain approval to use SNM by submitting form RRPO-2010A, "Application for Authorization to Posses and Use Radioactive Material Within the Reactor Facility Under SNM-License #986". The form provides specific information regarding the form and quantity of radioactive material and the radiological controls to be exercised. The submittals are reviewed and approved by the Radiation Safety Committee (RSC), assigned a sequential number, and a copy is retained in the records. Areas where SNM is used or stored were found to be properly posted and controlled, including a locked high radiation area called the Vault. Quarterly inspections of radiation safety activities are conducted by the RRPO in accordance with procedure RRP-0090. The inspections includes all active uses approved in accordance with RRPO-2010A. The inspection reports and corrective actions are submitted to the RSC. A review of records for 1992 and 1993 indicated that all inspections were completed as required.

Weekly staff meetings are held by the RRPO. Training is also provided during the meeting. Recent topics included a review of the analytical procedures for the new gamma spectrometer, changes to the SNM receipt procedures, and review of incident reports from other university research reactor facilities. The staff is required to read the new material provided by the RRPO and sign an acknowledgement. This training exceeds the requirements specified in license condition 15.

The Director of Reactor Operations, who possesses an advanced nuclear engineering degree and many years of experience, is the Criticality Officer. The RSC staff member who performs nuclear criticality evaluations for the RSC is similarly well qualified. The inspector reviewed the criticality alarm system for the Vault and found it operable and calibrated. The monitor was set to alarm at 5 millirem per hour in accordance with 10 CFR 70.24, "Criticality Accident Requirements".

Routine radiological surveys are conducted of areas where SNM is used during the routine reactor surveys. Since alpha radiation is associated with SNM, the inspector reviewed the licensee's capability to monitor alpha emitters. A portable alpha survey meter was available and in calibration. Two gas flow proportional counters were available in the counting laboratory for detecting alpha emitters on smears and air filters.

This equipment was calibrated using a plutonium reference standard. Within the scope of this review, no safety concerns were identified.

5.0 Campus SNM Program

There was no SNM in use at the Lincoln Laboratory in Lexington, MA and two millicurie-quantity Pu-Be neutron sources were in use at the Bates Linear Accelerator in Middleton, MA. The inspector did not tour these facilities. SNM is used on the main campus in Cambridge, MA at the Plasma Fusion Facility and the remainder is stored in the Building 20 Central Storage Facility. To obtain approval to use SNM on campus, an experimenter must submit detailed information to the RSC on a form called RPO-1. The RSC may approve or deny any request. This process is consistent with the procedure used at the reactor but the forms are different. The two active authorizations were reviewed and found to be properly completed. Recordkeeping, technical oversight, and quarterly inspection of campus radiation safety activities are provided by the CRPO.

The CRPO provides the annual training to his staff as required by license condition 15. However, the only training records available were the sign-in sheets. The licensee stated that for future training, the records will include a list of the subjects that were discussed. This matter will be reviewed in a future inspection (Followup Item 70-938/94-02-01). The inspector toured the Central Storage Facility which is adjacent to a by-product material analytical laboratory. Postings, physical security, and radiological controls were good. A review of records indicated that the SNM in storage had not been used for several years. The inspector commented that the licensee should dispose of the SNM for which there is no anticipated use. The MIT-RPO stated that this matter would be reviewed but the only recourse available is to transfer the material to the Department of Energy (DOE) since the radwaste disposal sites will soon close. The inspector toured the Plasma Fusion Facility to review the use of twelve fission chambers and a one Curie PuBe neutron source. No deficiencies were noted. The facility has been assigned a full time Assistant Campus RPO since upcoming operations will involve the activation of some structural materials of the Tokomak Fusion Reactor, particularly the plasma confinement tile blocks. This is a good initiative. However, the reactor has not been operated. Within the scope of this review, no deficiencies or safety concerns were identified.

6.0 Reactor Radiation Protection Program

6.1 Radiation Protection Procedures

The inspector reviewed the reactor radiation protection program procedures and policies with respect to the requirements in 10 CFR 20.1101. Procedures are found in the Technical Operations Manual and the Required Procedures for Radiation Protection Manual which was approved by the Radiation Protection Committee and given to all radiation workers. Selected procedures from the "RRP" series were reviewed and found

to be clear, detailed and consistently formatted. Data sheets and system diagrams are included in the procedures where appropriate. The RRPO pointed out the minor changes that were made to the procedures due to the revised 10 CFR 20 regulations. He also stated that increased formality and use of procedures will continue to be emphasized for radiation protection activities. Within the scope of this review, no safety concerns were identified.

6.2 Radiological Controls

The radiological controls implemented by the licensee were reviewed with respect to the requirements in 10 CFR 20 during tours of the NW-12 Building including the Hot Machine Shop, Waste Storage, Engineering Area, and Student Experiment Area and all levels inside the reactor containment building. All radioactive material, containers, and use areas were properly posted and labeled. Radiation areas and high radiation areas were posted and properly controlled. Some high radiation areas at beam ports are equipped with infrared sensors that activate audible and visual warnings on personnel entry. Other high radiation areas are enclosed to prevent access. The only potential grave danger area would be the medical therapy room during patient treatment. The licensee has fabricated signs for posting the room during use. The inspector noted that some controlled areas set up around student experiments were no longer required. The warning signs and tapes were removed and the areas were returned to normal access prior to the end of the inspection. The inspector observed the removal of the "PCCL Experiment" thimble from the reactor and its transfer to a shielded storage area. The licensee does not use a radiation work permit system but issues a written procedure for all radiologically significant work. The procedure for this work, PCCL-4 "Loop Removal From In-Core", provided excellent detail and included a detailed checklist for inspection of the rigging prior to use. Before the performance of the work, there was a meeting between the HP and reactor operations personnel. The HP group issued a "Work Scheduling Form" with an attached "Detailed Work Requirements" form that specifies the general radiological precautions that will be taken based on projected radiological conditions. Detailed requirements were established by the two HP technicians providing continuous job coverage. During the work, communications with the control room and among the members of the work team was excellent. Performance of surveys and precautionary measures taken were also excellent. Within the scope of this review, no safety concerns were identified.

6.3 Protective Clothing

The licensee requires all personnel entering the reactor controlled area to don a lab coat. In addition, gloves and shoe covers are required in the reactor head area. Used protective clothing (PC) is shipped to a local vendor where it is laundered and returned. The quantity of PC on hand for issue and the assortment of sizes was good. The collection and packaging of used PC was also good. Other PC, such as hood and full coveralls were available for work with higher levels of contamination such as the PCCL

thimble removal discussed above. The licensee has not implemented a respiratory protection program and intends to use the engineering controls specified in 10 CFR 20 Subpart H to control airborne particulate activity.

6.4 Personnel Dosimeters

Personnel dosimetry consists of a vendor-supplied thermoluminescent dosimeter (TLD) as the badge of record and self-reading pocket dosimeters (SRD) for routine estimates of exposure. The licensee has two complete sets of SRD for issuance to the staff and visitors. One set is issued for six months while the other set is tested. The SRD are leak tested and verified to be in calibration by irradiation with a cesium 137 source in accordance with procedure RRP 4401. Acceptance criteria are 2 millirem drift per 24 hours and reading within $\pm 15\%$ of the known exposure. SRD that pass these tests are saved and reissued during the next six month cycle.

The TLD vendor is National Voluntary Accreditation Program (NVLAP) accredited as specified by 10 CFR 20.1501. Badges are currently processed monthly but the licensee indicated that the schedule will be changed to quarterly as of July, 1994. The licensee has imposed administrative limits on exposures that are below the NRC limits. The licensee stated that internal exposures are not expected and calculated that ingesting the tritiated reactor shield water would result in less than 10% of the tritium ALI. Although the need for special recordkeeping is unlikely, the licensee has contracted with the vendor to perform dosimetry report services such as summing internal and external exposures and tracking Planned Special Exposures and exposures during pregnancies. The inspector requested the licensee to demonstrate these capabilities. The TLD vendor was contacted via computer connection and the MIT personnel exposure database was queried. The special services were not available. The licensee stated that this matter would be reviewed with the vendor. The inspector reviewed selected personnel exposure records. No overexposures were noted. Within the scope of this review, no safety concerns were observed.

6.5 Exit Surveys

Personnel are required to frisk the hands and feet prior to exiting the controlled area. Standard beta-gamma sensitive pancake probe equipment is used for the frisking. At the exit from the reactor containment air lock there is an automatic hand and foot monitor. The licensee stated that the frisking equipment is set to alarm when any contamination is detected. The inspector observed that personnel were properly frisking prior to exiting the area. The friskers were verified to be operable when an alarm was caused by a package of radioactive material that was being removed from the area as part of a shipment. Within the scope of this review, no safety concerns were identified.

6.6 Personnel Training

The RPO provides each prospective radiation worker with a packet of information for self study. The packet contains licensee procedures and policies and copies of NRC Regulatory Guides 8.13 and 8.29. After studying the material, the worker participates in an extensive review with the RRPO. There is no written exam. If the RRPO concludes that the worker has sufficient knowledge to work in the controlled area, the RRPO issues a "blue" TLD/identification badge to the worker. A "yellow" badge is issued to personnel who do not require supervision and a "red" badge is issued to workers who are authorized to escort others into the controlled area. Job specific training is provided to experimenters by the reactor operations supervisors prior to receiving a "yellow" badge. The various levels of authorization are indicated by appropriate signatures on authorization forms. A review of records did not reveal any discrepancies. The RRPO also conducts periodic group training for all badged personnel. Recent topics included changes in 10 CFR 20 and handling of radwaste. The RRPO stated that he provides reactor systems training to his staff on an ongoing basis. The HP staff is also encouraged to participate in professional society meetings. The inspector noted that some of the handout material given to new workers has not been updated since 1983. The RRPO stated that he intends to implement a video-based training program in the near future, with a written exam and formalized annual refresher training. This matter will be reviewed in a future inspection.

6.7 Radiation Surveys, Sampling, and Monitoring

Routine surveys for surface contamination and radiation levels are conducted in general use areas each day. Other surveys are conducted as directed by the RRPO. Airborne activity is monitored in eleven areas by Continuous Air Monitors (CAM) in accordance with procedure RRP 6001. The CAMs are operationally checked daily. The CAMs have the capability to measure airborne particulate activity, gaseous activity, or iodine or any combination of these parameters. There are two CAMs attached to the building main exhaust plenum and two attached to the main exhaust stack set to monitor particulate and gaseous activity. Grab samples are taken in various areas and analyzed for tritium using a liquid scintillation counter. The inspector reviewed selected air sampling data and determined that all results were below the Derived Air Concentration limits specified in 10 CFR 20. Within the scope of this review, no safety concerns were identified.

6.8 Events

The inspector reviewed the licensee action related to the detection of activated aluminum filings that were detected on the main floor in the reactor containment building. The licensee determined that the source of the contamination was trace amounts of aluminum in the containers used to house silicon ingots during irradiation. The documentation and records of reviews for this event were thorough. Corrective action included changing

the experimental protocol to delay removal of the ingot until the aluminum had decayed. The event and corrective actions were discussed with the facility staff and was mandatory training for the HP staff. Licensee action for this event was good.

7.0 Exit Interview

The inspector met with the licensee representatives indicated in Section 1.0 of this report on April 7 and April 8, 1994, and summarized the scope and findings of this inspection. The licensee acknowledged the inspection findings.