

U.S. NUCLEAR REGULATORY COMMISSION  
REGION I

Report No.: 86-01

Docket No.: 50-20

License No.: R-37

Licensee: : Massachusetts Institute of Technology  
138 Albany Avenue  
Cambridge, Massachusetts 02139

Facility Name: MIT Nuclear Laboratories

Inspection At: Cambridge, Massachusetts

Inspection Conducted: February 25-28, 1986

Inspectors: T. Foley, Senior Resident Inspector, Calvert Cliffs  
C. Holden, Senior Resident Inspector, Maine Yankee

Approved by:   
T. C. Elsasser, Chief, Reactor Projects Section 3C

4/23/86  
Date

Summary: Inspection on February 25-28, 1986 (Report No. 50-20/86-01)

Areas Inspected: A routine unannounced on-site inspection of licensee activities including: Action taken on Previous Inspection Findings, Facility Tour, Facility Operations, Requalification Training, Surveillance, Experiments, Radiation Protections, Audits and Committees, and verification of reduced on-site storage of High Enriched Uranium (HEU).

Results: Although no violations were identified, two concerns were identified regarding documentation of the licensee's bases for changes, test and experiments determined not to involve an unreviewed safety question (Paragraph 5.a), and calibrations of dosimetry instruments (Paragraph 10). Stored quantities of HEU on site are minimal, and operation of the facility appears to be in conformance with applicable requirements.

## DETAILS

### 1. Key Persons Contacted

- \*J. Bernard, Superintendent, MIT Research Reactor Operations and Maintenance
- \*L. Clark, Jr., Director of Reactor Operations
- \*O. Harling, Director, Nuclear Reactor Laboratory
- \*K. Kwok, Assistant Superintendent, MIT Research Reactor
- \*E. Karaian, MIT Radiation Protection Officer

\*Denotes those present at the exit interview.

### 2. Licensee Action on Previously Identified Enforcement Items

(Closed) (82-01-01) The failure to maintain at least 12 inches edge-to-edge separation of packages containing SNM was corrected by moving the BTF sub-assembly containing 1.1% enriched UO<sub>2</sub> to a location not within 12 inches edge-to-edge of any other SNM. Additionally, within each storage location signs are posted with instructions specifically prohibiting storage within 12 inches of other SNM.

(Closed) (83-02-01) The corrective actions identified in Inspection Report 50-20/83-02, regarding the licensee's failure to adequately post the Hot Cell Area as a High Radiation Area, are still in place. The inspector verified the actions taken by the licensee identified in the above report.

(Closed) (83-02-02) The inspector verified that the licensee no longer uses yellow and magenta ropes for barriers where radiation areas do not exist, and that Radiation Protection controls the use of radiation area barrier ropes.

(Closed) Violation (85-01-01) The licensee's corrective actions to packaging 281 millicuries of Rhenium-186 and 824 millicuries of Rhenium-188 wire and incorrectly labeling the package as 8 millicuries of Chlorine-38 for shipment to Massachusetts General Hospital were as follows:

- (1) a specific procedure for "Hot Cell" work was written,
- (2) the control of work was re-emphasized to Hot Cell workers,
- (3) specific references are now written on samples and pneumatic tube samples are identified,
- (4) specifically-shaped containers as indicated on Part II of the work form are used,
- (5) distinguishable markings on the samples are recorded on Part II of the work form, and
- (6) the gamma dose rate on the work form is verified.

The inspector verified that these actions were performed and in effect during inspection of the facility.

(Closed) (84-01-01) Procedure should be clearly labeled with the title of the individual responsible for its implementation. The licensee has placed the responsibility on the console operator for all immediate actions of Abnormal Operating Procedures (AOP) and Emergency Operating Procedures (EOP). The shift supervisor is responsible for review of the immediate actions and for follow up action. The inspector reviewed AOPs and found the procedures contained the necessary direction to the licensed operators.

(Closed) (84-01-03) Incorporate Emergency Action Levels (EAL) into procedures such that classification of events is readily available. The licensee has incorporated into procedures the EALs listed for non-radiological emergencies. EALs for "Excess Radiation at the Site Boundary Resulting from a Contained Source" were incorporated into the appropriate procedure. EALs are covered in procedures either as a sub-part of major radiological emergencies or emergency procedures.

(Closed) (84-01-04) Accuracy of Procedural References. The licensee reviewed procedures and corrected the typographical errors which led to the inaccuracies.

(Closed) (84-01-05) Provide high range dosimeters within the Containment building emergency lockers. The licensee located two high range dosimeters in the emergency locker in Containment. In addition, other high range dosimeters are located outside of the Containment for use by other personnel assisting in emergency actions.

(Closed) (84-01-06) Provide guidance on supplying dosimetry to medical personnel. Dosimeters will be issued to responding medical personnel if the injury involves radiation exposure or contamination. This action has been proceduralized for medical emergencies.

(Open) (84-01-02) Develop EALS based on specific instrument readings for each of the four classification levels specified in the Emergency Plan. The licensee responded to this item in its reply to Inspection Report 84-01 dated July 25, 1984. This particular item was confusing since the licensee interpreted the action necessary to close this item as being a rewrite of the Emergency Plan. The licensee listed the actions it would need to accomplish a rewrite of the Emergency Plan and requested additional guidance. NRC Region I responded on September 14, 1984 and forwarded this item to Headquarters for review. The inspector discussed the issue with Headquarters personnel and determined that resolution of this item does not require a rewrite of the Emergency Plan. Additional discussions between the licensee and Headquarters were conducted. Documentation of the resolution of this item will be reviewed in subsequent inspections. This item is open.

### 3. Facility Tour

On February 25, 1986 at about 6:00 p.m. the inspector arrived on site. Observation of physical security controls appeared adequate. The inspector met the Assistant Superintendent and ascertained that shift staffing was in con-

formance with Technical Specifications (TS). Subsequently a meeting was conducted with the Director of Reactor Operations regarding the scope and purpose of the inspection. A tour of the facility was conducted immediately thereafter. General observations of security, health physics controls, housekeeping, staffing and back shift operations were noted. Control Room observations and Reactor Plant system parameters were monitored by the inspector and compared to Technical Specifications. No inadequacies were noted. Additional tours were made later during subsequent days of the inspection. Inspection tours included: Spent Fuel Pool, New Fuel Vault, Reactor Vessel Head area, Hot Cell, Rad Waste Storage areas, experimental laboratories, Blanket Testing Facility, and Administrative Offices. No inadequacies were identified.

#### 4. Facility Operation Review

The facility is used primarily by MIT graduate students for a variety of neutron activation experiments. The licensee continues to operate the reactor continuously from 8:00 a.m. Monday until Friday evening using a three shift schedule. During the inspection the licensee performed various control rod manipulations and demonstrated the "automatic control of reactor power and reactivity constraints" experiment. The licensee demonstrated various reactivity limiting controls and safeguards associated with the reactivity control system. The inspectors reviewed shift staffing, Control Room logs and observed the operators' performance. Reactor coolant system parameters and system annunciators were discussed with the plant operators. General conditions as they applied to fire prevention and radiological cleanliness were observed. Although no discrepancies were noted in the above areas, the inspector had the following comments:

- (a) A review of the reactor start up and shutdown checklists was conducted. The inspector noted that several start up checklists were not complete since some instrumentation was not checked. The inspector was able to verify, through other documentation, the exact status of the equipment. The instrumentation in question did not impact on Technical Specification requirements. The licensee agreed that a more thorough review of checklists was necessary.
- (b) The inspector reviewed the hourly calorimetric calculation performed by the operators. Additionally, the Estimated Critical Position (ECP) calculations were reviewed. The October 21, 1985 and February 18, 1986 ECPs did not have all blanks completed. However, the inspector determined that the blanks did not apply to those startups. The licensee agreed that the ECPs should be annotated to show they are complete.
- (c) The inspector also compared Technical Specification surveillance requirements with Operator Logs. The DF-1 flow recorder is bypassed during reactor start-up. The bypass is removed prior to increasing power above a pre-set level. The inspector reviewed the Bypass Log and determined that the operators were removing this bypass and signing for its removal,



but the times and dates were not listed. This made verification of the reinstatement of the flow recorder difficult. The licensee agreed to study the problem.

Other operating documentation reviewed included the Job Workbook, Fuel Loading Permission, Shutdown Margin Calculations, and Operators' Logs. In general the licensee's record keeping was acceptable. The filing of data in logs was orderly, and data were easily retrievable.

5. Audits and Committees

A review of audit reports and committee activities was conducted.

a. Committees

The committee charged with the oversight of reactor safe operation is the Reactor Safeguards Committee. The committee meets at least once each year and is responsible to the Administration of MIT. The committee chairman establishes subcommittees to assist the committee in conducting its review functions. The committee or an active subcommittee reviews and approves all operating procedures, emergency plans, proposed modifications to the reactor, the use of reactor related experimental facilities and experiments, and all equipment and procedures involving the use of licensed radioactive material in the reactor building.

Through a review of committee activities, the inspector attempted to ascertain that the committee reviews abnormal occurrence and unusual occurrence reports, violations, categories of particular tests and experiments, Technical Specification changes, potential unreviewed safety questions (URSQ), emergency plans and security plans.

The inspector reviewed several unusual occurrence reports and associated corrective actions related to licensee experiments, logs, and emergency plans, and determined that each was properly documented by the Safeguards Committee. It was noted, however, that only "categories" of experiments are reviewed by the Safeguards Committee in order to determine whether an unreviewed safety question exists. The inspector further noted that within a "category", there are experiments which have no safety analysis. According to the licensee these other experiments do not require a review by the Safeguards Committee because they are considered "Class B" procedures, i.e., they are described in the Safety Analysis Report (SAR) and do not involve an URSQ. Instead, Class B procedures require a review by two licensed operators and the Director of Reactor Operations to determine, in part, whether a potential exists for an URSQ and consequently whether further review is required. The bases for this determination is not maintained. Similarly, bases are not maintained for other changes, tests and experiments, which have previously been reviewed, and determined not to involve a potential for an URSQ.

The inspector stated that 10 CFR 50.59 Paragraph (a) (1) is permissive in that it allows the licensee to make changes to the facility and its operation as described in the Safety Analysis Report (SAR) without prior approval, provided a change in Technical Specifications is not involved or an "unreviewed safety question" does not exist. Paragraph (b) requires that the licensee maintain records of changes made under the authority of Paragraph (a) (1). These records must include a written safety evaluation which provides the basis for determining whether an unreviewed safety question exists.

The inspector stated that this meant that any proposed change to a system or procedure, as described in the SAR, either by test or drawings should be reviewed by the licensee to determine whether it involves an unreviewed safety question, and in all cases, the safety evaluation must provide the basis for determination that the proposed change, test or experiment does not involve an unreviewed safety question.

The inspector determined that the licensee complies with the above for those changes, tests and experiments which have been reviewed and determined to have a potential for an URSQ, but not for those that have been determined not to involve an URSQ, in that the bases or reasoning for the "sorting out" (determination of why a potential for an URSQ does not exist) is not documented.

The licensee questioned the inspector as to what constituted "a change" and how other licensees resolve documenting the basis for changes which occur to system and procedures or drawings described in the SAR. The inspector discussed various acceptable alternatives and subsequently forwarded to the licensee the NRC Policy, Part 9800 of Inspection and Enforcement Manual "CFR Discussions" 10 CFR 50.59.

The licensee agreed to further evaluate the requirement in light of the provided NRC interpretation/policy. This matter is unresolved pending the licensee's action to provide the documented bases or rational for those changes, tests or experiments which do not involve an unreviewed safety question (50-20/86-01-01).

b. Audits

Audits of facility operations are performed primarily by the Reactor Superintendent. These audits are quite thorough and comprehensive. However, corrective action, recommendations and implementation are largely the responsibility of the Reactor Superintendent. The Superintendent completed audits of the following, during October through December 1985:

- (1) Reactor Console Log Unusual or Abnormal Entries
- (2) Changes to procedures/checklists/manuals
- (3) Job Workbook Records
- (4) Test and calibrations

- (5) Radiation Surveys and Environmental Monitoring Radioactive Effluent Records
- (6) Refueling and Excess Reactivity
- (7) Recommendation of Reportable Occurrence Reports and Unusual Occurrence Reports
- (8) Training Files
- (9) QA Program/Tagouts/License R-37.

The Reactor Superintendent performs these audits repetitively on three month cycles throughout the year in addition to his normal duties. The inspector reviewed the above audits for July through December 1985, and noted that there were no substantive findings.

However, the inspector questioned the lack of independence and organizational freedom provided by this method of auditing one's own work. The licensee had previously been concerned about this matter and subsequently initiated an annual independent audit by Mr. W. Fecych, a licensee consultant. Audits by Mr. Fecych for the 1984 and 1985 period were reviewed by the inspector and found to encompass outstanding items, operating logs, and dosimetry calibrations.

The inspector stated that although this independence provided more objectivity, the scope and depth of the audits was limiting and should be more comprehensive.

The licensee's Safety Analysis Report which described the Quality Assurance Plan, dated October 1970, provides justification for not requiring the independence and organizational freedom required by 10 CFR 50, Appendix B; however, Section II.2.2 provides a list of activities which fall under the licensee's Quality Assurance Program, and as such should be included in a schedule to be audited on a periodic frequency. Although a clear requirement for audits addressing all aspects of the Quality Assurance Program is not evident, current regulations and industry standards do place more emphasis in this area. The inspector recommended that the licensee consider evaluating current requirements and provide additional independence to those areas within the defined Quality Assurance Program.

#### 6. Technical Specification Surveillance

The inspector verified by review of plant surveillance and other records that the following TS surveillance requirements met frequency and acceptance criteria:

<u>TS No.</u>	<u>Requirement</u>
6.4.1.3	Helium Gas Holder Alarm
6.4.1.4	D <sub>2</sub> O Helium System Alarm

<u>TS No.</u>	<u>Requirement</u>
6.4.15	Reflector Tank D <sub>2</sub> O Level Scram
6.2.4	Period Level Indication Off Scale Scram
6.1.4.1	Nuclear Safety System Response Time
6.1.4.2	D <sub>2</sub> O Reflector Dump Time
6.1.4.4	Primary Coolant Flow Scram Time

No inadequacies were identified.

#### 7. Emergency Planning

The Massachusetts Institute of Technology Reactor Emergency Plan was reviewed. Drills and lectures are periodically (at least annually) performed. Training records, changes in the plan and audits of emergency planning activities were reviewed. The November 19, 1985 Emergency Plan Exercise consisted of MIT Reactor Operators, Radiation Protection Personnel and MIT campus police. Local police, hospital and fire department agreements were verified to be up-to-date. The Emergency Plan is up-to-date and being effectively implemented except as noted in paragraph 2, "Licensee Action on Previously Identified Items," Item 84-01-02, which remains open.

No inadequacies were identified.

#### 8. Experiments

Experiments performed at the MIT Reactor are varied. Currently, neutron activation and analysis and automatic reactivity control experiments are in progress. Experiments are divided into the following categories: reactor operation experiments, Beam Port experiments, incore experiments, thermal column experiments and medical therapy experiments. The licensee uses a "Proposed Experiment Review and Approval Form" in order to control the approval process. The inspector reviewed the following experiments for approvals and safety analysis:

- Use of Dry Ice in Pneumatic Tubes
- Sodium metal filled subassembly in the Blanket Test Facility
- Closed Loop Control of Reactor Power using Shim Blades and Regulating Rods simultaneously

The use-of-dry-ice experiment and use-of-sodium experiments were not accompanied by safety evaluations, however, they were reviewed and approved. The acceptability of these experiments was based on similarity to the other experiments which had previously been approved and which were accompanied by



a written safety evaluation. The inspector verified that in addition to reviews, approvals, and safety evaluations, predicted parameters were determined and ascertained within tolerance, irradiated items were properly controlled, and individuals conducting the experiments were trained prior to using the facility (see Training, paragraph 9.b).

No inadequacies were identified.

9. Training Review

a. Requalification Training

A review was conducted of licensed operator training, examinations and reactivity manipulation records. Schedules of lectures and samples of lesson plans were also reviewed. The inspector ascertained that required records were maintained and that the licensee requalification training program was current and fully implemented.

A review of the 1984 and 1985 records indicated that five senior reactor operators had passed their requalification examinations. One reactor operator was upgraded by virtue of passing the SRO examination. One reactor operator's license duties were suspended by the licensee for failure to take the requalification examination.

No inadequacies were identified.

b. Experiments and Student Training

The inspector reviewed documents and discussed with various department staff the training of individuals who conduct experiments. Personnel are trained in the following areas:

- 10 CFR Part 19
- 10 CFR Part 20
- Tables from 10 CFR Parts 20 and 30
- USNRC Regulatory Guide 8.13
- Procedures for Radiation Protection
- Facility Emergency Evaluation Procedure
- Film Badge Classification Procedure
- Radiation Exposure Record Application
- Exclusion Area Entry Permit
- Maximum Permissible Dose

Each person is given approximately three days to read the above material. A one and one-half hour lecture is given on the same material followed by a question/answer session to determine students' knowledge of exposure limits and restrictions. Twenty hours of classroom instruction is provided on the use and handling precautions associated with the experimental facility and equipment prior to allowing each person to work or attend classes in the building.

Retraining is given annually to persons who handle or receive radioactive materials. This retraining includes but is not limited to the following topics:

- Permissible Radiation Doses
- Facility Organization
- Biological Effects of Radiation
- Facility Evacuation Plan

No inadequacies were identified.

#### 10. Radiation Protection Controls

The inspector noted radiation postings and controls throughout the facility. Radiation instruments were noted to be calibrated and source checked regularly. Reviews were conducted of radiation surveys, contamination surveys, exposure records of experiments and MIT staff. (Generally, the radiation levels are less than 5 mr/hr in most accessible areas.) Hot Cells were adequately posted as High Radiation areas. Some small areas around the Beam Ports had higher radiation intensities (as high as 15-25 mr/hr) whereas other areas around the Beam Ports were 1-2 mr/hr. The inspector indicated that 10 CFR 50, Appendix I provides guides for maintaining dose to individuals as low as reasonably achievable. The licensee agreed to consider placing controls/signs in or around those areas where higher than normal (5 mr/hr) radiation levels could exist to make personnel aware of the potentially higher intensities and to aid personnel in minimizing their dose.

During review of dosimetry records and calibrations of instruments, the inspector determined that personnel pocket dosimeters were not being calibrated. The inspector noted that 10 CFR 50, Appendix B requires that all devices used to ensure quality should be properly calibrated. The licensee provided a quality assurance audit that previously had identified this same issue. The licensee stated that programs would be established to calibrate all dosimetry. The inspector indicated that pending licensee action on the Quality Assurance Audit, dated November 18, 1985, this item is unresolved (86-01-02).

#### 11. Stored Quantities of High Enriched Uranium (HEU) On Site

In accordance with NRC Inspection and Enforcement Temporary Instruction 2545/1, the inspector examined the quantity, storage and controls associated with HEU on site.

The inspector observed the new fuel vault contents to physically ascertain what new fuel was accessible. Only one fuel element and a few miscellaneous components totalling less than 1 kg of HEU were in the new fuel vault. Safeguard controls associated with the vault are described in Safeguard Inspection Report (50-20/84-02).

Through discussions with the licensee, review of operation history, and observation of the Spent Fuel Pool, the inspector determined that the quantity of material exempt from the licensee's inventory of accessible HEU was greater

than 100 Rem/hr at three feet. The current inventory of accessible fuel is of Low Strategic Significance. The current MIT policy is to maintain "hundreds" of grams of accessible HEU on site versus the "thousands" of grams permitted, excluding the self-protecting fuel, except just prior to fuel transfer. This was documented in a letter to the Secretary of the Commission from L. Clark, October 19, 1984.

The licensee is currently awaiting a fuel cask from DOE in order to reduce its inventory of spent fuel.

12. Exit Interview

At the conclusion of the inspection on February 28, 1986 the inspector met with the director of the facility and reviewed the scope and findings (i.e., unresolved items in paragraphs 5 and 10). The inspector noted the licensee's candor and good cooperation. At no time during this inspection was written material provided to the licensee by the inspector.