U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report/License Nos.: 50-20/95-02/R-37

Licensee: Massachusetts Institute of Technology
138 Albany Street
Cambridge, Massachusetts

Facility Name: MIT Research Reactor (MITR)

Inspection At: Cambridge, Massachusetts

Inspection Conducted: July 5-7 and July 24-26, 1995

Inspector: _____
Thomas Dragoun, Project Scientist

Approved by: _____
Robert Bores, Chief, Effluents Radiological Protection Section, Facilities Radiological Safety and Safeguards Branch

AREAS INSPECTED: Routine reactor operations program and a reportable occurrence regarding operation of the reactor at power with one control rod not withdrawn.

RESULTS: No deficiencies or safety concerns were identified. The complexity of factors contributing to the inadvertent operation of the reactor with one control rod inserted may indicate the need for an independent peer review of the reactor operations program.

DETAILS

1.0 INDIVIDUALS CONTACTED

+*M. Austin, Assistant Reactor Radiation Protection Officer
+*J. Bernard, Director of Reactor Operations
J. Bolton, Second Shift Supervisor
D. Kelley, Senior Reactor Operator
+*E. Lau, Assistant Operations Superintendent
*F. McWilliams, Reactor Radiation Protection Officer (RRPO)
+*T. Newton, Assistant Operations Superintendent

*Denotes those present at the exit meeting on July 7, 1995
+Denotes those present at the exit meeting on July 26, 1995

2.0 PURPOSE OF INSPECTION

The purpose of this inspection was to review the status of a previously identified item, organization and staffing, conduct of maintenance, licensed operator requalification, surveillances, limiting conditions for operation, and the circumstances involved in the power operation of the reactor with one control rod not withdrawn.

3.0 STATUS OF PREVIOUSLY IDENTIFIED ITEM

During an inspection in March 1995 of the radiation protection program (Inspection No. 50-20/95-01), the need for increased cooperation between the radiation protection (RP) staff and reactor operations staff was identified. This need particularly applied to the development of RP procedures and policies that affected the reactor operations staff. The Radiation Safety Officer advised the inspector that, since the March inspection, six RP policies were rewritten and 12 new RP policies were being developed with input from the reactor operators. Interviews with staff and supervisory personnel indicated that the relationship between the two groups was improving rapidly, including, the day-to-day working relationship. The inspector advised licensee management that the steps taken to correct the situation appeared to be effective.

4.0 ORGANIZATION AND STAFFING

The reactor is frequently operated three shifts per day for extended periods. The operations staff consist of 14 full time personnel and one student. The inspector reviewed shift staffing and the schedule of activities. The crew size was adequate to deal with routine and abnormal operations. A class of six reactor operator trainees were completing the qualification process. An operator examination by the NRC was scheduled for September 1995. Of the trainees, three will become full-time staff and the remainder will be part-time student operators. A reactor engineer position was added to the staff. These additions will permit crew staffing above minimum levels specified in Technical Specification (TS) 7.2. The Director of Reactor Operations temporarily assumed some of the facility director's management responsibilities during the time that the facility director is not

available. Within the scope of this review, no safety concerns were identified.

5.0 CONDUCT OF MAINTENANCE

The SENSOR experiment was complete and the in-core apparatus was scheduled to be removed during this inspection. The inspector reviewed the safety evaluation report (MIT-NRL-051), quality assurance program for the components and reactor modifications (M-92-7), as low as reasonably achievable (ALARA) radiation exposure analysis for the use of the equipment, and the deliberations of the Reactor Safeguards Committee prior to the approval of this experiment. A detailed emergency procedure was developed in the event of failure during operation of the apparatus. Since this apparatus possessed a high negative reactivity value (-1255 millibeta), the heavy water reflector tank was "dumped" (reactivity worth = 4000 millibeta decrease) and the removal of the apparatus handled as a refueling operation. A specific removal procedure was developed for this apparatus. The inspector observed the activities at the reactor top and noted that the oversight specified for a refueling operation was satisfied. The inspector also observed the activities in the control room and reviewed the core configuration record updates. No safety concerns were observed and the inspector concluded that the apparatus was removed in a safe manner.

The inspector observed a flushing operation on the secondary side of the primary heat exchangers with concentrated hydrogen peroxide to remove organic material. This is done periodically in accordance with a routine procedure to improve heat transfer characteristics. The personnel protective equipment used by the workers generally complied with the recommendations contained in the Material Safety Data Sheet (MSDS). Interviews with a few of the personnel doing the work indicated a general understanding of the exposure hazards associated with the chemical. The inspector could not verify if the material of construction used in the protective equipment, e.g., rubber gloves, lab coats, met the MSDS criteria. The licensee stated that this matter would be reviewed.

The inspector observed the replacement of the regulating rod (reg rod). Procedure PM 3.4.4 was followed for this work. The rod was replaced due to its decreased reactivity worth and the need for frequent and large shim motion to maintain reactor power steady. The inspector discussed with the work crew the precautions used to prevent damage to the fuel from dropped tools. The controls were good. The inspector noted good attention to the mechanical alignment of the rod to produce a smooth motion. This rod does not scram and is not accounted for in the reactor shutdown margin calculations. The safety precautions, care, and craftsmanship exercised during the installation of the new reg rod were very good.

The cooling tower basin was de-sludged and washed with high pressure water. One of the water supply pipes was replaced. This needed to be

coordinated with the peroxide flush discussed above. The coordination of the maintenance activities was good.

Within the scope of this review, no safety concerns were identified.

6.0 OPERATOR REQUALIFICATION

The second shift reactor operations supervisor is the training officer for the entire staff. He is responsible for training coordination, developing and correcting written exams, keeping records and requalification status for each licensed operator. Lectures are given only after major changes are made to programs or procedures. Instead of the lectures, old exams are given to guide self study. Console manipulations and supervisory time are logged by the operator. Progress is reviewed quarterly by the training officer. Written exams are given during the fourth quarter each year although the overall program is on a biennial schedule. The inspector reviewed selected personnel folders, written exams, and the "OST Log" of console manipulations. The cover page for the OST Log provides guidance for acceptable activities that are credited towards requalification. This information is helpful. No deficiencies were noted.

The inspector discussed the changes in the radiation protection training that were made for refresher training and the current class of operator candidates with the training officer and the RSO. Changes include more information about health physics in order to improve the cooperation between the two groups as discussed in Section 3.0 of this report. This is a good licensee initiative.

7.0 SURVEILLANCES

Section 4.0 of the Technical Specifications describes the requirements for the conduct of surveillances on safety related equipment. The inspector reviewed the scheduling, procedures, and data records relating to the surveillance program. The procedures were found to be good, surveillances were completed on schedule, and data records were clear and concise. However, TS 4.4(1) requires, in part, that the period trip rod drop response (scram times) shall be annually verified using simulated input periods of 0.1 seconds. Testing of the three period channels began on schedule on May 3, 1995, but was not completed due to a malfunction in the loss-of-signal scram relay in the channel #3 picoammeter. The licensee indicated there was difficulty in obtaining a replacement relay but repairs were scheduled for mid-July. The two other picoammeters (period channels) were functioning properly. TS 3.7 requires two period channels be operable for any mode of reactor operation. The status of repairs to channel #3 will be reviewed in a future inspection.

8.0 LIMITING CONDITIONS FOR OPERATIONS

The inspector reviewed the licensee's program for ensuring compliance with the Limiting Conditions of Operation specified in TS Section 3.0.

The areas reviewed included shim blade reactivity worth determinations, reactivity insertion rates, core excess reactivity, and core shutdown margin. Within the scope of this review, no safety concerns were identified.

(Note: The following event was reviewed during the July 24-26, 1995, portion of the inspection)

9.0 OPERATIONAL EVENT - OPERATIONS WITH SHIM BLADE FULLY INSERTED

On July 20, 1995, the licensee reported to the NRC by telephone that on July 19 the reactor was operated with one of the six shim blades fully inserted. This condition violated the Limiting Condition for Operation specified in TS 3.11(c), which requires that shim blades be within 2.0 inches of a banked position. Initial corrective actions included analysis of primary coolant water for evidence of fuel element cladding failure, replacement of defective blade-in proximity switches, and a requirement for management presence for reactor startups until final corrective actions were complete. The inspector attended the Reactor Safeguards Committee meeting on July 24. The review of the event by the committee was thorough and resulted in six recommendations. A summary of the event, analysis and corrective actions were sent to the NRC as Reportable Occurrence 50-20/1995-4 on July 28, 1995. Based on the inspector's interviews and observations, the information and actions reported by the licensee were essentially complete and reasonably appropriate. The inspector also observed that, as part of the corrective actions, written guidance should be provided to the reactor operators for dealing with equipment malfunctions, such as the lowering of control rod drive electromagnet currents to prevent spurious scrams. This guidance would be followed until permanent repairs can be made. The licensee stated that this would be done. This matter will be reviewed in a future inspection (Inspector Follow Item 95-02-01).

Since defective switches were a factor in this event, the inspector reviewed the licensee's program for the identification and repair of faulty equipment. Equipment defects are recorded by reactor operators in the "MITR2 Job Workbook" under mechanical, electrical, or electronic headings. The engineers and repair technicians respond by logging their findings and repairs. Each calendar quarter, the Reactor Operations Director performs an "administrative audit" which includes a review of the status of items in the job workbook. This audit also includes a review of test and calibration records, radiation surveys, radioactive effluent reports, refuelings, reportable occurrences and unusual events, status of training, quality assurance program, and equipment tagouts. The audit results in a written report of findings to the operating staff and repair technicians with instructions for areas needing attention. This is an excellent practice. Conduct of this audit is verified by an outside consultant during the "annual independent audit". The inspector reviewed the admin audit findings and noted that the backlog of electronic equipment repairs was identified. The failure to make timely and effective repairs to the blade-in proximity switches was a contributing factor to the reportable occurrence discussed above. The

inspector also noted that six new nuclear instrumentation channels, compensated ion chamber detectors, radiation hardened signal cables, and rod drive electromagnet supplies had been ordered and were due for arrival within a month. Replacement of this equipment is expected to eliminate the spurious scrams that were also a factor in the reportable occurrence. The inspector concluded that management oversight of equipment repairs was good within the limitations imposed by budget constraints and personnel performance issues. Within the scope of this review, no safety concerns were identified.

(Note: The following event occurred after completion of the on-site portion of the inspection.)

10.0 OPERATIONAL EVENT - OPERATION WITH SHIM BLADE PARTIALLY INSERTED

Subsequent to this inspection, the licensee submitted Reportable Occurrence 50-20/1995-5, "Malfunction of a Shim Blade Drive Mechanism" on August 18, 1995 to the NRC. The report stated that the shim blade drive mechanism involved in the July 19 event was replaced with a spare drive. On August 9, 1995, the spare drive slipped and resulted in reactor operations with the shim blade inserted 4.25 inches relative to the banked position. This event was discussed in telephone conversations with the licensee. From the written report, the inspector observed that it was not clear that the licensee had assessed the impact of the misaligned blade on the reactor. The licensee stated that a safety analysis would be completed to address this issue. This matter will be reviewed in a future inspection.

11.0 EXIT MEETING

The inspector met with the licensee representatives denoted in Section 1.0 of this report at the conclusion of the segments of the inspection on July 7 and July 26, 1995. The inspector summarized the purpose, scope and findings of the inspection. The licensee acknowledged the inspection findings.