U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No.: 50-20/92-02

Docket No.: 50-20

License No.: R-37

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

Facility Name: MIT Research Reactor

Inspection At: Cambridge, Massachusetts

Inspection Conducted: December 1-3, 1992

Inspectors: Thomas V Dragoun 12/30/92
Thomas Dragoun, Project Scientist, Effluents — date
Radiation Protection Section (ERPS), Facilities
Radiological Safety and Safeguards Branch (FRSSB)

M. Miller for 12-30-92
Stephen Holmes, Radiation Specialist, ERPS, — date
FRSSB

Approved By: Marie Miller 12-30-92
Marie Miller, Acting Chief, ERPS, FRSSB, — date
Division of Radiation Safety and Safeguards

Areas Reviewed: Previously identified items, treatment room modifications, facility staffing, control of experiments, safety system surveillances, shipment of waste, and implementation of the radiation protection program.

Results: The technical reviews of new experiments and the radioactive waste shipping program were excellent. The other program areas were determined to be acceptable, although two weaknesses identified in Section 5.0 and 8.5 of this report require additional reviews during future inspections. No safety concerns or violations were observed.

DETAILS

1.0 Individuals Contacted

M. Austin, Assistant Reactor RPO
J. Bernard, Director of Reactor Operations
O. Harling, Director of Nuclear Reactor Laboratory
E. Lau, Assistant Operations Superintendent
F. Massé, Institute Radiation Protection Officer
F. McWilliams, Reactor Radiation Protection Officer
T. Newton, Assistant Operations Superintendent

Above personnel were present at the Exit Interview on December 3, 1992. Additional personnel were contacted or interviewed during the course of the inspection.

2.0 Status of Previously Identified Items

2.1 **(Closed) Violation (70-938/92-01-01)** Loss of accountability for three fission chambers. Licensee corrective action described in letter dated July 2, 1992 is complete and satisfactory. This matter is closed.

2.2 **(Closed) Violation (50-20/91-01-01)** Failure to provide all information required by 10CFR20.311(B). Review of radioactive waste shipments indicated that the waste streams are being characterized and the results provided on the waste manifests as required. This matter is closed.

2.3 **(Closed) Inspector Followup Item (IFI) (50-20/90-01-01)** Lack of written implementing procedures for radiological controls program. Written radiological control procedures were available to the staff and were deemed adequate. This matter is closed.

2.4 **(Closed) IFI (50-20/91-01-04; 70-938/91-01-03)** Lack of technical adequacy of the calibration methods used at the facility. Existing calibration procedures were consistent with American National Standards Institute (ANSI) recommendations or the manufacturers' recommendations and the calibration source strength had been verified as a transfer standard from the campus NIST-traceable radium source. This matter is closed.

2.5 **(Closed) IFI (50-20/91-01-02)** Upgrading of stack sampling in Engineering Lab. The inspector examined the completed upgrade and reviewed the system design. The upgraded sampling system fulfilled the licensee's commitments. This matter is closed.

3.0 Treatment Room Modifications

A license amendment to allow human therapy in the Treatment Room has been under review by the NRC since March 1992. If approved, this amendment would require the licensee to make equipment changes to the Treatment Room systems. The inspector reviewed the changes that the licensee has initiated and determined that modifications were complete except for the following:

- Installation of inside and outside hand winches for manual opening the shield door (the winches were available on site).
- Installation of a radiation monitor with associated audible and visual alarms and backup power supply and of the on-line neutron beam monitor.
- Installation of a closed circuit television to allow visual monitoring of the patient.

The licensee plans to complete the modifications by the end of February 1993 in accordance with their schedule. Two physicians have thus far qualified to use the room. These matters will be reviewed in a future inspection.

4.0 Facility Staffing

A concern was raised during the last inspection that the level of reactor operations staffing might not be sufficient to maintain the level of experimental activity. Since then, staff losses included the Operations Superintendent, two full-time Senior Reactor Operators (SRO), and one student SRO. Replacements were hired except for the Superintendent, a position that is being temporarily filled by the Director. Current staffing consists of twelve full-time operators and two students to support three shifts of operation. Management approved a staffing increase of two positions to account for increased workload. These new positions are unfilled, but efforts to fill all positions appeared to be aggressive. The inspector concluded that management attention to the reactor operations staffing requirements was good.

Present health physics staffing consists of a Reactor Radiation Protection Officer (RRPO) an Assistant Reactor Radiation Protection Officer (ARRPO), and two technicians. The RRPO holds an advanced degree in Radiation Science in addition to six years in his present position and previous experience as a researcher at a university and work at a commercial power plant. The ARRPO also has an advanced degree in Radiation Science in addition to three years as a health physics technician at the facility. The senior technician has five years experience in his present position and six years military health physics experience. The new technician holds an advanced degree and has six years experience as a shipyard radiation technician. The staff is qualified and the staffing level is appropriate for the present activities of this facility. When the planned new in-core experiments and the medical treatment facility come on line, or if second shift activities increase, reevaluation of staffing levels would be appropriate. No safety concerns or violations were identified.

5.0 Control of Experiments

The licensee's program for the control of experiments was reviewed with respect to the requirements in Technical Specification (TS) 6.1, "General Experiment Criteria," and TS 7.9, "Experiment Approval Procedures." Overall responsibility rests with the Director of Operations, who also performs the initial review of new experiments and determines the review process to be followed. He also determines if there is an unreviewed safety question in accordance with 10 CFR 50.59. Administratively, new experiments are handled the same as permanent changes to reactor systems or straightforward sample irradiations. The review process is generally referred to as the "Quality Assurance Program" and is documented in Chapter 1 of the Reactor Procedures Manual. Items graded as category "c" are approved by the Director alone, while items graded "a" require approval from the Reactor Safeguards Committee. A handout called "Information for Experimenters" also provides a good outline of the review process.

The inspector reviewed the approvals and precautions incorporated in the following experiments: neutron chopper, prompt gamma facility, corrosion studies, rabbit tube and primary chemistry room irradiations. The technical reviews were found to be excellent, good controls and limitations were imposed, and a high level of safety was achieved. The use of radioactive material from the reactor is reviewed and approved by the reactor operations staff as well as the RRPO. A logbook of "MITRSC Experiment Review and Approval Forms" records the approvals. The form, "Irradiation Request Form," is then used by various on-campus and off-campus personnel to obtain irradiated material. These users are authorized to possess the irradiated material. The inspector reviewed several completed forms and noted that each had one or more inconsistencies. The licensee stated that this would be corrected by issuing instructions for the form or replacing it with another form with self-explanatory entries. This matter will be reviewed in a future inspection. (50-20/92-02-01)

6.0 Safety System Surveillances

The inspector reviewed selected records and procedures for the conduct of surveillances required by TS Section 4.0, "Surveillance Requirements." All surveillances were completed at the required intervals, while some, such as control rod drop times, were performed more frequently than required. This represents a good licensee initiative. Surveillances were conducted under actual operating conditions and provided high confidence that the system would operate as designed. Within the scope of this review, the licensee's program for surveillances was found to be effective.

TS 3.4 specifies that the hydrogen gas concentration in the air space above the core shall not exceed 3.5 volume percent. This is to prevent a flammable concentration of hydrogen from the radiolytic decomposition of reactor water. The hydrogen concentration is not measured, but there is a reactor start-up checklist entry that requires 4 to 5 standard cubic feet per minute (scfm) of purge air through the head area. There

were no calculations available for the minimum flow rate of purge air required to maintain the hydrogen in specification during full power operation. The licensee stated that estimates would be made. The need for a specification for minimum purge flow rate will be discussed by the inspectors with NRC/Office of Nuclear Reactor Regulation.

7.0 Shipment of Radwaste

During the course of this inspection, the licensee shipped several drums of dry active waste to a radwaste broker. Prior to shipment, each drum was brought to the counting laboratory and gamma scanned with the GeLi detector in a preset geometry. This is a very sensitive technique. Electronic calibration factors have been determined using a dummy drum loaded with test sources. The dose-rate-to-curie conversion factors were published by the licensee in a March 1992 report titled "Waste Stream Analysis and Characterization for Determining Compliance with 10 CFR 20 and 10 CFR 61." All conversion data was built into a computer spreadsheet that does the calculation of data for the shipping manifest. Records reviewed by the inspectors were proper. Fission product beta emitters were determined by ratios to cesium-137, while corrosion product beta emitters were ratioed from cobalt-60. Drums were properly labeled and loaded. Within the scope of this review, the radwaste shipping program was found to be excellent.

8.0 Radiation Protection Program

8.1 Training

The MIT "Required Procedures for Radiation Protection" training packet provides adequate guidance and instruction to radiation workers and, with the exception of a formal ALARA (As Low As Reasonably Achievable) statement, fulfills the requirements of an ALARA program. The RRPO stated that he is aware that the new 10 CFR 20, when implemented, will require a formal ALARA program. Additional training is given to students and experimenters by the operations staff prior to their use of the facility. The RRPO stated that a system of "qualification cards" is being developed to track and document the training qualifications and experience of the experimental users. This will be used to improve control of the different access levels to the reactor facilities. No safety concerns or violations were identified.

8.2 Procedures

The inspector reviewed the procedures used by the HP staff. The procedures covered appropriate areas of health physics operations. The individual instructions, though fairly general and broad, provided adequate information and direction based on the staff's high level of experience. The licensee's use of

procedures was determined to be acceptable. No safety concerns or violations were identified.

8.3 Radiation Surveys, Analyses, Signs, and Postings

The licensee is required by 10 CFR 20.201 and 20.203 to perform routine surveys to evaluate the radiation hazards present and to properly post such areas with the required signs. The inspector conducted tours of the reactor controlled area, observed daily radiation and swipe surveys, cooling tower water sample collection and analysis, accompanied staff on a general area walk-through, and observed a solid radioactive waste shipment. Additionally, procedures and records of these routine surveys, reactor pool water and air samples, liquid and gaseous effluent releases, and radioactive water analyses were reviewed by the inspector. Radiation controls were good. The warning signs and postings properly reflected the radiological conditions in the facility. The daily radiation area survey ensures that these posting are current. The licensee required specific protective clothing before granting access to the top of the reactor. However, no posting indicated the contamination hazard present. The licensee stated that the area will be posted appropriately. The type and frequency of the radiation surveys and analyses were appropriate for the facility. Results outside normal parameters are investigated and corrective action taken when required. All radioactive releases were well within regulatory limits and reviewed by the RRPO. Coordination between the reactor facility and the campus radiation protection office handling the radwaste shipment was excellent. The inspector determined that the routine survey and analytical programs and postings were good. No safety concerns or violations were identified.

8.4 Personnel Dosimetry

The licensee uses a National Voluntary Laboratory Accreditation Program (NVLAP)-accredited vendor to process personnel thermoluminescent dosimetry. The program includes action levels for investigation of elevated exposures and lost badges, and procedures for requesting previous exposures and responding to such requests. The monthly reports are informally reviewed by the RPO and reviewed by the RRPO. The inspector noted that there was no record that management had reviewed these reports. The RRPO stated that he would formally document his review in the future. The dosimetry results are posted on the facility bulletin board allowing the staff to examine their records. All dosimetry records appeared to be in order and no safety concerns were noted. A review of records indicated that all exposures were within NRC limits. The licensee has implemented an effective personnel monitoring program.

8.5 Calibration of Equipment

The inspector reviewed the use, inventory, and calibration of the portable radiation survey equipment. The inspector also reviewed calibration, quality control, and test source certification records for portable radiation monitoring instruments, counting room instruments, and the area radiation monitors. The inspector determined that sufficient amounts and appropriate types of portable survey equipment were available to the staff. The calibration of the portable survey and health physics counting lab equipment was performed in-house by the licensee. Calibration procedures were consistent with ANSI recommendations or the manufacturers' recommendations. The calibration source strength was verified as a transfer standard from the campus NIST-traceable radium source. The inspector noted the following weaknesses.

The data for calculating the 2.2 liter water jar geometry correction factor could not be located during the inspection. The licensee stated that the factor would be verified by recalibrating the geometry using NIST-traceable liquid check sources.

QC and QA controls consisted of background tracking, but did not include charting or informal peak drift verification. The licensee stated that, for the interim, a background control chart, a monthly check source control chart, and a formally documented monthly peak drift verification will be maintained. However, a new GENI 486PC based multichannel spectroscopy system is in place and being brought on line to replace the hardwired Canberra 85 series system presently being used. This system incorporates standard QC and QA tracking systems within its programmed daily setup. Upon turnover this will substantially enhance the analysis program.

These items will be reviewed in a future inspection. (50-20/92-02-02)

9.0 Exit Interview

The inspector met with the licensee representatives indicated in Section 1.0 on December 3, 1992 and summarized the scope and findings of this inspection.