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J. A. BERNARD, JR.
Director of Reactor Operations

October 2, 1996

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attn.: Document Control Desk

Subject: Peer Review Audit of MIT Research Reactor, License No. R-37, Docket No. 50-20

Gentlemen:

At the request of the Massachusetts Institute of Technology, the National Organization of Test, Research, and Training Reactors (TRTR) conducted a review of operations at the MIT Research Reactor on 19-20 August 1996. Enclosed as an item of information is a copy of this report.

Sincerely,

John A. Bernard, Ph.D.
Director
MIT Nuclear Reactor Laboratory

JAB/CRM

cc: USNRC - Region I - Project Scientist,
Radiation Safety Branch

USNRC - Region I - Senior Project Manager,
Non-Power Reactors and Decommissioning Project Directorate

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Reactor Division

September 17, 1996

Dr. John A Bernard
Director of Reactor Operations
Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street
Cambridge, MA 02139-4296

Dear John,

Enclosed is the report of the committee for the peer review which you requested. We would like to express our sincere thanks for the excellent cooperation we received from you and your staff during our review. Please do not hesitate to contact us if you have any questions about the report.

Sincerely,

William G. Vernetson
University of Florida

David C. Rorer
Brookhaven National Laboratory

c: Thomas Bauer / Bernard Wehring
University of Texas

REPORT OF THE PEER REVIEW COMMITTEE

Massachusetts Institute of Technology Reactor

August 19-20, 1996

A peer review committee, consisting of William Vernetson and David Rorer, visited the MIT Reactor to conduct a review on August 19-20, 1996. This review was triggered by a series of problems which arose in 1995, and the committee was asked to focus on the safety issues raised by these problems and to evaluate the adequacy of corrective actions taken.

Issues examined in this review stemmed from the following events:

- Concerns expressed during a visit by the NRC AEOD:

  Friction between the Reactor Operations and Reactor Radiation Protection Groups

  Cleanliness of facility (floors had not been washed and spare computer parts were piled in a corridor outside the reactor building)

- Reportable Occurrence 50-20/1995-1, "Operation for One Week Without Documenting Required Testing Results of Emergency Battery"

- Reportable Occurrence 50-20/1995-2, "Operation with Fewer than the Required Number of <100 kW Nuclear Safety System Level Channels"

- Reportable Occurrence 50-20/1995-4, "Operation with One Shim Blade Fully Inserted"

- Reportable Occurrence 50-20/1995-05, "Malfunction of a Shim Blade Drive Mechanism"

The most serious event was clearly ROR 95-4, "Operation with One Shim Blade Fully Inserted." The requirement in Technical Specification 3.11 to maintain all blades within 2" of each other was violated as a result of this occurrence. At a special meeting concerning this event, the MIT Reactor Safeguards Committee recommended a number of corrective actions to prevent recurrence and improve safety and reliability of operations. The peer review committee agrees fully with those recommendations.

The peer review committee found that the reactor is being operated safely and in accordance with NRC Regulations and the provisions of the facility license and Technical Specifications. Corrective actions taken as a result of the events listed above were evaluated, and the underlying safety concerns were examined. We found the majority of the corrective actions which were taken to be appropriate and effective. This report contains five recommendations for additional improvement in the safe and reliable operation of the MIT Reactor.

The peer review committee would like to thank the staff at MIT for their time and valuable assistance. The cooperation and openness of the staff were very much appreciated.

STAFFING AND ORGANIZATION

The facility is staffed adequately and the organization, roles and responsibilities were well understood by everyone we interviewed.

The MIT students who are hired as operators appear to be very bright, mature, and reliable. Turnover is not a problem because of the support of the experienced main core of the staff and the training which is provided. We were very impressed with the conduct of a training startup which we observed. The questions posed by the instructor and the general manner of interaction between the instructor and trainee showed a high level of competence and were evidence of an effective training program.

We found no evidence of any friction between the Operations Group and the Reactor Radiation Protection Group. Indeed, a small area of contamination was discovered at the facility during the peer review. The Radiation Protection personnel and Operations personnel interacted effectively and cordially in addressing and correcting the problem. Our interviews with various staff members did indicate that in the past there had been some communications problems and lack of cooperation between Operations and Maintenance personnel. These problems have been significantly reduced during the past year, primarily because of personnel changes. Some of the staff members had some ideas about how to further improve communications between the Operations and Maintenance Groups. We suggest that management consider these ideas and continue to explore other ways to encourage and develop a real sense of joint ownership of the equipment (and its problems) by the two groups. This will enhance the rapid identification and correction of equipment malfunctions and significantly improve reliability.

We do note the retirement of the Nuclear Reactor Laboratory Director and interim appointment of the Director of Reactor Operations as the acting Nuclear Reactor Laboratory Director. We would urge that the facility make a permanent appointment of a qualified individual to this position at the earliest time possible consistent with hiring policies.

CONDITION OF THE PHYSICAL PLANT

Housekeeping within the reactor containment was generally very good. The experimental floor was clean and free of excessive clutter. The presence of a rather large amount of equipment was investigated and appears to be necessary for the continued effective conduct of operations and the experimental mission of the facility. The exterior of the containment building was in the process of receiving a

new coat of paint during our visit. Physical barriers and postings for radiological control were in place as required.

We did observe a significant number of large, color-coded plastic containers used to handle irradiated silicon. These containers, many of which were apparently empty, were stored inside the containment in order to provide radiological control of contamination in the containers. The fire loading presented by these containers has not been analyzed, and this raises a concern, not only because of the potential fire hazard to the reactor and to personnel within the building (which may in fact be minimal), but also with respect to the potential impact on public relations due to the extreme sensitivity of the news media to even a small fire within a reactor containment.

Recommendation 1: Evaluate the fire hazard presented by the plastic containers for irradiated silicon, and, if necessary, take action to reduce this fire loading.

The housekeeping outside the containment, especially in the experiment preparations and electronics repair areas, is somewhat lax. We suggest that some consideration should be given to improving the storage of unused materials and to clean up areas not currently in use. At the very least this would improve the image of the facility presented to technical as well as non-technical visitors.

CONDUCT OF OPERATIONS

We visited the control room several times during the course of this review. The control room was clean, quiet and orderly, and communications among the operators were carried out in a professional manner.

We understand that the operators are permitted to eat in the control room while on duty there. This appears to be an acceptable practice, provided that 1) tight radioactive contamination controls are maintained, such as thorough frisking upon leaving contamination areas, and 2) the control room does not become a gathering place for others to socialize while eating, thereby causing a potential source of distraction for the operators. During our visit, we observed no infringement of these qualifying conditions.

We note that a common factor exists in the events documented in ROR's 95-01, 95-02, and 95-05: the reported errors all seem to involve a lack of attention to detail. The corrective actions taken were, in our opinion, necessary and sufficient

to fix the immediate problem. There is a possibility that the lack of attention exhibited in each of these events might be indicative of some other more fundamental underlying weakness. We emphasize that we have no evidence that these occurrences were anything more than random errors, but we do suggest that management be on the alert for any signs of an upward trend in personnel errors.

Failure to follow procedures was an important factor in the incident documented in ROR 95-4. The MIT Reactor Safeguards Committee recommended "management action to ensure that all personnel follow facility procedures." We therefore took special note of whether or not procedures were being followed. Facility procedures were readily available to the operators; they were located in binders several feet behind the operators positioned at the control console and instrument panels. We noticed that personnel referenced these manuals on several occasions and we observed that checklists were being accurately followed during the startup.

However, we observed some experimenters go onto the top of the reactor without first notifying the operators or receiving authorization to do so, as required by procedures. The operators took no action to remind the experimenters that they had violated procedures at the time of the visit. Management did indicate later that a reminder would be conveyed to the experiment group members. We also witnessed unsupervised trainees taking some non-safety-related readings in the control room in preparation for reactor startup, a practice apparently not in strict accordance with facility policy.

As outside observers, it is difficult for us to accurately determine the normal level of procedural compliance, since the very presence of the observers inevitably alters the behavior of the persons observed. Nevertheless, we feel that these procedural deviations indicate that some further management attention is necessary to assure that all personnel understand and comply with established policies and procedures governing the operation of the facility.

Recommendation 2: Increase upper management attention and presence in the facility to ensure that all aspects of day-to-day operations are actually being performed in accordance with the applicable policies and procedures.

The Reactor Safeguards Committee also recommended that a better method of communication be developed among all operators, especially regarding abnormal situations. In response, a monthly meeting with operators was instituted, together with the operators' required reading of a "blue book" for logging unusual conditions or events. We found this to be an excellent approach for improving operator communications; indeed, all of the people with whom we spoke seemed well aware

of the current status of the plant. They were all also well aware of the contents of the book and we noted their reference to it prior to initiating startup.

While verifying the corrective actions taken for ROR 95-4, we noted that the new procedure to be followed when the reactor does not go critical within 0.5" of the Estimated Critical Position (ECP), does not necessarily require that the reactor be shut down, but only that the rods be inserted one inch. In our opinion, if the ECP is missed by a sufficient amount (this may be 0.5" or some other value to be determined best by those who know the facility, in conjunction with the Safeguards Committee), a mandatory shutdown of the reactor should be required. It is essential that the operators' natural "momentum" to continue with the startup be unequivocally interrupted, and that their full attention be focused on the ECP problem without having to worry about the reactor being in operation. Although admittedly conservative, this shutdown requirement will permit the operators to concentrate on a thorough investigation of the causes of error in the ECP, inform upper management, and obtain a broader-based consensus on the appropriate actions to take. We also suggest that if conditions exist (such as an in-core experiment with large uncertainty in reactivity) which make an accurate estimate of the Critical Position impossible, an approach to critical using a 1/M plot should be substituted for the normal ECP procedure.

Recommendation 3: Establish a requirement for mandatory shutdown of the reactor when the ECP is missed by more than a prescribed amount during startup.

Although the blade-in indicators are not considered "required" instrumentation, we feel that it is not good practice to permit startup of the reactor with known false indications present on the control panel. Even though the operators may be well aware that a blade-in indicator is out of commission, operation of a reactor is complicated enough without introducing any potential source of confusion. Also, redundancy and diversity features of the reactor instrumentation design are defeated if routine operation is permitted with instruments out-of-commission.

In this regard, one outstanding problem remains with the blade-in indicator system: the cause of the high failure rate of the proximity switches still has not been positively identified. The approach of trying to solve the problem by selective replacement of parts in order to find the optimum configuration of switches, wires, insulation, and encapsulation takes time, because of the need to test to failure each configuration in the harsh reactor environment. It appears that a workable solution may now have been found. However, if the problem is not resolved in the very

near future, we urge that additional resources be committed to finding a satisfactory solution as rapidly as possible.

As a result of the ROR 95-4 incident, we were concerned about possible pressure to operate the reactor from experimenters or other reactor users. We could find no evidence of any undue overt pressure; however, from our own experience we know that there is always subtle pressure from the users of any facility to have that facility operate on demand. Furthermore, facility operators themselves tend to be driven by their own desire to operate the facility, as well as to please their clients by "delivering the goods." For these reasons, management must be constantly on guard to resist the tendency to postpone preventive maintenance ever longer in favor of continued operation (see next section below), or to continue to operate under slight but gradually increasing conditions of system degradation. We believe that it is better to err more on the side of conservatism than has been the case at this reactor, and to lower the threshold for perturbing the operating schedule in order to correct minor equipment problems.

Recommendation 4: Establish more conservative criteria for startup of the reactor with equipment out of commission. Evaluate the need to prohibit startup with known false or misleading indications on the control room instrumentation.

MAINTENANCE

We were pleased to see that a number of new reactor instruments have been installed, and more systems are about to be replaced. Because of their much higher reliability, the new instruments will enhance safety, alleviate the need for frequent repairs, and permit more attention to be focused on preventive maintenance.

We also noted that a large backlog of maintenance work requests, some outstanding for periods of two or three years, has been substantially reduced during the last 10 months. A fundamental contributor to the occurrence in ROR 95-4 was, in our view, the general lack of an aggressive approach to maintenance problems. It is commendable that such significant progress in overcoming this problem has been made in such a short time.

It is essential that this progress be continued. In order to achieve high reliability, the focus of maintenance must gradually shift from repair and replacement to

preventive maintenance. This will require consistent and unflagging attention and support from upper management.

Recommendation 5: Continue to strengthen and improve the maintenance program, with emphasis on aggressive pursuit of preventive maintenance.

RADIOLOGICAL CONTROLS

All personnel observed entering the containment building were wearing dosimeters, and all those leaving the containment were using the contamination monitor correctly. A spot of radioactive contamination discovered during a survey within the controlled area was promptly cleaned up by the HP tech; persons in the area were frisked and found to be clean. Radiological controls were deemed to be appropriate and effective. It was good to see management in both the radiation protection area and the operations area work with and consult with each other to assure this minor incident was addressed properly. The congenial cooperation between the two groups was an excellent indicator that past friction between these groups has been adequately addressed.

SAFETY OVERSIGHT

We noted that the Reactor Safeguards Committee has three members who have direct line responsibility for the Reactor Division. This gives at the very least the appearance of a possible conflict of interest. These individuals certainly should be present at meetings of the Committee in order to give presentations and answer technical questions, but we suggest that they ought not be voting members of the Committee.

CONCLUSIONS

Overall, as with any facility, there are certainly areas in which improvements are needed. However, the reviewers feel this reactor is making good progress and does not have any serious safety problems in areas which were reviewed. It is important that this facility continue to maintain its long-held place among the finest training and research reactors in the United States. We believe that the recommendations and suggestions contained in this report will prove of value in preserving that distinction.