NUCLEAR REACTOR LABORATORY
AN INTERDEPARTMENTAL CENTER OF
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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

March 2, 1992

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Reportable Occurrence 50-20/1992-1, Improper Increase of Reactor Power Causing a Brief Excessive Power Level

Gentlemen:

Massachusetts Institute of Technology hereby submits this ten-day report of an occurrence at the MIT Research Reactor (MITR) in accordance with paragraph 7.13.2(d) of the Technical Specifications. An initial report was made by telephone to NRC Region I (Mr. Thomas F. Dragoun) on February 21, 1992. A telephone report was also made to NRC Headquarters, Mr. Alexander Adams, on the same day. These telephone reports were delayed beyond the normal 24 hours because this occurrence was not identified by the MITR's senior staff until late on February 20, 1992. This is further discussed in the report.

The format and content of this report are based on Regulatory Guide 1.16, Revision 1.

1. Report No.: 50-20/1992-1

2a. Report Date: 2 March 1992

2b. Date of Occurrence: 18 February 1992

3. Facility: MIT Nuclear Reactor Laboratory
138 Albany Street
Cambridge, MA 02139

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1/1

4. Identification of Occurrence:

Improper performance of an increase in reactor power so that as a result of manual withdrawal of individual shim blades, the reactor's neutronic power attained 5.25 MW. The control devices were then inserted with the result that the total time for which the neutronic power exceeded 5.0 MW was about 22 s. This occurred at 1921 on 18 February 1992. The reactor's thermal power, which is continuously computed by a calorimetric balance and recorded, never exceeded 4.69 MW.

5. Conditions Prior to Occurrence:

The reactor was on analog automatic control at steady-state with the shim bank at 15.40 inches. The regulating rod which was connected to the analog controller was at 7.04 inches. Channel #7, the linear flux channel, was indicating 84.8 μa which corresponds to 4.8 MW. The reactor had been at this power level for about 24 hours and had not yet attained thermal equilibrium. As a result, the thermal power was 4.69 MW. Several experiments were in progress, including one which required a near-constant temperature environment. This in turn meant that the power level had to be maintained constant.

6. Description of Occurrence:

The performance of reactor power increases at the MIT Research Reactor is governed by written procedures that have been reviewed and approved by the MIT Reactor Safeguards Committee (MITRSC). These procedures require, among other things, that (1) reactor power be increased on a period that is longer than 100 s whenever power is within 80% of the demanded level and (2) that two licensed operators, one of whom holds a senior license, be present in the control room during any power increase of more than 10%.

At approximately 1921 on February 18, 1992, a malfunction occurred in the reactor's analog controller with the result that the regulating rod was continuously inserted until it reached its near-in limit. This caused the reactor's neutronic power, as indicated by channel #7, to decrease to 33.0 μa (1.87 MW). The console operator, a licensed senior operator, then took manual control of the reactor and notified the Duty Shift Supervisor and the Reactor Superintendent of the problem. Permission was given for a return to the normal operating power. The operator was anxious to minimize the temperature perturbation to the on-going experiment and therefore, instead of waiting for the Duty Shift Supervisor to reach the control room, asked another operator, who was in the immediate area, to witness the power increase. This was an acceptable practice except that the increase was initiated before the second operator had fully reviewed the situation. The console operator sequentially raised each of the reactor's six shim blades by several tenths of an inch so as to create a positive period and to maintain a uniform bank height. This was in accordance with the governing procedure, except that enough reactivity was inserted to create a reactor period of about 50 s and, contrary to the approved procedure, the operator maintained this period until approaching the desired power level. He then began to insert the shim blades sequentially, but was unable to negate completely the positive period because the differential reactivity worth of an individual blade at a height of about 16.00 inches is not sufficient to immediately

offset the reactivity associated with a 50-s period. As a result, an overshoot of the neutronic power occurred. This is shown in the attached figure which is the strip-chart recording of linear flux channel #7. (Note: Once it was apparent that the power would overshoot, the operator drove one of the shim blades in continuously.) An error in judgment was then made in that the console operator did not notify the Reactor Superintendent of the overshoot. As a result, the occurrence was not identified by the MITR's senior staff until the evening of February 20, 1992.

7. Description of Apparent Cause of Occurrence:

The apparent cause of this occurrence was operator error in that the operator performed a power increase on a period shorter than 100 s while the power was within 80% of the demanded level.

8. Analysis of Occurrence:

The reactor's neutronic power, as measured by the trace recorded on the strip chart for channel #7 (the linear flux channel) reached 5.25 MW and was above 5.0 MW for 22 s. The reactor safety system is set to activate at 5.5 MW and this level was not reached. Reactor power, as recorded on the thermal power strip chart, did not exceed 4.69 MW. It should be noted that the MITR-II Facility Operating License is written in terms of thermal power and hence no limiting condition for operation was exceeded.

It is not expected that an excursion to the 5.25 MW neutronic power level reached in this case, which is well below the authorized limiting safety system setting of 6 MW, would in any way cause any damage to the reactor. Nevertheless, analyses were made of the primary coolant. No abnormalities were identified. The core purge gas monitor was normal and a subsequent visual inspection of the reactor core revealed no abnormalities. These actions confirmed that no damage occurred to the reactor.

9. Corrective Action:

The following corrective actions have been taken:

(a) This occurrence was reviewed verbally with the operator in question with emphasis on the proper conduct of power increases.

(b) The Senior Review Board met to discuss the occurrence and decided to require that the operator involved complete a special review of the procedures and principles that govern power increases. (Action to be completed by 13 March 1992.)

(c) The Senior Review Board also decided that the protocol for information exchange between operators, the details of this occurrence, and the criteria for notifying the senior MITR staff of occurrences be reviewed by all licensed operators. (Action to be completed by 30 April 1992.)

(d) Investigated and repaired analog automatic control system. (Temporary repair completed 25 February 1992. Permanent repair is still pending.)

10. Failure Data:

An improper reshim that resulted in an overshoot of the neutronic power occurred on 19 November 1987. (See ROR #50-20/1987-2.)

Sincerely,

Kwan S. Kwok, Ph.D.
Superintendent

John A. Bernard, Ph.D.
Director of Reactor Operations
MIT Research Reactor

JAB:CRH

Attachment: Figure One

cc: MITRSC
USNRC– Region I - Chief,
Reactor Projects Section No. 3A
USNRC – Region I - Reactor Engineer,
Reactor Projects Section No. 3A
USNRC – Project Manager,
Standardization and Non-Power Reactor Project Directorate
USNRC – Region I - Chief,
Effluents Radiation Protection Branch

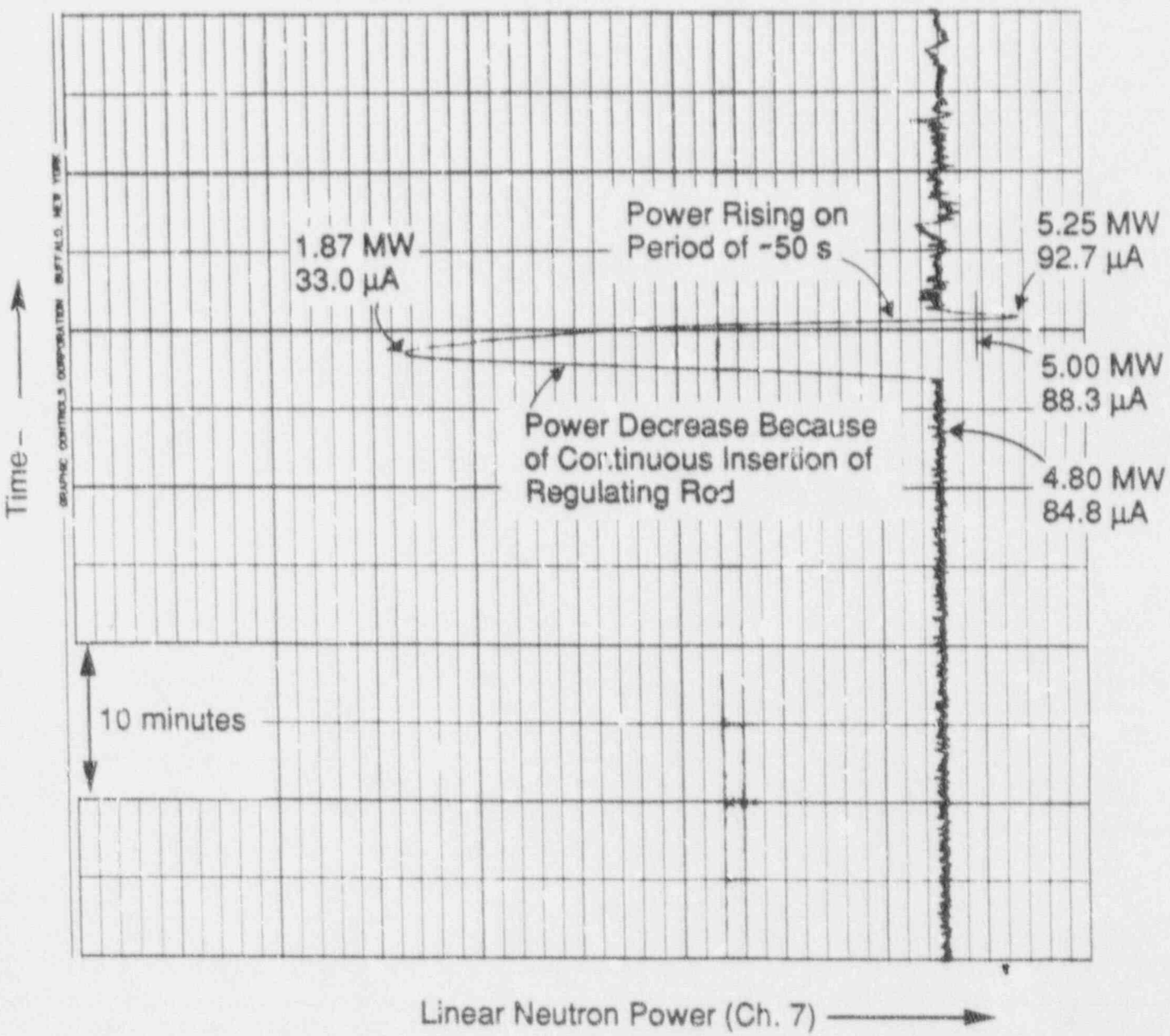

Figure One: Strip Chart Recoding of Linear Flux Channel