



NUCLEAR REACTOR LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



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October 19, 1979

Mr. Boyce H. Grier, Director
U.S. Nuclear Regulatory Commission
Region #1
631 Park Avenue
King of Prussia, PA 19406

Attention: Mr. T. Stetka, Reactor Inspector

Re: Reportable Occurrence 50-20/79-5, License R-37: Operation with Fewer than the required number of Nuclear Safety Channel Level Scrams

Gentlemen:

Massachusetts Institute of Technology hereby submits this 10 day report of an occurrence at the MIT Research Reactor in accordance with Paragraphs 7.13.2d, 1.15.1 and 3.7.1 of the Technical Specifications. An initial report was made by telephone to Region #1 on October 11, 1979.

The format and content of this report is based on Regulatory Guide 1.16.

1. Report No. 50-20/1979-5
2. a) Report Date: October 19, 1979
b) Date of Occurrence: October 10, 1979
3. Facility: M.I.T. Research Reactor
138 Albany Street
Cambridge, Mass. 02139
4. Identification of Occurrence: Startup of the reactor on October 10, 1979 with only one operable nuclear safety channel level scram. Technical Specification 3.7 stipulates that at least two such channels must be operable prior to the reactor's being brought critical.
5. Conditions Prior to Occurrence: The reactor had been operated at a power level of 500 watts on October 10, 1979 in order to calibrate the shim blades as per procedure 6.5.16.2. This procedure specifies that the reactor be operated in accordance with procedure 3.1.3, Startup for Less Than 100 kw Operation. The latter, in turn, requires that low range amplifiers be installed in channels #5 and #6 of the neutron safety system. This was done, and the blade calibration successfully completed. Full power checklists were then performed. In accordance with these procedures, the high-range amplifiers were reinstalled in safety channels #5 and #6. In addition, neutron safety level channel #4, whose chamber had been previously identified as having failed, was repaired. This channel was considered out-of-commission pending observation of its performance during both reactor startup and full power operation.

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6. Description of the Occurrence: The reactor was brought critical at 1906 on October 10, 1979. The cooling towers were then realigned for full power operation, and a slow rise to full power, 4.9 MW, was initiated. It was noted at 2019 on October 10, 1979 that the level signal on safety system channel #5 was reading approximately half its normal operating value and, hence, incapable of causing an automatic reactor scram at less than 6 MW, the limiting safety system setting. The reactor was immediately shut down. Safety channel #6 was observed to have been operating properly during the rise to full power. In addition, level channel #8, which, while not part of the safety system, does provide an alarm if power exceeds 5.1 MW, was also observed to be operating correctly. Safety channel #4, which had been considered out-of-commission during the start-up, was determined to still be malfunctioning. The maximum reactor power attained during this rise to full power was 4.80 MW.
7. Description of the Apparent Cause of the Occurrence: Following the shut down of the reactor, the high-range amplifier for channel #5 was removed and inspected. It was found that a lead to one of the resistors on the circuit board on which the amplifier's electronic components were mounted was broken. It is believed that the lead had been inadvertently broken when the changeover from the low-range to the high-range amplifiers was performed following the completion of the shim blade calibration. This evolution requires that a circuit board, the one on which the resistor in question was mounted, be transferred between the low and high-range units. Channel #6's circuit board was examined and found to be intact.
8. Analysis of the Occurrence: Neutron level safety channel #4 was out-of-commission during the period in question and not capable of causing an automatic reactor scram. Channels #5 and #6 had been set to provide automatic scrams at a power level of 5.5 MW. The proper setpoint for each channel was determined by comparing readings taken on the channels during the preceding week with thermal power data for that week. The procedure for doing this is specified in the startup checklist. The operability and validity of these trip points had been tested and verified using electronically-simulated input signals. The fact that a resistor lead in channel #5's circuitry became broken caused the input of that channel's neutron-sensing chamber to the scram amplifier to be about half its anticipated value based on the previous week's data. Specifically, the input signal was 12 μ a at 4.80 MW. A value of 25 μ a was expected. Hence, channel #5 was not capable of causing an automatic reactor scram. Safety channel #6 was observed to be operating properly, and it would have caused a scram if reactor power had exceeded the setpoint of 5.5 MW. In addition, channel #8 was functioning correctly and would have caused an alarm if power had exceeded 5.1 MW.
9. Corrective Action: The immediate corrective actions consisted of:
 - a) An immediate shutdown of the reactor.
 - b) Inspection of the amplifier circuit board for channel #6 and repair of the circuit board for channel #5.

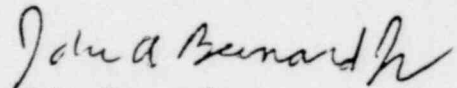
The steps taken to prevent a recurrence of this type are as follows:

- a) Complete repairs to safety system level channel #4.

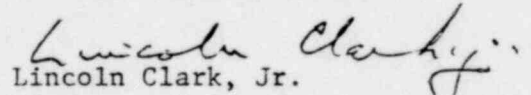
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- b) Construct separate circuit boards for the low and high range amplifiers thereby eliminating the need to interchange these circuit boards whenever the low-range amplifiers are installed.
10. Failure Data: This is the first failure of this nature to have occurred at the facility.

Sincerely,



John Bernard
Reactor Superintendant



Lincoln Clark, Jr.
Director of Reactor Operations

JB/gw

cc: MISTRSC
USNRC-OMIPC

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