

MIT NUCLEAR REACTOR LABORATORY

AN MIT INTERDEPARTMENTAL CENTER

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January 30, 2018

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

Re: Massachusetts Institute of Technology; License No. R-37; Docket No. 50-20; Reportable Occurrence 50-20/2018-2: Operation with Fewer than the Required Number of Full Power Nuclear Safety System Level Channel Scrams; NRC OPS Center Log #EN 53174.

Dear Sir or Madam:

The Massachusetts Institute of Technology hereby submits a report of an occurrence at the MIT Research Reactor (MITR) in accordance with paragraph 7.7.2 of the Technical Specifications. An initial verbal report was made by telephone to the U.S. Nuclear Regulatory Commission Headquarters Operations Center on 18 January 2018 at 0915.

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

1. Report No. 50-20/2018-2; Ops Center Log #EN 53174
- 2a. Report Date: 30 January 2018
- 2b. Date of Occurrence: 17 January 2018
3. Facility MIT Nuclear Reactor Laboratory
4. Identification of Occurrence:

The reactor was critical at 1 MW with only one operable neutron flux level channel scram. Technical Specification No. 3.2.3.1 requires that "the reactor shall not be made critical unless the reactor protection system is operable in accordance with Table 3.2.3-1." In full power configuration, i.e. using two primary pumps, this table requires two operable neutron flux level channels set to scram at < 7.4 MW.

5. Condition Prior to Occurrence:

The reactor full power startup checklists were complete and a startup to 1 MW was planned for training. Channel 5 neutron flux level channel was declared out-of-commission for the startup. Channel 4 and 6 neutron flux level channels were operable with their scram trips set at 6.5 MW.

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6. Description of Occurrence:

The reactor reached 1 MW at 1219 on 17 January 2018. The shift supervisor was completing the required procedure checks at this power level and observed that the Channel 4 neutron flux level channel was still reading zero. At 1 MW the shift supervisor expected a reading $\sim 8 \mu\text{A}$. Channel 6 was responding with a reading $\sim 7 \mu\text{A}$. The reactor operator scrammed the reactor at 1228.

7. Description of Apparent Cause of Occurrence:

The apparent cause of this occurrence was a loss of signal from the neutron detector for the Channel 4 neutron flux level channel.

8. Analysis of Occurrence:

The detector input cable to channel 4 neutron flux level channel was verified to be connected. The detector high voltage was verified to be "on" and supplying the correct voltage. In order to troubleshoot, the signal input cable from the associated detector for Channel 4 was disconnected from the channel 4 neutron flux level channel's Safety Amplifier and a current simulator was connected. The current simulator was used to verify proper response of the Safety Amplifier. The simulator was disconnected and the detector signal input cable was re-connected.

The Channel 4 neutron detector is located in the 4IH2 horizontal instrumentation port. The port box was opened to gain access to the detector connections. The signal cable at the detector was disconnected and the female center pin on the detector side fell out of the connector. The signal cable going to the control room from the instrument port was tested using a current simulator and there was no response in the control room. When the current simulator was removed, the signal cable connector came off the cable.

9. Corrective Action:

The immediate corrective action consisted of soldering the female connector's center pin back in place on the detector connector. The signal cable connector was replaced for the cable that leads to the control room. All connections in the port box were made and checked independently by a second person.

The Channel 5 neutron flux level channel was placed back in service and tested per reactor startup checklists so that Channel 4 could remain out-of-commission for a startup for observation and troubleshooting. The reactor was restarted to 1 MW to verify the repairs. At 1 MW the Channel 4 neutron flux level channel initially showed a reading of $\sim 8 \mu\text{A}$. After about five minutes the reading went to zero. The reactor power was reduced to 500 kW. Additional testing showed the connector on the back of the Channel 4 Safety Amplifier was causing the intermittent signal. This connector was then replaced and the cable reconnected to the Channel 4

Safety Amplifier. The reading on Channel 4 was then steady at $\sim 4 \mu\text{A}$. Manipulation of the cable and connector did not cause any further changes in the signal.

The long-range corrective action is to complete installation of the new Mirion Wide-Range Nuclear Safety System. (Action to be completed, four to six months after NRC approval of the associated License Amendment Request.)

10. Failure Data:


Related occurrences were documented in the following RORs:

ROR 50-20/2011-3 dated 28 July 2011 was an instance where the Channel 5 neutron flux level channel was out-of-commission coupled with an operator error in which the Channel 6 detector signal was swapped for the Channel 3 detector signal, thereby resulting in only one operable neutron flux level channel.

ROR 50-20/1989-1 dated 17 March 1989 was an instance where the Channel 4 neutron flux level channel was out-of-commission due to recent repairs and the Channel 5 detector high voltage was left secured, thereby resulting in only one operable neutron flux level channel.

ROR 50-20/1979-5 dated 19 October 1979 was an instance where the Channel 4 neutron flux level channel was out-of-commission due to repairs and the Channel 5 neutron flux level channel showed reduced response by 50%, thereby resulting in only one operable neutron flux level channel.

Sincerely,


Sarah M. Don
Superintendent
MIT Research Reactor


Al Queirolo
Director of Reactor Operations
MIT Research Reactor

cc: MITRSC

USNRC - Senior Project Manager
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Senior Reactor Inspector
Research and Test Reactors Branch B
Division of Policy and Rulemaking
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