MIT NUCLEAR REACTOR LABORATORY

AN MIT INTERDEPARTMENTAL CENTER

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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 50-20/2017-1: Operation with Fewer than the Required Number of Nuclear Safety Channel Period Scrams; NRC OPS Center Log # EN 52497.

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 19 January 2017 at 1012.

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

1. Report No. 50-20/2017-1; Ops Center Log # EN 52497

2a. Report Date: 24 January 2017

2b. Date of Occurrence: 18 January 2017

3. Facility MIT Nuclear Reactor Laboratory

4. Identification of Occurrence:

A startup of the MIT Research Reactor was conducted on 18 January 2017, during which there was only one operable Nuclear Safety Channel Period Scram for a time period of about 15 seconds. Technical Specification No. 3.2.3 requires that the reactor shall not be made critical unless there are at least two operable period channel scrams.

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5. Condition Prior to Occurrence:

Full power instrumentation and mechanical checklists had been completed in preparation for a scheduled reactor startup. Nuclear Safety System channels 1-3 provide short period safety scrams with their inputs being from respective Keithley picoammeters. Channels 1 and 2 picoammeters have two modes of operation; fission chamber and ion chamber. Channel 3 picoammeter operates only in the ion chamber mode and is therefore off-scale low while the reactor is operating at source range. For channels 1 and 2 it typically takes over a minute for the corresponding picoammeter electronics to reach a stable reading on the lower ion chamber signal when the higher fission chamber signal is removed. During this switching time, the channel is considered non-operational. Once channel 3 ion chamber is responding (picoammeter on scale and reset) during a reactor startup, the normal procedure is to switch one of the dual channels from fission chamber to ion chamber, verify the ion chamber signal response and then shift the second dual mode channel.

For this startup, channel 2 ion chamber had been placed out of commission (fission chamber mode remained operable). Channel 3 was off scale with its low trip signal locked in due to being a single mode ion chamber channel. Channel 1 and 2 were operating in fission chamber mode with both picoammeters' off scale trips reset.

6. Description of Occurrence:

Reactor startup commenced at 1100 on 18 January 2017. Once period channel 3 came on scale and the low trip was reset, the supervisor proceeded to switch channel 1 to its ion chamber mode per normal procedure. There are three steps to switch channel 1 or 2 from the fission chamber mode to the ion chamber mode. The first step is to reduce the amplifier gain to its minimum value. The second step is to increase the discriminator setpoint to its maximum value. The third step is to disconnect the corresponding fission chamber signal cable. During this last step, the supervisor inadvertently disconnected channel 2's fission chamber signal cable instead of channel 1's, leaving channel 3 as the only period channel on scale and operating. The supervisor immediately realized what had happened and instructed the operator to manually scram the reactor, which the operator did. During the time the dual channels were being switched, channel 3 was fully functional and showed no indication of a safety limit being approached.

7. Description of Apparent Cause of Occurrence

The supervisor mistook channel 2's fission chamber signal cable for channel 1's fission chamber signal cable and inadvertently disconnected the wrong cable. The fission chambers being utilized by the Nuclear Safety System channels 1 and 2 are fission chambers ultimately to

be used in the Mirion Safety System. The Mirion fission chamber signal passes the raw pulses from the detector directly to the DWK 250 front panel connector prior to any processing. The fission chamber signal for channel 1 and 2 comes from this front panel connector on the Mirion DWK 250 chassis labeled "M2" and "M1" respectively. The labels "M2" and "M1" are in a location and font that is more prominent than their "channel 1" and "channel 2" labels (as shown in Figure 1).

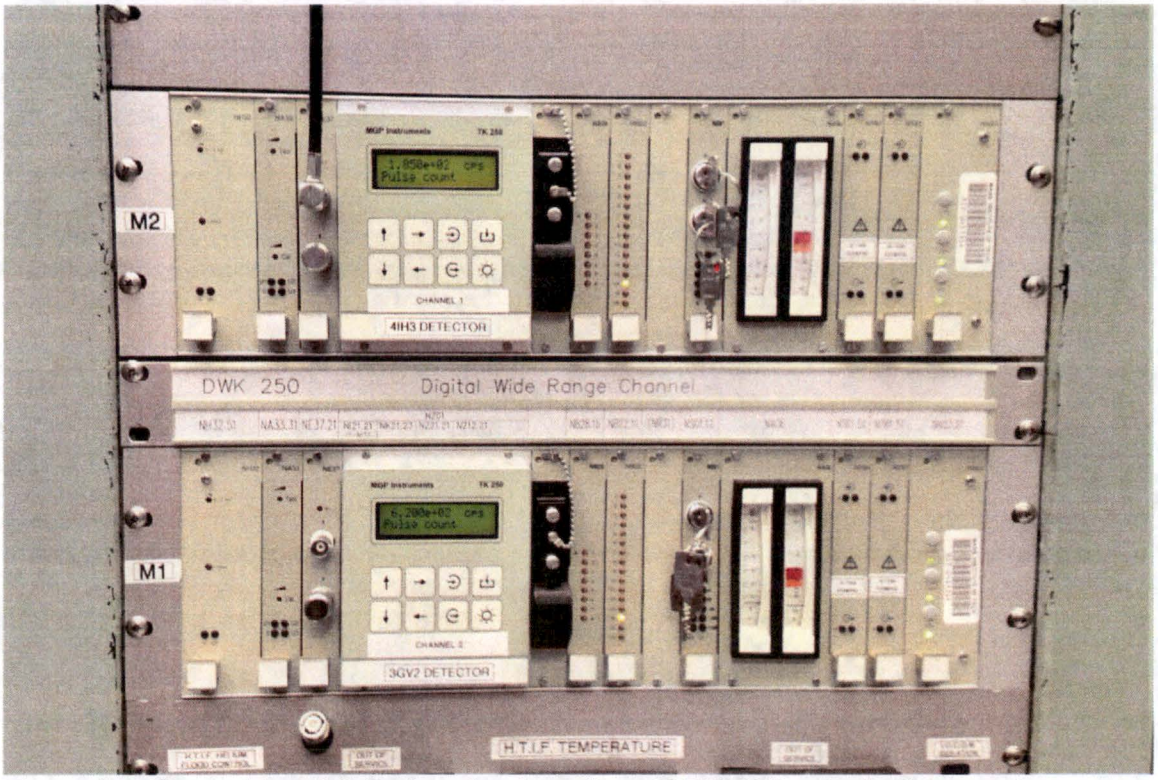

Figure 1 – Channel 1 and 2 fission chambers from DWK 250 units in the console.
Note: Channel 1's fission chamber cable is shown connected and Channel 2's is disconnected.

8. Analysis of Occurrence:

The "M2" and "M1" labels on the Mirion chassis (see Figure 1) correspond to the order in which the units were installed in the console and provide no additional use. The presence of the confusing labels in a large font and a prominent location on the chassis made it easy to confuse the operator of channel 1 and 2. These labels were applied to the Mirion DWK 250 chassis with "Mirion 1" or "M1" for the unit that was installed in July 2012, and "M2" for the unit that was installed in October 2013. These labels should have been removed or re-labeled once their fission chamber signals were transferred for use in the existing Nuclear Safety System.

9. Corrective Action:

The immediate corrective action consisted of shutting down the reactor upon determination that only one of the three period channels picoammeters was considered operational. The long-range corrective actions consist of:

1) Removing unnecessary and confusing labels from the power supply units. (Action completed, 18 January 2017.)

2) Creating a standing order that a 3rd licensed person be present in the control room for startups for the purpose of verifying that the power supply cables for channels 1 and 2 are disconnected properly when switching the channels from fission chamber mode to ion chamber mode, until the new nuclear safety system is installed. (Action completed, 18 January 2017.)

3) Complete installation of new Mirion Wide-Range Nuclear Safety System. (Action to be completed, four to six months after NRC approval of LAR.)

10. Failure Data

Related occurrences were documented in ROR 50-20/1979-5 dated 19 October 1979, ROR 50-20/1989-1 dated 17 March 1989, ROR 50-20/1998-2 dated 6 Jan 1999, ROR 50-20/2011-3 dated 18 July 2011 and ROR 50-20/2011-4 dated 7 Sept 2011.

Sincerely,

Sarah M. Don
Superintendent
MIT Research Reactor

John P. Foster
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

USNRC - Senior Reactor Inspector
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation