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

Subject: Reportable Occurrence 50-20/1999-1, Failure of Main Ventilation Damper to Close on Receipt of a High Radiation Test Signal.

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 7.13.2(d) of the Technical Specifications. An initial report was made by telephone to NRC Region I on 12 March 1999.

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

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|---|---|---|
| 1. | Report No.: | 50-20/1999-1 |
| 2a. | Report Date: | 19 March 1999 |
| 2b. | Date of Occurrence: | 10 March 1999 |
| 3. | Facility: | MIT Nuclear Reactor Laboratory<br>138 Albany Street<br>Cambridge, MA 02139 |

4. Identification of Occurrence: Routine tests of the reactor building ventilation dampers were performed on 10 March 1999, in accordance with written procedures. One of these tests involves verification that the main ventilation dampers close on receipt of a high radiation signal. In addition, the ventilation fans should stop. An initial test found that the main dampers failed to close and the fans did not stop. The auxiliary ventilation dampers did close as they are designed to do in the event of a main damper failure. The test was then repeated several times and all dampers functioned properly. The individual who performed the test notified the Reactor Superintendent and entered a job in the official work book (No. E2794, dated 3-10-99) with further investigation scheduled for the next reactor shutdown which was slated for 17 March 1999.

The above test results were discussed at a regularly scheduled Operations/Radiation Protection review meeting that was held on 11 March 1999 and it was decided to investigate the damper closure issue immediately. The concern was that there may have been a violation of Technical Specification No. 3.8.2(a) which stipulates that a ventilation damper shall close within a specified time of receipt of

a high radiation signal. (Note: The auxiliary dampers did close but they are not required to meet the time requirement.) Accordingly, the reactor was shut down on 11 March 1999. No cause for the initial test failure was found and the failure could not be repeated. The closure time of the auxiliary damper was modified to satisfy Technical Specification No. 3.8.2(a), and the reactor was restarted.

5. Conditions Prior to Occurrence: The reactor was operating at 1 MW.

6. Description of Occurrence: Figure One is a diagram of the circuitry associated with the plenum gas and particulate monitors and the ventilation dampers. The system is redundant in that there are two sets of plenum gas and particulate monitors, a main and auxiliary intake damper, and a main and auxiliary exhaust damper. The main and auxiliary dampers are in series. The system is interlocked so that receipt of a high radiation signal on any one of the four plenum monitors will stop the ventilation fans and cause the main ventilation dampers to close. Also, if those dampers fail to close within ten seconds, the auxiliary dampers will close as the result of a second interlock. The main damper interlock is tested by lowering the trip on one of the plenum monitors to the background level.

7. Description of Apparent Cause of Occurrence: The reactor was shut down on 11 March 1999 to check both electronic and mechanical systems. Also, a review of records was conducted. The following conclusions were reached:

a) A similar sequence of events (initial failure of main dampers to close; closure of auxiliary dampers) under different conditions occurred on two previous occasions, 7 August 1998 and 4 December 1998. See Table One, Note #3.

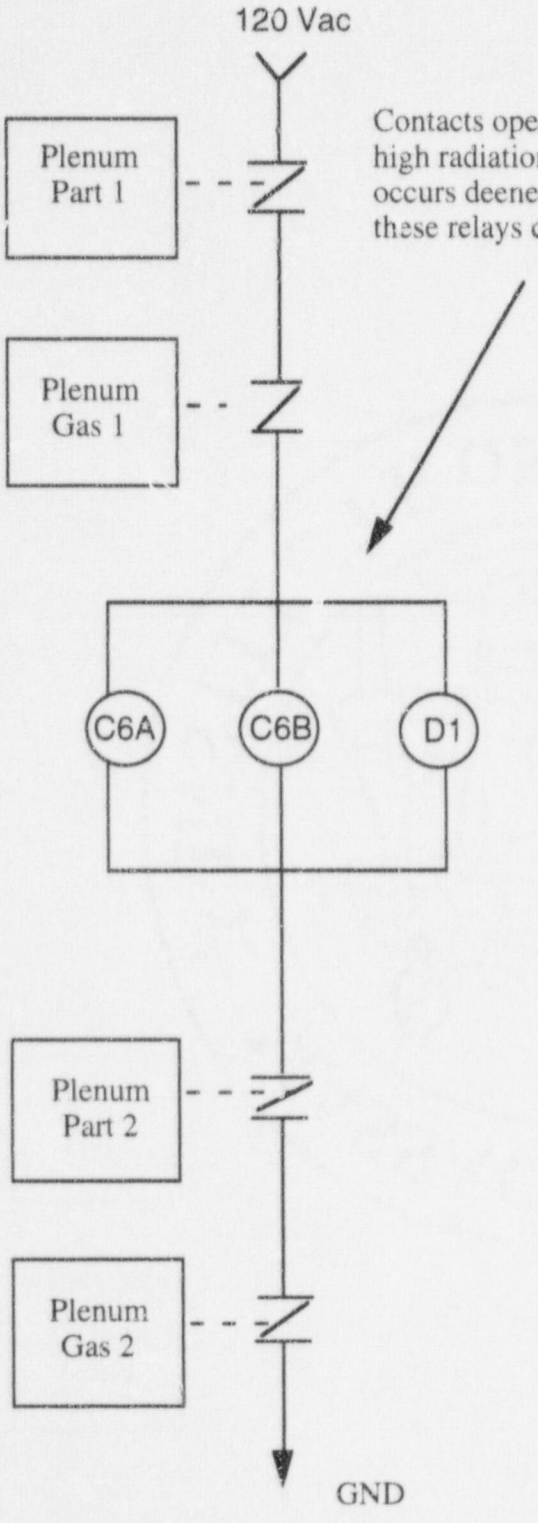
b) The expected interlock sequence (fans stop, main dampers close; auxiliary dampers remain open) was observed to occur on all tests except those noted above. Table One lists all tests since August 1998, when the system last underwent major maintenance.

c) Physical inspection of the dampers showed no mechanical defects. (Note: If a mechanical defect were present, then one would expect the fans to stop and the main dampers to remain open. A mechanical failure does not explain the continued operation of the fans.)

d) Physical inspection and testing of the ratemeters (the plenum monitors) showed no defects. These are all newly installed equipment. As is evident from Figure One, a failure in the ratemeter would have resulted in the auxiliary dampers remaining open also.

e) Physical inspection and testing of the relays that control the exhaust damper/fans, intake damper, and auxiliary dampers revealed no defects. However, an intermittent failure of the first two of these relays could not be eliminated as a possible failure mechanism.

f) No errors were noted in the conduct of the test procedure.




When the relays deenergize they perform the following acts:

C6A - Deenergizes the exhaust fan and core purge blower. Closes both main dampers.

C6B - Denergizes the intake fan.

D1 Closes auxiliary dampers if associated main damper is still open 10 s after receipt of a trip signal.

Figure One: Schematic of Effluent Monitor - Interlock Damper

**TABLE ONE**

Chronology of Tests of Effluent Monitor - Ventilation System Interlocks

| Date | Test Result (1) | Time Since Last Test (2) |
|---|---|---|
| 08/07/98 | Initial Test Unsatisfactory; Subsequent Tests Satisfactory (3) | (Major Maintenance) |
| 08/21/98 | Satisfactory | 2 Weeks |
| 09/17/98 | Satisfactory | 4 Weeks |
| 10/15/98 | Satisfactory | 4 Weeks |
| 10/19/98 | Satisfactory | 4 Days |
| 11/17/98 | Satisfactory | 4 Weeks |
| 12/04/98 | Initial Test Unsatisfactory; Subsequent Tests Satisfactory (3) | 2 Weeks |
| 12/28/98 | Satisfactory | 4 Weeks |
| 02/01/99 | Satisfactory | 4 Weeks |
| 02/04/99 | Satisfactory | 3 Days |
| 02/22/99 | Satisfactory | 3 Weeks |
| 02/23/99 | Satisfactory | 1 Day |
| 03/10/99 | Initial Test Unsatisfactory; Subsequent Tests Satisfactory | 2 Weeks |

Notes: (1) Required test frequency is monthly.

(2) All tests prior to 08/07/98 were satisfactory.

(3) Reactor was shut down at time of test and fans were not operating. Maintenance was in progress on the ventilation system and it was not clear if the failure was related to the on-going maintenance. Tests performed upon completion of the maintenance were satisfactory.

8. Analysis of Occurrence: There was no safety significance to this occurrence because of the redundancy of the dampers in the ventilation system. The auxiliary dampers always closed within ten seconds of receipt of a high radiation signal and the amount of radiation available for release in ten seconds would be minor. This is because the MITR operates at low temperature and atmospheric pressure and because it uses cermet fuel. Hence, even if something as serious as the clad failure were to occur, a radiation release would be limited by the need for the fission products to diffuse through the fuel. Other factors that lead to this conclusion are that:

a) The reactor console operator has the option to close the main intake and exhaust dampers manually. This can be done from the reactor control room; and

b) Written procedures instruct the operator to close the main ventilation dampers should they not close in an actual emergency.

9. Corrective Action: The immediate corrective action was to replace the relays associated with the main exhaust damper/fans and the main intake damper. Subsequent testing showed all interlocks to be functional. However, given the intermittent nature of this problem, it can not be assumed that the situation has been corrected. Accordingly, the closing time for the auxiliary dampers has been reduced to meet the requirements of Technical Specification No. 3.8.2(a).

Long-term corrective action will consist of continued testing of the interlock. (Note: An increased test frequency (daily) has been instituted for one week. No repetition of the problem has been found thus far. A long-term increased test frequency is undesirable because it will cause damage to the damper gaskets.)

10. Failure Data: None.

Sincerely,

Thomas H. Newton, Jr., P.E.
Asst. Superintendent for Engineering

Edward S. Lau, NE
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Director