NUCLEAR REACTOR LABORATORY

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July 2, 1979

Mr. Boyce H. Grier, Director
U. S. Nuclear Regulatory Commission
Region #1
631 Park Avenue
King of Prussia, PA 19496

Attn: Mr. E. Stetka, Reactor Inspector

Re: Reportable Occurrence 50-20/79-4, License R-37
Apparent Fuel Element Cladding Failure

Gentlemen:

Massachusetts Institute of Technology hereby submits this 10 day report of an occurrence at the MIT Research Reactor in accordance with Paragraph 1.15.4 of the Technical Specifications. An initial report was made by telephone to Region #1 on June 22, 1979.

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

1. Report #50-20/79-4

2. a) Report date: July 2, 1979
b) Occurrence date: June 22, 1979

3. Facility: MIT Research Reactor
138 Albany Street
Cambridge, Massachusetts 02139

4. Identification of Occurrence: An increase to 20 - 25% of the maximum permissible concentrations (MPC) for gaseous fission products, as compared to the 1 - 5% of MPC normally experienced as the result of diffusion through the aluminum cladding, was interpreted as an indication of a possible fuel element cladding failure, and the reactor was shut down for the purpose of identifying and removing the potentially faulty element.

5. Conditions Prior to Occurrence: In the course of normal, full power operation during the period of May 22 - 26, 1979, it was noted that the monitor sampling core purge gas from the open space below the reactor tank lid indicated an increase in the background level of gaseous fission

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products, which is normally the result of diffusion through the aluminum cladding. During the previous year, the level had run at about 1.6% of MPC. Grab samples confirmed an increase by a factor of 3 - 3.5 to a new "steady state" background condition, which continued until June 21st.

A potential, though unlikely, cause of the background change was considered to be an experimental foil measurement that had been made on an in-core element on May 22, just previous to the increase in the background level. When the higher level persisted, a refueling was accomplished on June 19th which removed the suspect element from the core and replaced it with another. This did not, however, correct the problem, as described in the following paragraph.

6. Description of Occurrence: The reactor was started up during the late afternoon of June 19th in compliance with standard reactor start up procedures in preparation for a normal 90-hour full power operating week. A spiking of the core purge monitor by another factor of about three occurred at 1100 on June 21st, increasing the total fission product concentration to approximately 18% of permissible. The concentrations returned to levels which had existed earlier in the week, but rose again at 0200 on the following day, June 22nd. Three more peaks occurred, each higher than the preceding one, but with intervening decreases. However, the data appeared to indicate an increasing trend, and levels were 20 - 25% of permissible for a six hour period. The reactor was shut down at 1317 on June 22nd for investigation of the problem, and the core purge levels returned to normal.

7. Description of Apparent Cause of Occurrence: Analysis of data available from MITR-I operating reports indicate that a low level of fission product off-gassing by plate-type aluminum-clad elements similar to those of MITR-II had been experienced and resulted in normal low background levels of gaseous fission products and particulate daughters in the primary system. The increase in background levels in late May and the spiking effects noted on June 21 and 22 can probably be attributed to a minute degradation in the cladding of one or more fuel elements. The exact mode of failure cannot be determined until the problem element is identified, and it and its history can be evaluated. Even if the suspect element can be identified, it is unlikely that the cause can be determined without the use of hot cell and special facilities not available at MIT.

8. Analysis of the Occurrence: The probable degradation apparently occurred initially in late May and was then enlarged during June 21 and 22. The total maximum release of gaseous fission products during spiking peaks was

20 - 25% of MPC. As soon as a trend indicating increased releases was identified, the reactor was secured to halt the release. In the event that the release rate had sharply increased, the two plenum particulate and gas systems would each individually have automatically isolated the building ventilation prior to release to atmosphere. Additional alarms on the core purge (1), the stack gaseous monitor (2), and the stack particulate (2) would also have drawn the operator's attention to an abnormal condition.

9. Corrective Actions:

(a) Immediate steps:

(i) Plotting core purge indication and taking grab samples to verify a trend and exact release rates.

(ii) When a trend was identified, securing reactor by normal shutdown.

(iii) Major refueling of 2/3 of reactor core (15 C-ring elements, one A-ring and one B-ring element) in an effort to insure the removal of the failed element.

(iv) Gradual restart of reactor to full power under continuous monitoring and sampling of core purge to detect any problems. This reactor restart was completed on June 27, 1979, by taking the reactor to full power in 1 MW steps in accordance with approved procedures.

(b) Steps taken to prevent a reccurrence of this type are:

(i) Fuel element "sipping" will be attempted during shutdown on July 2 and 3 in an attempt to identify the failed assembly from those assemblies that were removed in (a)(iii) above.

(ii) Further analysis of the discharged fuel (including re-insertion of specific elements in-core) is being planned in an attempt to identify the leaking element if (b)(i) above fails. When the core purge monitor and grab samples indicate total fission product levels in excess of 10% of MPC, operation will not continue with the suspect element in the core.

10. Failure Data: This is the first known failure of this type to occur at the reactor.

Sincerely,

William S Clancy

William Clancy

Lincoln Clark, Jr.

LC/kc

cc: MITRSC
USNRC-OMIPC