April 16, 2001

Dr. John A. Bernard, Director
Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street
Cambridge, MA 02139-4296

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (TAC NO. MA6084)

Dear Dr. Bernard:

We are continuing our review of your license renewal request for Amended Facility Operating License No. R-37 for the Massachusetts Institute of Technology Research Reactor which you submitted on July 8, 1999, as supplemented. During our review of your request, questions have arisen for which we require additional information and clarification. This letter represents a partial request for additional information. The due date for responses to the enclosed questions will be the due date of the last set of partial questions, which will be sent to you in the near future. In accordance with 10 CFR 50.30(b), your response must be executed in a signed original under oath or affirmation. Following receipt of the additional information, we will continue our evaluation of your amendment request.

If you have any questions regarding this review, please contact me at (301) 415-1127.

Sincerely,

/RA by M. M. Mendonca Acting For/

Alexander Adams, Jr., Senior Project Manager
Events Assessment, Generic Communications and
Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-20

Enclosure: As stated

cc w/enclosure:
Please see next page

cc:

City Manager
City Hall
Cambridge, MA 02139

Assistant Secretary for Policy
Executive Office of Energy Resources
100 Cambridge Street, Room 1500
Boston, MA 02202

Department of Environmental
Quality Engineering
100 Cambridge Street
Boston, MA 02202

Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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REQUEST FOR ADDITIONAL INFORMATION
MASSACHUSETTS INSTITUTE OF TECHNOLOGY RESEARCH REACTOR
DOCKET NO. 50-20

1. Section 1.2.2, Safety Considerations on Choice of Site, Fuel, and Power Level, page 1-3. Technical Specification (TS) 5.3 discusses both UAl alloy fuel and UAl_x fuel. This section of the SAR takes credit for the cermet form of the fuel plates. If you want both fuel forms to be authorized please discuss both fuel forms in the appropriate sections of the SAR. For this section, discuss how the use of the UAl alloy fuel affects the conclusions of the SAR.

2. Section 2.2.1, Locations and Routes, page 2-6. Please describe the types of cargo carried on the CONRAIL line next to the facility. Could derailment or other accident on the line cause damage to the reactor facility? What plans are in place to deal with this type of problem?

   The SAR discusses an ammonia sensor that activates an alarm. What is the staff response to the alarm?

3. Section 3.1.1.5, Containment Building, page 3-4. Please discuss the referenced aluminum-water reaction. Please discuss the credibility of this accident and why its analysis should or should not be included in chapter 13. If it is not a credible accident, what is the maximum pressure rise in the containment from a credible accident?

   What events would cause manual initiation of the over-pressure protection system? How is this system initiated?

   Please discuss an accident that could cause an increase in the vacuum in the containment building. Please discuss the rate of decompression that can be accommodated by the vacuum breakers. Please discuss the maximum decompression rate for any credible accident.

4. Section 3.1.1.7, Liquid Waste Discharge Isolation, page 3-5. Please discuss and provide the basis for specific exemptions in the Technical Specifications (TSs) for liquid effluent releases that are in excess of 10 CFR 20 limits (as stated in proposed TS 3.7.2).

5. Section 3.1.2.5, Reactivity Insertion Rate Limit, page 3-7. Please discuss the definition of core damage in the context of the reactivity insertion rate limit.

6. Section 3.1.2.6, Maximum Safe Step Reactivity Addition, page 3-7. Please discuss why clad softening is not the criterion rather than fuel melting.

7. Section 3.1.2.7, Core Monitoring, page 3-7. Are there any conditions for which core monitoring may be secured?

8. Section 3.1.3.4, Reactor Protection System, page 3-9. Please provide a definition of “off-scale” as it is used as an initiator for reactor scrams by the reactor protection system (RPS). Please discuss how the RPS detects the “off-scale” condition.

9. Section 3.1.3.5, Reactor Protection System Redundancy and Diversity, page 3-9. Please discuss RPS diversity beyond separate cable runs. Please discuss any other common mode failures of the RPS that were investigated beyond those that are related to common cable runs.

10. Section 3.1.5, Provisions to Avoid or Mitigate Consequences of Fire or Explosion, page 3-12. Please clarify the statement that the MITR fire protection program "conforms to the intent of ANSI/ANS 15.17-1987."

11. Section 3.2.1, Wind Loading, page 3-13. Please justify the statement that "it is apparent that the containment building will not be damaged by winds."

12. Section 3.5, Systems and Components, page 3-15. Section a. (i). Please discuss the reason the limit of 50 w% U in the fuel matrix is not specified in the TS.

    Section a. (iii). Please discuss the reason the loading is not specified in the TSs.

13. Section 3.5, Systems and Components, page 3-15. Section a. (iv). Please discuss the difference in the range of percent voids in this section of the SAR with the range in specification 3 of proposed TS 3.1.6; Section 4.2.1, Reactor Fuel, of the SAR (page 4-5); and Table 4-2.

    Section a. (v). Specification 3 of proposed TS 3.1.6. limits the fission density for UAl alloy fuel. Please discuss the design criteria for UAl alloy fuel and whether or not they should be specified in the TS. The proposed TS contains two fission density limits per fuel type. This section of the SAR contains one fission density limit. Please discuss.

14. Section 4.1, Summary Description, page 4-1. Your cover letter for license renewal states that MIT is requesting an increase in reactor power to 6000 kW. However, this section of the SAR states that the licensed power level is 6.6 MW, while it is intended that the reactor operate at or below a steady-state thermal power level of 6.0 MW. It is also stated that the LSSS is 7.4 MW. Please explain.

15. Section 4.2.1, Reactor Fuel, page 4-4. This section discusses the design of the UAl_x cermet fuel. Please provide a similar discussion for the UAl alloy fuel. Please discuss whether or not operational limits on the use of UAl alloy fuel should be in the TSs.

16. Table 4-2, Material and Physical Properties of MITR Fuel, page 4-7. Please provide the material and physical properties for the UAl alloy fuel.

17. Section 4.2.1, Reactor Fuel, page 4-8. Please discuss incipient excess outgassing. Please provide the equivalent fission density (fissions/cm^3) for the 40-42% burnup.

18. Section 4.2.2.1, Shim Blades, Page 4-9. Please provide a sample calculation showing that the shutdown margin is met with: (1) only 5 of 6 shim blades functional and the non-functional one at or above the average height of the functional ones, (2) the most reactive of the 5 plus the regulating rod stuck full out during a trip, and (3) the core is early in life (most reactive).

19. Section 4.2.2.5, Parameters Associated with Kinetic Behavior of Control Device, Table 4-4, page 4-16. Please discuss a credible failure that could result in the maximum allowed ramp reactivity insertion rate.

20. Section 4.3.1.1, Design Considerations, page 4-24. Please provide a sample calculation of the ratio of design pressure to working pressure.

21. Section 4.3.1.2, Shielding/Adequacy of Depth, page 4-25. What activity is considered significant in the phrase "…Na-24 activity is still significant…."

22. Section 4.3.1.6, Core Shroud, page 4-27. Please discuss the polyethylene packing between the core shroud and the core tank (e.g., What is its expected lifetime? Is there any way to monitor its functionality? How often is it replaced?).

23. Section 4.3.1.6, Core Shroud, page 4-28. Please discuss the Al-Cd storage structures that are located in the reactor tank for fuel storage (e.g., How are they monitored for perforation, corrosion, and other effects that could reduce their absorption?).

24. Section 4.4.3, Materials, page 4-35. Please discuss the Al-Cd storage structures that are located in the spent fuel storage pool (e.g., How are they monitored for perforation, corrosion, and other effects that could reduce their absorption?).

25. Section 4.5.1.9, Core Reactivities, page 4-44, and Section 4.6.1.2, Thermal Power Density Distribution, page 4-55. These sections imply that MCNP is fully accepted whereas sections 4.5.b. and 4.5.2.3 state that the MCNP code is still being evaluated. Please discuss the different statements.

26. Section 4.5.3.4, Limiting Core Configuration for Thermal-Hydraulic Analysis, page 4-52 and Section 4.6.3.2, Core Flow Distribution, page 4-64. Please discuss the effect of the number of non-fueled positions and what is located in those positions (e.g., experiments, solid aluminum dummy, or approved ICSA) on the channel flow disparity factor (d_f), the coolant flow factor (F_f), and the minimum coolant channel flow.

27. Section 4.6.2.2, Correlation for Onset of Flow Instability, page 4-58. Please be more specific as to how reference [4-17] was used in this section. Define D_e by equation and please discuss how it relates to D_h (heated equivalent diameter) as defined on page 97 of reference [4-14] and D (heated diameter) used in reference [4-18].

28. Section 4.6.6.1, Comparison of OFI and CHF, page 4-70. Please illustrate by detailed calculation the determination of the mass flux (2000 kg/m^2s) of the coolant channel that receives the least flow when the total flow is 1800 gpm.

29. Section 4.6.6.2, Calculation of the Safety Limits for Forced Convection, page 4-71. On page 4-59 of section 4.6.2.2 it is stated that equation (4-8) is used in the thermal hydraulic calculations of the MITR since it provides the most conservative OFI flow rate. On page 4-72 the value of R=0.86 appears to be correct if equation (4-6) is used rather than equation (4-8). Please provide a detailed calculation of R showing the values used for L_h and D_e. If equation (4-6) is being used please justify its use in reference to the statement about equation (4-8). If the value of R=0.86 is not correct what is the correct value and how does the correct value affect the SL?

30. Section 4.6.6.3, Calculation of the Safety Limits for Natural Convection, page 4-72. The reference citation for equation (4-30) does not appear to be correct. Page 4-72 and 4-73. In reference [4-20] Y. Sudo et al. caution that the rms error for the correlation is 33%. Please discuss how that error is incorporated in the calculation of the SL for natural circulation.

31. Section 4.6.7, Calculation of Limiting Safety System Settings, page 4-73. It appears that evaluating equation (4-4) using P=1.3 bar does not lead to equations (4-34, 4-37, and 4-40). Please discuss this difference. If equation 4-40 is incorrect how are figures 4-27 and 4-28, and table 4-10 affected?

32. Section 4.6.7.2, Calculation of the Limiting Safety System Settings for Natural Convection, page 4-76. Please discuss the affect of the initial reactor power on the calculation of the natural convection LSSS.

33. Section 4.6.7.1, Calculation of the Limiting Safety System Settings for Forced Convection, page 4-76 and section 4.6.7.2, Calculation of the Limiting Safety System Settings for Natural Convection, page 4-76. The regulations in 10 CFR 50.36(c)(1) define limiting safety system settings for nuclear reactors as “settings for automatic protective devices related to those variables having significant safety function. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Please show that your proposed limiting safety system settings will prevent the safety limits from being exceeded considering process uncertainty, overall measurement uncertainty, transient phenomena of the process instrumentation, and time to carry out protective actions (e.g., rod drop times). Your forced flow safety limit curves are given for coolant heights of 6 and 10 feet above the top of the fuel plates but your limiting safety system setting is given as 10 feet which allows for no error. Please address. You have a limiting safety system setting for core outlet temperature for natural convection operation but no corresponding safety limit. Please address.