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

July 20, 1998

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (TAC NO. M99844)

Dear Dr. Bernard:

We are continuing our review of your amendment request for Amended Facility Operating License No. R-37 for the Massachusetts Institute of Technology Research Reactor which you submitted on October 3, 1997. During our review of your amendment request, questions have arisen for which we require additional information and clarification. Please provide responses to the enclosed request for additional information within 90 days of the date of this letter. 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,

ORIGINAL SIGNED BY:

Alexander Adams, Jr., Senior Project Manager
Non-Power Reactors and Decommissioning
Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 50-20

Enclosure:
As stated

cc w/enclosure:
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Massachusetts Institute of
Technology

Docket No. 50-20

cc:

City Manager
City Hall
Cambridge, Massachusetts 02139

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

Department of Environmental
Quality Engineering
100 Cambridge Street
Boston, Massachusetts 02108

ENCLOSURE

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

SAFETY EVALUATION REPORT

1. Page 1-2. Please provide clarification on the use of light water versus heavy water in the converter facility. Do you intend to choose one over the other, with the final decision still pending, or do you intend to use either as conditions dictate? If you intend to use either coolant, how often will the change be made and what complications will exist? What conditions or criteria will affect these decisions?

2. Pages 2-1, 3, 4, and 5. Please provide information concerning the building codes that will be used for the fabrication, construction, and installation of the converter facility. Will a Uniform Building Code, a Massachusetts code, a Cambridge code, or another standard be used? (Discuss this issue relative to the codes or standards used for construction of the MITR reactor, modifications I and II.)

3. Page 2-6. Please discuss the minimal bypass flow in more detail. Is the bypass flow accounted for in the thermal hydraulic calculations? How will the bypass flow be verified?

4. Page 2-8. Please discuss the controls (administrative, mechanical, electrical) that may be required to ensure that the cadmium curtain is fully inserted and to prevent its movement before and during startup of the reactor.

5. Page 2-8. Please provide the rational for exempting the fission converter from MITR Technical Specification (TS) 6-1. (When the bases of the TS are considered, the use of TS 6.4 for the fission converter is not apparent.)

6. Pages 2-9 and 10. Although differences between some of the numbers used in Tables 2.3 and 2.4 are small, please explain the differences.

7. Page 2-11. Please discuss the material selections for the proposed filter installation. If the materials used during the life of the installation will vary, describe the pertinent selection process.

8. Page 3-1. Please discuss the definition of "incipient" boiling in relation to "nucleate" or some other form of boiling. Discuss placing this definition in the Definitions section of the TS.

9. Page 3-1. Please discuss the cooling of the shutdown converter facility without removal of the inlet pipes from the downcomers. Discuss natural convection flow in the event of loss of flow, or reference an existing discussion.

10. Page 3-3. Please discuss the conditions under which it would be necessary to remove decay heat using the cleanup pump.

11. Page 3-3. Please discuss the Δp value for over-pressure protection of the converter tank. Are there any consequences of continued operation at the allowable over-pressure?

12. Page 3-3. Please discuss the Δp between the primary and secondary coolants under all allowed and postulated accident conditions. In each instance, what is the magnitude and direction of the Δp? Is it possible for primary coolant to enter the secondary coolant system if a leak developed in the heat exchanger? If so, what is the consequence of the leak? Please discuss any systems that are used to quickly detect primary piping leakage when the converter is cooled with heavy water.

13. Page 3-3. Does "voluntary" use of ASME Code, Sections II and IX, mean that you are committing to use the code and to document the results? Please discuss if the tank was designed with any seismic loading considerations.

14. Page 3-3. Please discuss the use of the aluminum block. Is the aluminum block used for light water only? Should there be a TS on use of the aluminum block? Does use of the block affect the results of the criticality, reactivity worth, or power level and density analysis?

15. Page 3-3. Please discuss potential tritium release to the building atmosphere when operating in the natural convection mode at low reactor power and with the converter tank lid open or the inlet and outlet pipes removed.

16. Page 3-3. Please discuss the method of closure for the converter tank. Is there an air or watertight seal between the tank and lid?

17. Page 3-9. Discuss the operation of the recombiner for a minimum of five hours per month. Should there be some consideration as to when the recombiner is operated in relation to use of the converter?

18. Page 3-14. Please discuss the bases and physical criteria that define significant voiding. Compare OSV with ONB. (See question 8.)

19. Page 3-15, Paragraph 3.4. If the values of parameters as measured during the commissioning tests vary from those used in the calculations, will the calculations be redone using these measured values? Please propose a TS requirement for a startup report including required contents.

20. Pages 3-22, 23, 24, and 25: Your safety limits (SLs) and limiting safety system settings (LSSSs) for the converter facility appears to be based on the MITR operating at 10 MW(t). This is acceptable if you can justify this type of operation. However, please ensure that your entire discussion is based on reactor operation at 10 MW(t). For example, Table 2.4, which presents nuclear hot channel factors which are assumptions in the determination of the SLs, are based on the MITR operating at 5 MW(t). Please address.

21. Page 3-25. Please clarify "top of fuel." Does this mean the top of the plate, or does it refer to the top of the fueled region?

22. Pages 3-25 to 3-27. In your discussion of LSSSs for natural convection cooling, you state that as a result of the maximum coolant temperature and the maximum fuel clad temperature simultaneously approaching the saturation temperature, ONB and OSV coincide and the SL curve was used to determine the LSSS. However, the discussion of LSSS in 10 CFR 50.36(c)(1)(ii)(A), states that LSSSs must be chosen so that automatic protective action will correct an abnormal situation before a SL is exceeded. Because of instrument uncertainties and response times, the SL and LSSS cannot have similar values. This issue appears to have arisen from your decision to use ONB as the factor for determining LSSSs. Please address.

23. Page 4-1. Please describe the calculations performed to determine the opening speed of the curtain, which in turn results in a 50-sec period. What is the total reactivity effect of the curtain drop?

24. Pages 4-2 and 3. Please explain why these graphs appear to limit the converter power to about 80 KW, given that elsewhere in the document (e.g. Table 2.3) the power is given as up to 251 kW.

25. Page 4-4. Please discuss the intended drive mechanism for the cadmium curtain in terms of the driving mechanism and the interlocks against inadvertent movement. How would you ensure that a variable speed motor would operate at the proper speed?

26. Page 4-4. Please describe the results of calculations performed to determine whether it will be necessary to add boron-10 to the water shutter. What will be the effect of boron-10 on the reactivity of the system?

27. Page 4-5. Please discuss the operation of the solenoid valve that provides the water for the water shutter. From what location is the solenoid valve opened manually? What is the power failure mode of the valve? For emergency operation, must someone enter the therapy room?

28. Page 4-6. Please provide a systematic discussion of the shutter controls, including the locations of controls and of manual override. Please include those functions that will be controlled using override or permissive circuitry. A drawing might be useful in this regard. It appears that it is not possible to scram the reactor from within the medical therapy room. Please discuss not having this scram feature. Is the water shutter or mechanical shutter capable of reducing radiation levels to acceptable levels in the medical therapy room if the other shutter cannot be closed? If the key switch is removed from the shutter control panel, can the shutters still be closed? Will opening of the cadmium curtain be under the control of a licensed reactor operator? If not, how will the requirements of 10 CFR 50.54(i) be met?

29. Page 4-7. Please provide additional detail about the design of the medical therapy room. What radiation levels are anticipated on the outside surface of the room with the beam in use with the reactor at 10 MW power? How will patients be observed during therapy? Please outline the design features of the room to minimize activation of the room from the therapy beam. Please discuss the radiation monitoring system to be used in the room.

30. Page 4-7. Please describe the administrative controls that will be required for the bypassing of medical therapy room door interlocks.

31. Page 6-2. Please provide maximum doses for a fuel plate melting accident assuming a reactor power of 10 MW(t) for fuel used in the converter and driving the converter (if you want the converter to be licensed for use with that reactor maximum power). Please provide radiation doses based on a converter operational assumptions.

32. Page 6-3. Please provide data for radiation doses after a material handling accident in the converter. Please consider the accidental dropping of a fuel element and dropping a heavy load on the converter.

33. Page 6-7. Is the fourth assumption in the loss of coolant flow analysis conservative considering Figure 4.1?

34. Page 7-2. Please specify the safety system settings for the converter at the licensed reactor power of 5 MW(t). Please propose protective action settings for reactor power at 5 MW(t) and 10 MW(t).

35. Page 7-5. Please explain the measurement of "design" power. Is this design power measurement performed by the channel labeled "Power" in Table 6.6.2.6-1 on page 6-53? Does the instrumentation that measures design power and operating power contain one neutron detector or two? Please explain the difference between the MRCP and the FCCP.

36. Chapter 7. Please explain the staff requirements for operating the converter. How will individuals other than licensed reactor operators be qualified to operate the converter? Are there any converter operations that require the presence of a senior reactor operator? How will you ensure that reactor operators will not be distracted from operating the MITR by converter operation? What is the control room operator's responsibility in the case of an emergency with the converter?

37. Chapter 7. Please provide a one-line electrical diagram of the converter safety system and its interface with the reactor control and safety system. Please discuss how the different limiting safety system settings (LSSS) will be automatically and electronically set in the control and safety system for both natural and forced convection.

38. Page 8-1. Please discuss the aspects of the MIT Quality Assurance Program concerning the conduct of tests and the presentation of test results for the

converter facility. Also, discuss the basic parameters of the startup/test program for the converter facility (see question 19).

39. Page 8-2. Please discuss the calibration of the nuclear instrumentation for the fission converter with the converter TS stated for reactor operation at 5 MW(t). Please determine and justify the conservative operating condition that will be used for an initial calibration of the nuclear instrumentation.

40. Page 8-4. Please discuss the differences between the dynamic period equation and the in-hour equation.

41. Page 8-4. Please discuss the method used to limit the curtain speed to achieve a 50-second period. Will the speed be controlled manually by the operator, or will it be electronically limited?

42. Page 8-5. Please confirm that "in-core" means "in a converter" in this section.

TECHNICAL SPECIFICATIONS

43. General. Where applicable, please state converter limits for MITR operation up to 5 MW(t) and up to 10 MW(t).

44. Technical Specification (TS) 6.6.1.1. Please clarify the reference point for water height. Is that point intended to be the fuel plate or the fuel meat?

45. TS 6.6.1.2 (2.). The margin between the SL and LSSS for natural convection cooling appears small. Are you sure that calibration uncertainty and instrument accuracy is within the 3-degree difference between the SL and LSSS? Please elaborate (See question 22).

46. TS 6.6.2.1. (4.). The basis for this TS states that the evaluation was performed for 10 or 11 fuel elements. This is not clear from your SER. For example, were Table 2.4 and 2.5 based on 10 fuel elements? The nuclear hot channel factor from Table 2.4 is used in TS 6.6.2.1.(1). Please address.

47. TS 6.6.2.1.(8). Does having the converter tank lid in place also mean that the lid is sealed?

48. TS 6.6.2.2. Please explain what "or its equivalent" means in the Applicability section.

49. TS 6.6.2.3. Please discuss the necessity of a surveillance requirement on the closure time for the cadmium curtain.

50. TS 6.6.2.5. The acceptable concentrations of H_2 in the helium blanket and in the event that the recombiner is not operable in the proposed TS are greater than those concentrations given in MITR TS 3.4. Please explain.

51. TS 6.6.2.7. Please discuss the specifications on pH and conductivity in terms of operation outside the specified range. Specify actions that should be taken for conditions outside the range. What value will be used as a baseline for activity in the primary coolant until enough monthly measurements are made to establish an average.

52. TS 6.6.3. Please provide clarification on this specification. For example, if the converter is not scheduled to be used and use becomes necessary, will functional tests of the instrumentation be made prior to use? Should "neutron flux level" be stated as "power level" to match TS 6.6.2.6? The TS refers to determining chloride content of the primary coolant monthly. However, there does not appear to be a TS limit on chloride content. Please address. Please propose a TS that will allow initial start-up of the converter to conduct those initial calibrations that can only be performed with the converter operating.

53. TS 6.6.4(4.). Please discuss the sample assemblies that might be introduced into the fueled region of the converter. Will the TS limits for the conduct of experiments apply to the use of these sample assemblies?

54. TS 6.5. Some parts of this TS appear to be written for one beam (e.g., the applicability section of the TS refers to the beam). Please address. TS 6.5.16(c.). This proposed TS discusses the cadmium shutter. Is this the same as the cadmium curtain? The curtain is similar to a control rod and may need to be withdrawn by a licensed operator (See questions 28 and 36.).

55. Discuss the need for TS requirements on who can operate the cadmium curtain. Discuss the need for a TS requirement for a start-up report with required content on the converter facility.

REFERENCES

56. Please forward the following references cited in the safety evaluation report:

- Reference 1-1
- Reference 1-2
- Reference 2-1
- Reference 2-2
- Reference 2-3
- Reference 2-4
- Reference 2-5
- Reference 2-6
- Reference 3-3
- Reference 4-2
- Reference 5-1
- Reference 5-2
- Reference 5-3
- Reference 6-4
- Reference 6-5
- Reference 6-6