

April 22, 2005

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

SUBJECT: ISSUANCE OF AMENDMENT NO. 37 TO AMENDED FACILITY OPERATING
LICENSE NO. R-37 - MASSACHUSETTS INSTITUTE OF TECHNOLOGY
(TAC NO. MC5201)

Dear Dr. Bernard:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 37 to Amended Facility Operating License No. R-37 for the Massachusetts Institute of Technology Research Reactor. The amendment consists of a revision to Appendix A of the facility operating license in response to your application of December 1, 2004, as supplemented on April 11, 2005.

The amendment adds titanium alloys to the list of materials allowed to be in contact with the primary coolant.

A copy of the safety evaluation supporting Amendment No. 37 is also enclosed.

Sincerely,

/RA/

Daniel E. Hughes, Project Manager
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-20

Enclosures: 1. Amendment No. 37
2. Safety Evaluation

cc w/enclosures: See next page

Massachusetts Institute of Technology

Docket No. 50-20

cc:

City Manager
City Hall
Cambridge, MA 02139

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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ACCESSION NO.: ML050450354

TEMPLATE No.: NRR-106

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DOCKET NO. 50-20

AMENDMENT TO AMENDED FACILITY OPERATING LICENSE

Amendment No. 37
License No. R-37

1. The U.S. Nuclear Regulatory Commission (Commission) has found that
 - A. The application for an amendment to Amended Facility Operating License No. R-37 filed by the Massachusetts Institute of Technology (licensee) on December 1, 2004, as supplemented on April 11, 2005, conforms to the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the regulations of the Commission as stated in Chapter I of Title 10 of the *Code of Federal Regulations* (10 CFR);
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance that (i) the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) such activities will be conducted in compliance with the regulations of the Commission;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;
 - E. This amendment is issued in accordance with the regulations of the Commission as stated in 10 CFR Part 51, and all applicable requirements have been satisfied; and
 - F. Prior notice of this amendment was not required by 10 CFR 2.105 and publication of a notice for this amendment is not required by 10 CFR 2.106.

2. Accordingly, the license is amended by changes to paragraph 2.C.(2) of Amended Facility Operating License No. R-37 to read as follows:

- (2) Technical Specifications

- The Technical Specifications contained in Appendix A, as revised through Amendment 37, are hereby incorporated in the license. The licensee shall operate in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Enclosure: Appendix A Technical Specifications Changes

Date of Issuance: April 22, 2005

ENCLOSURE TO LICENSE AMENDMENT NO. 37

FACILITY LICENSE NO. R-37

DOCKET NO. 50-20

Replace the following pages of the Appendix A Technical Specifications with the enclosed pages. The revised pages are identified by amendment number and contain vertical lines indicating the areas of change.

Remove

5-5
5-6

Insert

5-5
5-6

5.3 Primary Coolant System

Applicability

The specification applies to the design of the primary coolant system.

Objective

To assure compatibility of the primary coolant system with the safety analysis.

Specification

The reactor coolant system shall consist of a reactor vessel, a single cooling loop containing three heat exchangers, and appropriate pumps and valves. All materials, including those of the reactor vessel, in contact with primary coolant (H₂O), shall be aluminum alloys, stainless steel, or titanium alloys except small non-corrosive components such as gaskets, filters and valve diaphragms. The reactor vessel shall be designed in accordance with the ASME Code for Unfired Pressure Vessels. It shall be designed for a working pressure of 24 psig and 150°F. Heat exchangers shall be designed for 75 psig and a temperature of 150°F. The connecting piping shall be designed to withstand a 60 psig hydro test.

Basis

The reactor coolant system has been described and analyzed in the Safety Analysis Report as a single loop system containing two heat exchangers. Additional analysis based on the use of three heat exchangers, has been described in the NRC staff's Safety Evaluation of Amendment No. 14 to these Technical Specifications. Materials of construction, being primarily stainless steel, are chemically compatible with the H₂O coolant. The stainless steel pumps are heavy-walled members in areas of low stress and should not be susceptible to chemical attack or stress corrosion failures. The failure of the gaskets and valve bellows, although undesirable, would not result in catastrophic failure of the primary system; hence, strict material limitations

are not required for technical specifications. The design, temperature, and pressure of the reactor vessel and other primary system components provide adequate margins over operating temperatures and pressures, and it is believed prudent to retain these margins in order to further reduce the probability of a primary system failure. The reactor vessel was designed to Section VIII, 1968 edition, of the ASME Code for Unfired Pressure Vessels. Subsequent design changes should be made in accordance with the most recent edition of this code.

Since the safety analysis is based on the reactor coolant system as presently designed and with the present margins, it is considered necessary to retain this design and these margins or to redo the analysis.

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 37 TO

AMENDED FACILITY OPERATING LICENSE NO. R-37

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DOCKET NO. 50-20

1.0 INTRODUCTION

By letter dated December 1, 2004, as supplemented on April 11, 2005, the Massachusetts Institute of Technology (MIT or licensee) submitted a request for amendment of Amended Facility Operating License No. R-37 for the MIT Research Reactor (MITR). The requested amendment adds titanium alloys to the list of materials allowed to be in contact with the primary coolant.

2.0 BACKGROUND

The MITR is a 5 MW(t), heavy-water reflected, light-water cooled and moderated nuclear research reactor that utilizes flat, plate-type fuel elements. The reactor is located on the MIT campus in Cambridge, Massachusetts. The licensee has requested an amendment that adds titanium alloys to the list of materials allowed to be in contact with the primary coolant.

3.0 EVALUATION

The present Technical Specifications (TS) in Section 5.3, Primary Coolant System, states, in part, that “[a]ll materials, including those of the reactor vessel, in contact with primary coolant (H₂O), shall be aluminum alloys or stainless steel, except small non-corrosive components such as gaskets, filters and valve diaphragms.” The specification meets the requirements of 10 CFR 50.36(c)(4). The TS specifies materials of construction, which, if altered or modified, could have a significant affect on safety and are not covered by other categories of 10 CFR 50.36. The concern is that if the materials are not compatible with the primary coolant or the other materials in the primary coolant system, then corrosion may become significant. Corrosion could lead to failure of the coolant boundary or cause activation of increased corrosion products in the coolant system. Significantly, the TS does not prohibit any specific materials; it is only silent on materials other than those listed. The main reason for leaving a material off the list is that it was not analyzed in the current Safety Analysis Report (SAR).

The licensee has proposed a change to TS 5.3 to include titanium alloys to the list of materials allowed to be in contact with the primary coolant. The licensee has provided an analysis with references justifying the change. The licensee states that:

1. The corrosion resistance of titanium is similar or superior to that of stainless steels and aluminum that come in contact with 50° C primary coolant (de-ionized water), in the core tank.
2. Titanium placed in contact with dissimilar metals does not produce increased levels of galvanic corrosion.
3. The activation of titanium is similar or superior to that of stainless steels or aluminum that are subject to neutron irradiation.

The licensee's conclusion is that having titanium and its alloys in contact with the primary coolant does not significantly reduce safety.

The licensee provides references in support of their statements and the conclusion above. These references include ASH Handbooks on General Corrosion and Corrosion of Titanium and its Alloys, and an MIT Safety Review.

The NRC staff, including a materials chemical engineering expert, have reviewed the licensee's analysis and justification for the change and have reviewed additional literature which corroborates the licensee's conclusions. In addition, the staff believe that the licensee's use of titanium and its alloys may decrease the total corrosion and activated material since its superior strength properties may decrease the total material (stainless steel, aluminum and titanium) in contact with the primary coolant. The staff find that the change does not significantly affect safety and therefore the TS continues to meet the requirements of 10 CFR 50.36(c)(4). The staff find that TS 5.3, as changed, continues to protect the health and safety of the public and the environment while imposing the minimum amount of regulation as directed by Section 104.c of the Atomic Energy Act of 1954, as amended. Therefore, the NRC staff find this change acceptable.

The NRC noted that there appeared to be typographical errors in the licensee's proposed TS. A conversation between the NRC MIT project manager and the MIT reactor engineer confirmed there were errors made by the licensee while retyping the TS. The licensee addressed the typographical errors in a letter dated April 11, 2005.

4.0 ENVIRONMENTAL CONSIDERATION

This amendment involves changes in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes in inspection and surveillance requirements. The staff has determined that this amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released off site, and no significant increase in individual or cumulative occupational radiation exposure. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSION

The staff has concluded, on the basis of the considerations discussed above, that (1) the amendment does not involve a significant hazards consideration because the amendment does not involve a significant increase in the probability or consequences of accidents previously evaluated, create the possibility of a new kind of accident or a different kind of accident from any accident previously evaluated, or involve a significant reduction in a margin of safety; (2) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities; (3) such activities will be conducted in compliance with the Commission's regulations; and (4) the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

Principal Contributor: Daniel E. Hughes

Date: April 22, 2005