



**NUCLEAR REACTOR LABORATORY**  
AN INTERDEPARTMENTAL CENTER OF  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



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Director

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J. A. BERNARD, JR.  
Director of Reactor Operations

February 23, 1996

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

Subject: SNM Possession Limit, License R-37, Docket 50-20

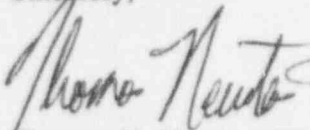
Gentlemen:

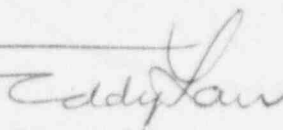
The Massachusetts Institute of Technology hereby submits an application to amend its Facility Operating License No. R-37. The requested amendment is for a temporary increase in the possession limit for uranium-235 in paragraph 2B(2) of the license from 29 kilograms to 41 kilograms. There is precedent for this request in that, as originally licensed, the authorization was 45 kilograms. Also, amendment No. 25 authorized a temporary increase to 41 kilograms. The reason for this request is, as discussed in the enclosed analysis, the continuing inability of the U.S. Department of Energy (DOE) to accept returns of spent fuel because of lack of storage space at DOE facilities. Once we have been able to ship out our inventory of spent fuel, the authorized possession limit would revert to 29 kilograms.

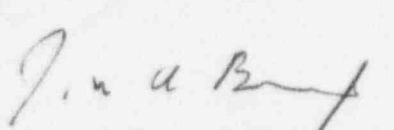
We note that a similar request was approved as license amendment No. 25 on 11 December 1989. That temporary increase in the possession limit expired on 1 January 1992. DOE was able to accept return of spent fuel in the early 1990s.

This request has been reviewed and approved by the MIT Reactor Safeguards Committee.

Sincerely,

  
Thomas H. Newton, PE  
Asst. Superintendent  
for Reactor Engineering

  
Edward S. Lau,  
Asst. Superintendent  
for Reactor Operations

  
John A. Bernard, Ph.D.  
Director of Reactor Operations  
MIT Research Reactor

JAB/gw

Enclosure: Safety Review #0-96-2

cc: MITRSC (with enclosures)

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Safety Review #0-96-2

SNM Possession Limit for License R-37 (Docket 50-20)

The objective of this analysis is to provide information in support of the request by the Massachusetts Institute of Technology (MIT) to amend its Facility Operating License No. R-37 so that the possession limit for uranium-235 in paragraph 2B(2) of the license is increased from 29 kilograms to 41 kilograms. This requested change would be temporary and would remain in effect only until it has been possible to ship out our inventory of spent fuel.

Background

Amendment No. 10 to the Facility Operating License No. R-37 for the Massachusetts Institute of Technology Research Reactor (MITR) was approved and issued by the United States Nuclear Regulatory Commission (USNRC) on 23 July 1975 [1]. That amendment, among other things, authorized the possession and use of 45 kilograms of uranium-235. The USNRC requested by letter on 29 Aug. 1975 [2] that MIT voluntarily request a license amendment to reduce its possession limit for uranium-235 to the "lowest acceptable quantity" or LAQ. The LAQ was defined by the USNRC to be "the amount necessary to sustain current operations and those projected for the immediate future, i.e., 12 months". Given that the MITR had at that time recently completed a major modification and was beginning a new type of fuel cycle, it was very difficult to estimate the LAQ. Nevertheless, MIT did so and by its letter of 25 Sept. 1975 [3] requested that its SNM possession limit be reduced to 29 kilograms. This request, which was subsequently approved by the USNRC, was based on the following considerations:

- (a) Unirradiated fuel would be ordered in batches of about 27 fuel elements. This fuel would be stored off-site with only the minimum required to facilitate refuelings being brought on-site. The amount on-site would always be less than a formula-quantity.
- (b) The reactor core would operate with 26 elements.
- (c) The reactor's fuel management program would maximize burnup by cycling elements through each of the core's three rings. As many as 25 partially-burned elements could be in storage awaiting reuse.
- (d) The burnup per element would average 25%.
- (e) Shipments of spent fuel would consist of 28 elements each and be made whenever that many spent elements were accumulated.

Using these assumptions, it was estimated in 1975 that the MITR's fuel inventory would peak at 35 kilograms in 1981. A possession limit of 29 kilograms was requested with the understanding that MIT would, once some operating experience was obtained with the new fuel cycle, "reevaluate its requirements on the basis of operating experience and subsequently request an increase above 29 kilograms if necessary".

On 17 Nov. 1975, Amendment No. 11 to the Facility Operating license was issued. As noted, it reduced the allowed inventory of contained U-235 to 29 kilograms [4]. Unfortunately, the MITR was never able to establish a steady-state operating point in its fuel cycle because of difficulties experienced by the U.S. Department of Energy in

providing a shipping cask for the return of spent fuel. Accordingly, in 1984, it was necessary to request a temporary increase in the possession limit to 41 kilograms. Seven shipments of spent fuel were made (total of 56 elements) in the early 1990s and the possession limit reverted to 29 kilograms. Timely returns of spent fuel are again not possible and hence it is again necessary to request a temporary increase.

#### Operating Experience with Fuel Cycle

The MITR's fuel management program has been extremely successful. The salient features are:

- (a) Unirradiated fuel is ordered, inspected for compliance with quality assurance requirements, and installed in the core. MITR policy is to keep the inventory of fresh fuel at zero to the maximum extent possible. Fresh fuel is ordered only when needed.
- (b) The reactor core operates with 24 or 25 elements.
- (c) There are frequently as many as 27 partially-spent fuel elements awaiting reuse.
- (d) The burnup per element averaged 40-43% for the original 445 gram MITR elements made by Gulf Atomic. It is averaging 35-37% for the more heavily loaded 506 gram MITR elements that are now in use. These were made by AI and more recently by Babcock & Wilcox.
- (e) Shipments of spent fuel were not possible for decades because of the lack of a suitable cask. As a result, it was necessary in 1989 to request a temporary increase in the possession limit to 41 kilograms. This request was approved by the USNRC. This approval expired in 1992. (DOE did accept returns of spent fuel in the early 1990s and it was possible to reduce the MITR inventory to less than 29 kilograms.)
- (f) Return of spent fuel to DOE is currently not possible because of the lack of storage space at DOE facilities.
- (g) Usage of fuel has recently increased because of increased reactor utilization (67% capacity factor for last 12 months).

Other relevant information is that:

- (h) The reactor currently generates 1300 MWD of energy per operating year. Assuming 1.25 grams of U-235 per MWD, the reactor therefore consumes about 1600 grams of uranium-235 per year. This is the equivalent of about three fresh 506 gram MITR fuel elements. (Note: In terms of actual fuel elements, this amounts to a discharge rate of  $[(1300 \text{ MWD}) (1.25 \text{ g/MWD})] / [(0.35)(506 \text{ g/element})]$  or 9.2 elements per year when at equilibrium.
- (i) The actual rate of addition of fresh fuel elements to the core is shown in Table One.

Table One

Rate of Introduction of Fresh Elements to the MITR Core

Year	# Fresh Elements Introduced
1985	3
1986	0
1987	3
1988	3
1989	0
1990	6
1991	8
1992	5
1993	6
1994	6
1995	9

### Fuel Management Policy

The MIT Research Reactor's core is a hexagon consisting of three rings which are labeled 'A', 'B', and 'C'. The 'A' ring is the center one and contains three element positions. The 'B' ring is the intermediate one with nine positions. The 'C' ring is the outer one with fifteen positions. The standard fuel management plan calls for:

- (a) Insertion of fresh fuel in the A or B-rings where the power peaking is least.
- (b) Placement of partially spent fuel that has been removed from the A or B-rings in temporary storage.
- (c) Once sufficient partially-spent fuel has accumulated, it is placed in the C-ring where the peaking is more severe because of the surrounding heavy water reflector.

Fuel depletion is maximized by rotating elements in place to negate radial gradients and by inverting elements to negate axial ones. Details are given in [5,6]. As noted, this policy has been extremely successful. In particular, average fuel burnups of 178-190 grams per element for all types of MITR fuel have been obtained while still observing the technical specification limit on fission density.

The Massachusetts Institute of Technology desires to return spent fuel to DOE. However, this is not possible at present because DOE is limiting its acceptance of returns until it acquires additional storage capacity. As of this writing (2/20/96), DOE had the following schedule for the MITR: no shipments of spent fuel in 1996 or 1997; three shipments (eight elements each) of spent fuel in 1998, one shipment of spent fuel per year thereafter. DOE will confirm the above in writing and we will forward their letter upon receipt. This schedule may not be achieved. Moreover, even if it is, continued operation of the facility will require an increase in the possession limit. Given the recent increase in reactor utilization, this rate of return (24 elements in 1998, 8 per year thereafter) will not immediately lower our inventory to less than 29 kilograms. Hence the temporary increase is requested to 8 August 1999, the current expiration date of the R-37 license.

### Current Situation Regarding Fuel Supplies

The MIT Research Reactor currently has about 27.5 kilograms of SNM on site. Therefore, under the present license limit of 29 kilograms, only two additional elements can be brought in. Reactor operation can and will be continued through the reinsertion of partially-spent elements. Nevertheless, unless additional fresh fuel can be brought in, it will not be possible to continue reactor operation for more than four to six months. (The exact figure depends on experiment schedules and is difficult to determine precisely.) Hence, the Massachusetts Institute of Technology is hereby requesting a temporary increase in the SNM possession limit. Specifically, it is requested that the possession limit for uranium-235 in paragraph 2B(2) of Facility Operating License No. R-37 be increased from 29 kilograms to 41 kilograms as was authorized on a temporary basis under MITR license amendment No. 25[7]. MIT would, of course, strive to maintain its inventory as low as possible and would order fresh fuel only as needed to maintain uninterrupted reactor operation. Also, this request is temporary. The possession limit would revert to 29 kilograms once a sufficient quantity of the reactor's spent fuel was shipped. Table Two provides a projection of the total amount of U-235 that would be on-site.

TABLE TWO

Projected Inventory of U-235

Date	Fresh Fuel Added* (kg)	Burnup (kg)	Total (kg)
March 1, 1996	—	—	27.5
March 1, 1997	4.55	-1.6	30.5
March 1, 1998	5.06	-1.6	33.9
March 1, 1999	4.55	-1.6	36.9
June 30, 1999	1.69	-0.5	38.1

\* Addition is during the preceeding operating interval

- Notes:
- (1) Assumes no returns to DOE.
  - (2) The requested 41 kg limit exceeds the projected 38.1 kg. The difference (2.9 kg) allows for a maximum of three elements (1.6 kg) in an unirradiated state and also for the possibility of unanticipated eventualities such as elements that must be prematurely discharged because of excess off-gassing.



Arguments Supporting a Temporary Increase in the Possession Limit

- (a) MIT received a uranium-235 possession limit of 45 kilograms on 23 July 1975 as part of Amendment No.10 to Facility Operating License No. R-37.
- (b) MIT voluntarily requested a reduction in its possession limit to 29 kilograms on 25 Sept. 1975. No safety system or safety-related procedure or regulatory requirement was relaxed or eliminated as a result of this reduction.
- (c) Several safety improvements relative to the storage of fuel have been made at MIT since 1975. Physical security, never a problem, was increased in accordance with revised NRC regulations. The criticality analyses of all fuel storage locations were redone using the latest calculational methods. The results which confirmed the safety aspects of the fuel's storage were reported to the NRC in License Amendment No. 21 to Facility Operating License No. R-37.
- (d) Storage facilities for spent fuel are well below capacity. Also, the fuel in those facilities is well above the self-protection guideline.
- (e) The proposed increase will be temporary.
- (f) No changes will be needed or made to procedures for fuel receipt, Q/A, storage, handling, or security as a result of this request.
- (g) No unreviewed safety question exists because this limit (41 kilograms) was previously in effect. Since receipt of that approval, only conservative changes have been made that affect any facet of the handling of fresh fuel. In particular,
  - (i) There is no increase in the probability of occurrence or the consequences of an accident that was previously evaluated. In particular, the requirements of MITR Technical Specification 3.10 concerning the security, storage, and handling of unirradiated fuel remain unchanged.
  - (ii) No new type of accident is created.
  - (iii) No margin of safety as defined in any technical specification is decreased.

Proposed Wording of Change

If approved, it is proposed that Facility License No. R-37 be amended by revising in its entirety paragraph 2.B(2) therefore to read as follows:

- (a) The limit for possession, receipt, and use of contained uranium-235 is temporarily increased to 41 kilograms of which not more than 1.6 kilograms may be in an unirradiated state until August 8, 1999, for the purpose of maintaining uninterrupted reactor operation pending the establishment of a capability for the off-site shipment of spent fuel and the actual shipment of the spent fuel accumulated prior to the establishment of that capability.

- (b) The licensee shall, as part of its annual reporting requirements, report the status of the establishment of the shipping capability and other activities relevant to the use of this temporary increase in the possession limit.

Please note that, except for the expiration date, the wording of the proposed change is identical to that contained in MITR License Amendment No. 25[7].

#### References

- [1] Amendment No. 10 to Facility Operating License R-37.
- [2] USNRC letter to Mr. L. Clark, Jr. dated 29 August 1975.
- [3] MITR letter to USNRC dated 25 September 1975.
- [4] Amendment No. 11 to Facility Operating License R-37.
- [5] Bernard, J.A., Lanning, D.D., and L. Clark, Jr., "Use of Element Rotation/Inversion to Increase MITR-II Fuel Depletion," Transactions of the American Nuclear Society, Vol. 38, Suppl. 1, Aug. 1981, pp 17-18.
- [6] Bernard, J., Kwok, K.S., Lanning, D.D., and L. Clark, Jr., "Calculational Procedures Used to Extend MITR-II Fuel Burnup," Transactions of the American Nuclear Society, Vol. 44, Suppl. 1, Aug. 1983, pp 14-15.
- [7] Amendment No. 25 to Facility Operating License R-37.

Copies of references [1]-[4] and [7] are attached.



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

JUL 23 1975

Docket No. 50-20

Massachusetts Institute of Technology  
ATTN: Mr. Lincoln Clark, Jr.  
Director  
138 Albany Street  
Cambridge, Massachusetts 02139

Gentlemen:

The Commission has issued Amendment No. 10 to Facility Operating License No. R-37 for the Massachusetts Institute of Technology Research Reactor (MITR). The amendment revises the license in its entirety. The Technical Specifications which are incorporated in the license have also been revised in their entirety, and have been designated Change No. 13 to the Technical Specifications. This action is in accordance with your application dated November 18, 1970 and supplements thereto.

The significant changes in the amended license are to authorize (1) operation of the modified reactor, (2) the possession and use of an additional 27.5 kilograms of uranium 235, and (3) the possession and use of 2 one-curie plutonium-beryllium neutron sources.

The Commission's staff has evaluated the potential for environmental impact associated with operation of the MITR in the proposed manner. From this evaluation, the staff has determined that there will be no significant environmental impact attributable to the proposed action. Having made this determination, the Commission has further concluded, pursuant to 10 CFR Part 51, Section 51.5(c)(1) that no environmental impact statement need be prepared for this action. Copies of the related Negative Declaration, which is being filed with the Office of the Federal Register for publication, and the Environmental Impact Appraisal are enclosed.

Also enclosed are copies of the Safety Evaluation and the Federal Register Notice of Issuance of Amended Facility License.

Sincerely,

*George Lea*

George Lea, Chief  
Operating Reactors Branch #3  
Division of Reactor Licensing



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Mr. Lincoln Clark

- 2 -

JUL 23 1975

Enclosures:

1. Amendment No. 10
2. Negative Declaration
3. Environmental Impact Appraisal
4. Safety Evaluation
5. Federal Register Notice

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-20

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

AMENDED FACILITY OPERATING LICENSE

Amendment No. 10  
License No. R-37

1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for license filed by by Massachusetts Institute of Technology (the licensee) complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. Construction of the facility has been substantially completed with Construction Permits Nos. CPRR-5 and CPRR-118, and the application, as amended, the provisions of the Act and the rules and regulations of the Commission;
  - C. The facility will operate in conformity with the application, as amended, the provisions of the Act, and the rules and regulations of the Commission;
  - D. There is reasonable assurance (i) that the activities authorized by this operating license can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the rules and regulations of the Commission;
  - E. The licensee is technically and financially qualified to engage in the activities authorized by this operating license in accordance with the rules and regulations of the Commission;
  - F. The Massachusetts Institute of Technology is a nonprofit educational institute and will use the facility for the conduct of educational research and development activities. The applicant is therefore exempt from the financial protection requirement of subsection 170a of the Act;



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- G. The Massachusetts Institute of Technology has executed an indemnity agreement which satisfies the requirements of 10 CFR Part 140;
  - H. The issuance of this operating license will not be inimical to the common defense and security or to the health and safety of the public; and
  - I. The receipt, possession, and use of byproduct and special nuclear material as authorized by this license will be in accordance with the Commission's regulations in 10 CFR Parts 30 and 70 (including Sections 30.33, 70.23 and 70.31).
2. Facility Operating License No. R-37 issued to the Massachusetts Institute of Technology is hereby amended in its entirety to read as follows:
- A. This license applies to the light-water cooled, heavy-water reflected tank-type nuclear reactor (herein "the facility" or "the reactor") which is owned by the Massachusetts Institute of Technology (herein "MIT") and located on MIT's campus in Cambridge, Massachusetts, and described in the application dated February 20, 1954, and subsequent amendments thereto, including the application dated November 18, 1970, and amendments thereto including the amendment dated June 2, 1975 (herein "the application").
  - B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses MIT:
    - (1) Pursuant to Sections 104a. and c. of the Act and 10 CFR Part 50, "Licensing of Production and Utilization Facilities", to possess, use and operate the reactor as a utilization facility at the designated location on the MIT's campus in Cambridge, Massachusetts, in accordance with the procedures and limitations described in the application and in this license;
    - (2) Pursuant to the Act and 10 CFR Part 70, "Special Nuclear Material", to receive, possess and use in connection with operation of the reactor up to 45 kilograms of contained uranium 235 and 2 one-curie plutonium-beryllium neutron sources;
    - (3) Pursuant to the Act and 10 CFR Part 30, "Rules of General Applicability to Licensing of Byproduct Materials", to possess and use a 150-curie antimony-beryllium sealed neutron source in connection with operation of the reactor; and

- (4) Pursuant to the Act and 10 CFR Parts 30 and 70, to possess, but not separate, such byproduct material and special nuclear material as may be produced by operation of the reactor.
- C. This license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Sections 50.54 and 50.59 of Part 50 and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations and orders of the Commission now or hereafter in effect, and is subject to the additional conditions specified or incorporated below:
- (1) MIT is authorized to operate the reactor at steady state power levels up to 5 megawatts (thermal).
- (2) Technical Specifications
- The Technical Specifications contained in Appendix A (designated Change No. 13) are hereby incorporated in the license. The licensee shall operate the reactor in accordance with these Technical Specifications. No changes shall be made in the Technical Specifications unless authorized by the Commission as provided in Section 50.59 of 10 CFR Part 50.
- D. This amended license is effective as of its date of issuance and shall expire at midnight, May 7, 1996.

FOR THE NUCLEAR REGULATORY COMMISSION

*Karl R. Goller*

Karl R. Goller, Assistant Director  
for Operating Reactors  
Division of Reactor Licensing

Attachment:  
Technical Specifications  
(Change No. 13)

Date of Issuance: JUL 23 1975

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

2

Docket No. 50-20

AUG 29 1975

Massachusetts Institute of Technology  
ATTN: Mr. Lincoln Clark, Jr.  
Director  
138 Albany Street  
Cambridge, Massachusetts 02139

Gentlemen:

RE: MASSACHUSETTS INSTITUTE OF TECHNOLOGY RESEARCH REACTOR

Your utilization facility license authorizes you to possess special nuclear material (SNM) of a type and amount that exceeds the "threshold" quantity defined by 10 CFR Part 73, §73.1(b) (copy enclosed). It is our objective that the amount of SNM that facility licensees are authorized to possess and the amount that they actually possess be consistent and furthermore, that these amounts be reduced to the "lowest acceptable quantity". This "lowest acceptable quantity" is defined as the amount necessary to sustain current operations and those projected for the immediate future, i.e., 12 months.

Therefore, we request that you review your requirements for SNM and provide adequate justification for the "lowest acceptable quantity" for your facility as defined above. If the amount of SNM currently authorized by your license is greater than the "lowest acceptable quantity" for your facility, then you should submit a request for a license amendment to reduce the authorized amount to that quantity. We ask that your response to this request, including an application for a license amendment, if appropriate, be submitted within 30 days from the date of this letter.

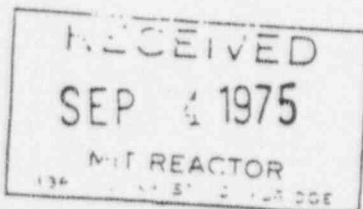
This request for generic information was approved by GAO under a blanket clearance number B-180211 (R0072); this clearance expires July 31, 1977.

Sincerely,

*Walter A. Paulson*

*for* George Lear, Chief  
Operating Reactors Branch #3  
Division of Reactor Licensing

Enclosure:  
Copy of 10 CFR Part 73  
§73.1(b)



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MASSACHUSETTS  
INSTITUTE OF  
TECHNOLOGY  
RESEARCH REACTOR  
DEPARTMENT OF NUCLEAR ENGINEERING

138 Albany St., Cambridge, Massachusetts 02139

3

September 25, 1975

Docket No. 50-20

U.S. Nuclear Regulatory Commission  
Division of Reactor Licensing  
Attn.: Mr. George Lear, Chief  
Operating Reactors Branch #3  
Washington, D.C. 20555

Subject: SNM Possession Limit, License R-37

Gentlemen:

In response to Nuclear Regulatory Commission, Division of Reactor Licensing letter of August 29, 1975, Massachusetts Institute of Technology hereby submits an application to amend its Facility Operating License No. R-37.

The requested amendment consists of reducing the possession limit for uranium-235 authorized in paragraph 2B(2) of the license from 45 kilograms to 29 kilograms.

The U-235 possessed and used under License R-37 is in the form of fuel elements and falls into three categories:

- a) Unirradiated fuel
- b) Partially burned fuel
- c) Spent fuel.

The unirradiated fuel is purchased periodically. Because we have made only one purchase of this type of fuel in the past and because it will be necessary to find a new fabricator for future procurements, we do not have significant experience on which to evaluate the effect of purchase quantity on cost. It has been our expectation that a two-year supply (27 fuel elements) would be about the minimum economic quantity to fabricate in one batch. At 0.445 kg U-235 per element this amounts to 12 kg. U-235.

In order to remain below the "threshold" quantity defined by paragraph 73.1(b) of 10 CFR 73, it will be necessary for us to take delivery of only the number of elements needed for refuelling, plus a few more standby elements which would be stored in an acceptable vault at the MITR. The unirradiated

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fuel stored in the vault together with other special nuclear material at the site would be kept below the "threshold" quantity. The remaining newly-purchased elements would be stored elsewhere, as is now being done with some of the elements from our last purchase.

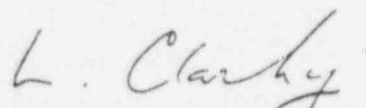
A core loading for the reactor is normally 26 elements. In order to achieve maximum authorized burnup, a fuel management program has been developed, which calls for cycling some of the elements from the reactor to storage in the reactor pool and then back into the reactor before being discharged as spent fuel. The amount of partially burned fuel being stored for re-use varies from year to year, but it never exceeds 25 standard elements plus a few special elements used for reactor physics and other tests.

Spent fuel will be discharged to a storage tank, probably in batches of 15 elements. It has been our practice in the past, for reasons of economy, to accumulate enough fuel (i.e. 56 elements) so that we could make two consecutive shipments of 28 elements each. However, the savings over making periodic single shipments were not great, and so the above amended possession limit of 29 Kg U-235 is based on the single shipment schedule. It also assumes 25% burnup in the spent fuel. When the steady state condition has been reached for the MITR-II, spent fuel shipments will be made about every second year, assuming 28 elements per load.

Because we have recently shipped all of the spent fuel from operation of the MITR-I and have on-site only 32 elements for startup of the MITR-II, our current inventory under License R-37 is only 15.1 Kg U-235. This includes 0.8 Kg U-235 in excess, unirradiated, special fuel elements for the MITR-I, which we hope to dispose of shortly. The MITR-II inventory will increase 4 Kg or 5 Kg each year until it reaches 27 Kg in 1978. The schedule calls for 29 Kg in 1980 and then a peak of 35 Kg in 1981, followed by varying but lesser amounts thereafter.

In response to your letter, we are requesting a possession limit of 29 Kg U-235 at this time, since it is clear that our inventory must increase after the reactor gets back into operation. We will then re-evaluate our requirements on the basis of operating experience and subsequently request an increase above 29 Kg if necessary.

Sincerely yours,

  
Lincoln Clark, Jr.  
Director

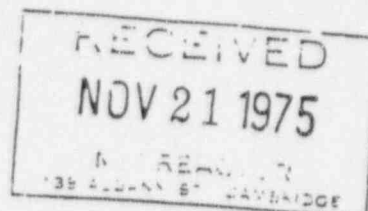
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xc: J.L. Cochrane  
D.D. Lanning  
MITRSC

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

Docket No. 50-20

November 17, 1975

Massachusetts Institute of Technology  
ATTN: Mr. Lincoln Clark, Jr.  
Director  
138 Albany Street  
Cambridge, Massachusetts 02139



Gentlemen:

In accordance with your application dated September 25, 1975, enclosed is Amendment No. 11 to Facility License No. R-37 which reduces the maximum quantity of Uranium 235 which you may receive, possess, and use in connection with operation of the Massachusetts Institute of Technology Research Reactor from 45 kilograms to 29 kilograms.

A copy of our related Safety Evaluation is also enclosed.

Sincerely,

George Lear, Chief  
Operating Reactors Branch #3  
Division of Reactor Licensing

Enclosures:

1. Amendment No. 11
2. Safety Evaluation

cc w/encls:

Henry Kolbe, M. D.  
Acting Commissioner of Public Health  
Massachusetts Department of Public Health  
600 Washington Street  
Boston, Massachusetts 02111

Honorable Walter Sullivan  
Mayor of the City of Cambridge  
Cambridge, Massachusetts 01401

Mr. John Corcoran, City Manager  
795 Massachusetts Avenue  
Cambridge, Massachusetts 02139



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UNITED STATES NUCLEAR REGULATORY COMMISSION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DOCKET NO. 50-20

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 11  
License No. R-37

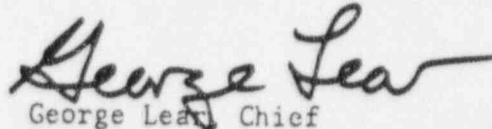
1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment by the Massachusetts Institute of Technology (the licensee) dated September 25, 1975, complies with the requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - 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: (i) that the activities authorized by this operating license can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the rules and 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. The receipt, possession and use of the special nuclear material as authorized by this license, as amended, will be in accordance with 10 CFR Part 70, including Sections 70.23 and 70.31; and
  - F. Publication of Notice of this amendment is not required since the amendment does not involve a significant hazards consideration.
2. Accordingly, Facility Operating License No. R-37, as amended, is hereby further amended by revising in its entirety paragraph 2.B.(2) thereof to read as follows:

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"(2) Pursuant to the Act and 10 CFR Part 70, "Special Nuclear Material", to receive, possess and use in connection with operation of the reactor up to 29 kilograms of contained Uranium 235 and 2 one-curie plutonium-beryllium neutron sources;"

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

FOR THE NUCLEAR REGULATORY COMMISSION

A handwritten signature in cursive script, reading "George Lear".

George Lear, Chief  
Operating Reactors Branch #3  
Division of Reactor Licensing

Date of Issuance: November 17, 1975

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 11 TO LICENSE NO. R-37

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DOCKET NO. 50-20

Introduction

The Nuclear Regulatory Commission requested, by letter dated August 29, 1975, that the Massachusetts Institute of Technology (MIT) review its requirements for special nuclear material (SNM) and determine the amount of SNM that constitutes the "lowest acceptable quantity" (LAQ) of SNM necessary to sustain current operation of the MIT Research Reactor (MITRR). The letter further requested that if the amount of SNM currently authorized by the MITRR Operating License is greater than the LAQ, that MIT should request that its authorization for possession of SNM be reduced to its LAQ. By letter dated September 25, 1975, MIT requested that its possession limit for SNM be reduced from 45 kilograms to 29 kilograms of contained Uranium 235.

Evaluation

We have reviewed the analysis provided in support of MIT's September 25, 1975, requested license amendment and have determined that the licensee has accurately calculated the lowest acceptable quantity of SNM required to sustain current operations. Furthermore, our evaluation of MIT's September 25, 1975, submittal supports the conclusion that reduction of the authorized amount of SNM to 29 kilograms of contained Uranium 235 will allow sufficient operational freedom with respect to: (1) the storage of new, unirradiated fuel elements, (2) the storage of irradiated fuel elements, and (3) the reactor core uranium inventory. The proposed reduction in the allowable quantity of special nuclear material authorized for receipt, possession and use at the MITRR is an administrative change only and does not affect the conduct of operations at the reactor. The reduction of the quantity of SNM is consistent with the Commission's objective of authorizing only the "lowest acceptable quantity" of SNM to licensees, and should not affect the licensee's ability to sustain current operation for the immediate future. On the basis of the above, we find the proposed change acceptable.

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CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) because the change does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: November 17, 1975



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

7

December 11, 1989

Docket No. 50-20

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

Dear Dr. Bernard:

SUBJECT: ISSUANCE OF AMENDMENT NO. 25 TO FACILITY OPERATING LICENSE  
NO. R-37 - MASSACHUSETTS INSTITUTE OF TECHNOLOGY RESEARCH  
REACTOR

The Commission has issued the enclosed Amendment No. 25 to Facility Operating License No. R-37 for the Massachusetts Institute of Technology Research Reactor (MITR-II). The amendment consists of changes to the Technical Specifications in response to your submittal dated February 14, 1989 as supplemented on August 24, 1989.

The amendment allows a temporary increase in the possession limit for uranium-235. In addition, we have updated the NRC addresses in the Technical Specifications to which reports should be sent.

A copy of the related Safety Evaluation supporting Amendment No. 25 is enclosed.

Sincerely,

Alexander Adams, Jr., Project Manager  
Non-Power Reactor, Decommissioning and  
Environmental Project Directorate  
Division of Reactor Projects - III,  
IV, V and Special Projects  
Office of Nuclear Reactor Regulation

Enclosures:

1. Amendment No. 25
2. Safety Evaluation

cc w/enclosures:  
See next page

MIT-REACTOR  
DEC 15 1989

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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



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DOCKET NO. 50-20

AMENDMENT TO FACILITY OPERATING LICENSE

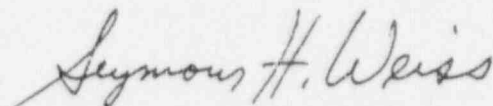
Amendment No. 25  
License No. R-37

1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment to Facility Operating License No. R-37 filed by the Massachusetts Institute of Technology (the licensee), dated February 14, 1989 as supplemented on August 24, 1989 complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations as set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the regulations of the Commission;
  - C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;
  - 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. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied; and
  - F. Prior notice of this amendment was not required by 10 CFR §2.105(a)(4) and publication of notice of this amendment is not required by 10 CFR §2.106(a)(2).
2. Accordingly, the license is amended by changes to paragraph 2.B.(2) which is hereby amended to read as follows:
  - (2) Pursuant to the Act, 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," and the Commission Order dated September 27, 1985, to receive, possess, and use in connection with operation of the reactor up to 29 kilograms of contained uranium-235 of which not more than 1.6 kilograms may be in an unirradiated state and 2 one-curie plutonium-beryllium neutron sources subject to the following:

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- (a) The limit for possession, receipt, and use of contained uranium-235 is temporarily increased to 41 kilograms of which not more than 1.6 kilograms may be in an unirradiated state until January 1, 1992, for the purpose of maintaining uninterrupted reactor operation pending the establishment of a capability for the off-site shipment of spent fuel and the actual shipment of the spent fuel accumulated prior to the establishment of that capability.
  - (b) The licensee shall, as part of its annual reporting requirements, report the status of the establishment of the shipping capability and other activities relevant to the use of this temporary increase in the possession limit.
3. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the enclosure to this license amendment, and paragraph 2.C.(2) of License No. R-37 is hereby amended to read as follows:
- (2) Technical Specifications
- The Technical Specifications contained in Appendix A, as revised through Amendment No. 25, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.
4. This license amendment is effective as of its date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Seymour H. Weiss, Director  
Non-Power Reactor, Decommissioning and  
Environmental Project Directorate  
Division of Reactor Projects - III,  
IV, V and Special Projects  
Office of Nuclear Reactor Regulation

Enclosure:  
Appendix A Technical  
Specifications Changes

Date of Issuance: December 11, 1989

ENCLOSURE TO LICENSE AMENDMENT NO. 25

FACILITY OPERATING 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 a vertical line indicating the area of change.

Remove Pages

7-28

7-29

7-30

Insert Pages

7-28

7-29

7-30



### 7.13 Plant Reporting Requirements

In addition to the requirements of applicable regulations, and in no way substituting therefore, reports shall be made to the NRC as follows:

7.13.1 Within 24 hours, a report (by telephone or telegraph to the USNRC Region I) of:

- a. Any accidental release of radioactivity to unrestricted areas above permissible limits, whether or not the release resulted in property damage, personal injury or exposure.
- b. Any significant variation of measured values from a corresponding predicted or previously measured value of safety-related operating characteristics occurring during operation of the reactor.
- c. Any reportable occurrences as defined in Paragraph 1.15 of these specifications.
- d. Any violation of a Safety Limit.

7.13.2 A written report within 10 days to the Document Control Desk, USNRC, Washington, D.C., with a copy to the Regional Administrator, USNRC Region I of:

- a. Any accidental release of radioactivity above permissible limits in unrestricted areas, whether or not the release resulted in property damage, personal injury, or exposure; the written report (and, to the extent possible, the preliminary telephone and telegraph report) shall describe, analyze and evaluate safety implications, and outline the corrective measures taken or planned to prevent recurrence of the event.

- b. Any significant variation of measured values from a corresponding predicted or previously measured value of safety-related operating characteristics occurring during operation of the reactor.
- c. Incidents or conditions relating to operation of the facility which prevented or could have prevented the performance of engineered safety features as described in these specifications.
- d. Any reportable occurrences as defined in Paragraph 1.15 of these specifications.
- e. Any violation of a Safety Limit.

7.13.3 A written report within 30 days to the Document Control Desk, USNRC, Washington, D.C., with a copy to the Regional Administrator, USNRC, Region I of:

- a. Any substantial variance from performance specifications contained in these specifications or in the Final Safety Analysis Report.
- b. Any significant change in the transient or accident analyses as described in the FSAR.
- c. Any observed inadequacies in the implementation of administrative or procedural controls which threaten to cause reduction in the degree of redundancy provided in reactor protection systems or engineered safety feature systems.

7.13.4 A written report to the Document Control Desk, USNRC, Washington, D.C., with a copy to the Regional Administrator, USNRC, Region I within 60 days after completion of startup testing of the reactor upon receipt of a new facility license or an amendment to the license authorizing an increase in

reactor power level, describing the measured values of the operating conditions or characteristics of the reactor under the new conditions, including:

- a. An evaluation of facility performance to date in comparison with design predictions and specifications; and
- b. A reassessment of the safety analysis submitted with the license application in light of measured operating characteristics when such measurements indicate that there may be substantial variance from prior analysis.

7.13.5 An annual report shall be submitted in writing to the Document Control Desk, USNRC, Washington, D.C., with a copy to the Regional Administrator, USNRC, Region I within 60 days following the 30th of June of each year, providing the following information:

- a. A narrative summary of operating experience (including experiments performed) and of changes in facility design, performance characteristics and operating procedures related to reactor safety occurring during the reporting period, as well as results of surveillance tests and inspections required by these Technical Specifications.
- b. Tabulation showing the energy generated by the reactor (in megawatt days), the number of hours the reactor was critical, and the cumulative total energy output since initial criticality.
- c. The number of emergency shutdowns and inadvertent scrams, including the reasons therefore.
- d. Discussion of the major maintenance operations performed during the period, including the effect, if any, on the



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 25 TO

FACILITY OPERATING LICENSE NO. R-37

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DOCKET NO. 50-20

1.0 INTRODUCTION

By letter dated February 14, 1989, as supplemented on August 24, 1989, the Massachusetts Institute of Technology (MIT) requested a change to Facility Operating License No. R-37 for the MIT Research Reactor (MITR-II). The requested change would temporarily increase the license possession limit for uranium-235. In addition, the NRC mailing addresses in the Technical Specifications to which reports should be sent are updated to agree with 10 CFR 50.4.

2.0 EVALUATION

2.1 Temporary Increase in Uranium-235 Possession Limit

The current uranium-235 (U-235) possession limit for the MITR-II is 29 kilograms (kg). There were two fuel shipping casks with the capability to transport MITR-II spent fuel, the MH-1A and the GE-700. The Department of Energy sought to license the MH-1A cask but abandoned the effort in 1988 in light of continuing uncertainties concerning the licensability of the cask. Within the last several months, the General Electric Company has decided for economic reasons to remove the GE-700 cask from service. This means that MIT must retain spent fuel on site until a suitable shipping cask can be found. The Department of Energy and the cask user community are exploring several options, but resolution of the problem may take until 1992 or beyond.

MIT originally requested that their U-235 possession limit be increased to 45 kg which was the license limit prior to September 1975. However, based on further analysis by the MIT reactor staff in response to a NRC request for additional information, MIT has modified their possession limit request to 41 kg. This will be the maximum U-235 allowed under the reactor license through January 1, 1992 assuming continued unavailability of a suitable shipping cask. This number was derived by considering projected operating schedules, anticipated experimental usage, operating experience with the fuel cycle, the need for excess reactivity, and Technical Specification constraints on fission density. MIT's practice is to keep the amount of U-235 on site to a minimum and to maximize fuel depletion by rotating and inverting fuel elements. The staff agrees with the licensee's estimates of the increase in possession limit.

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This change to the license will not require changes in the "Physical Security Plan for the M.I.T. Research Reactor Facility." Existing storage facilities for spent fuel have the capacity to hold the fuel discharged from the reactor during the time period that this amendment will be in effect. Criticality aspects of fuel storage at MIT that are addressed by Amendment No. 21 issued on May 28, 1982 are not changed by this amendment.

This increase is temporary in nature and will be in effect until January 1, 1992. If spent fuel is shipped before January 1, 1992, MIT will apply for a license amendment to return the possession limit to 29 kg. If unavailability of shipping casks continue, MIT will perform a new analysis and apply for a new license amendment before the January 1, 1992 expiration date. While this temporary possession increase is in effect, MIT will provide information on the status of the establishment of shipping capability and other activities relevant to the amendment as part of their required annual report to the NRC.

The license condition on possession of U-235 is clarified with the addition of a clause to the license that limits total unirradiated fuel to 1.6 kg.

The staff concludes that the temporary increase in the possession limit of U-235 and the clarification of the license condition concerning unirradiated U-235 are acceptable.

## 2.2 Changes to NRC Mailing Addresses

In a telephone conversation between the MITR-II Superintendent and the NRC Project Manager for the MITR-II on October 16, 1989, it was agreed to update the NRC addresses in the Technical Specifications to which reports should be sent. These changes bring the Technical Specifications into agreement with 10 CFR 50.4, "Written Communications." These changes are editorial in nature and do not affect the operation of the reactor.

## 3.0 ENVIRONMENTAL CONSIDERATION

### 3.1 Temporary Increase in Uranium-235 Possession Limit

This portion of the amendment involves changes in the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20 and changes in inspection and surveillance requirements. The staff has determined that this portion of the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and there is no significant increase in individual or cumulative occupational radiation exposure. Accordingly, this portion of the 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 portion of the amendment.

### 3.2 Changes to NRC Mailing Addresses

This portion of the amendment involves changes in the category of recordkeeping, reporting, and administrative procedures and requirements. Accordingly, this portion of the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(10). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this portion of the amendment.

### 4.0 CONCLUSION

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

Dated: December 11, 1989