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NUCLEAR REGULATORY COMMISSION

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY RESEARCH REACTOR

ENVIRONMENTAL ASSESSMENT AND FINDING OF

NO SIGNIFICANT IMPACT

[NRC-2010-0313]

The U.S. Nuclear Regulatory Commission (NRC, the Commission) is considering issuance of a renewed Facility Operating License No. R-37, to be held by the Massachusetts Institute of Technology (MIT, the licensee), which would authorize continued operation of the Massachusetts Institute of Technology Research Reactor (MITR-II, the facility), located in Cambridge, Middlesex County, Massachusetts. Therefore, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 51.21, the NRC is issuing this Environmental Assessment (EA) and Finding of No Significant Impact.

ENVIRONMENTAL ASSESSMENT

Identification of the Proposed Action:

The proposed action would renew Facility Operating License No. R-37 for a period of twenty years from the date of issuance of the renewed license and increase the maximum licensed power level from 5 megawatts thermal (MW(t)) to 6 MW(t). The proposed action is in accordance with the licensee's application dated July 8, 1999, as supplemented by letters dated February 10 and May 8, 2000, January 29, 2004, July 5 and October 11, 2006, January 26, 2007, February 22, May 29, August 15, August 21, August 26, October 6, October 7 and December 1, 2008, May 26, August 27, October 5, October 9 and November 19, 2009, and

March 30, August 6 and August 26, 2010. In accordance with 10 CFR 2.109, the existing license remains in effect until the NRC takes final action on the renewal application.

Need for the Proposed Action:

The proposed action is needed to allow the continued operation of the MITR-II to routinely provide teaching, research, and services to numerous institutions for a period of twenty years. The proposed action is also needed to enhance the facility's experiment capabilities by increasing the maximum neutron flux in the experiment facilities.

Environmental Impacts of the Proposed Action:

The NRC staff has completed its safety evaluation of the proposed action to issue a renewed Facility Operating License No. R-37 to allow continued operation of the MITR for a period of twenty years at an increased power level of 6 MW(t) and concludes there is reasonable assurance that the MITR-II will continue to operate safely for the additional period of time at the increased licensed power level. The details of the NRC staff's safety evaluation will be provided with the renewed license that will be issued as part of the letter to the licensee approving the license renewal application. This document contains the environmental assessment of the proposed action.

The MITR-II is located on the MIT campus and is a part of the MIT Nuclear Reactor Laboratory. The reactor is housed in a dedicated building constructed primarily of reinforced concrete and steel which serves as a containment. The reactor site comprises the reactor building and a small area immediately surrounding it, bounded by a chain-link fence, and a portion of an attached multipurpose academic building. Adjacent to the site are an industrial building to the north, a parking lot and warehouse building to the east, a warehouse building to the south, and academic and dormitory buildings to the west. According to the licensee, the nearest point of normal public occupancy is on Albany Street, approximately 21 meters (68 feet) northwest of the reactor building, the nearest dormitories are located approximately 100 meters

(330 feet) west of the reactor, and the nearest non-MIT residence is approximately 250 meters (820 feet) from the reactor building.

The MITR-II is a tank-type, light-water-cooled and heavy-water-moderated research reactor that will be licensed to operate at a maximum steady-state power level of 6 MW(t). The core is located at the bottom of an aluminum tank surrounded by a heavy water reflector tank and a concrete biological shield. The reactor is fueled with plate-type, aluminum-clad fuel arranged in a compact core. A detailed description of the reactor can be found in the MITR-II Safety Analysis Report (SAR).

There have been no major modifications to the Facility Operating License since Amendment No. 10, dated July 23, 1975, which approved operation of a modified reactor core at a maximum power level of 5 MW(t). In connection with Amendment No. 10, the NRC staff evaluated the potential for environmental impacts associated with operation of the MITR-II. Based on that evaluation, the NRC staff concluded that there would be no significant environmental impact associated with licensing the MITR-II to operate at a maximum power level of 5 MW(t).

The licensee requested a change in the facility operating conditions as part of the renewal request. Specifically, the licensee requested an increase in the licensed maximum steady-state power level. This change should not affect the types of effluents released off site. There may be an increase in the quantity of gaseous effluents released offsite due to the increase in maximum power level. As discussed in this EA, off site concentrations of airborne radioactive material and potential radiation doses should continue to be a small fraction of the limits established in 10 CFR Part 20. The licensee has systems in place for controlling the release of radiological effluents and implements a radiation protection program to monitor personnel exposures and releases of radioactive effluents. As discussed in the NRC staff's safety evaluation, the systems and radiation protection program are appropriate for the types

and quantities of effluents expected to be generated by continued operation of the reactor at the increased power level. Accordingly, there should be no significant increase in routine occupational or public radiation exposure as a result of license renewal or the increase in maximum power level. As discussed in the NRC staff's safety evaluation, the proposed action will not significantly increase the probability of accidents. The proposed action may increase the consequences of accidents. Specifically, the increase in maximum steady-state power level may increase the fission product source term and potential occupational and public accident doses for the maximum hypothetical accident. As discussed in the NRC staff's safety evaluation, the worst case fission product source term will not result in occupational doses or doses to members of the general public in excess of the limits specified by 10 CFR Part 20. Therefore, the proposed action should not significantly change the environmental impact of facility operation. The NRC staff evaluated information contained in the licensee's application and data reported to the NRC by the licensee for the last five years of operation to determine the projected radiological impact of the facility on the environment during the period of the renewed license at the increased power level. The NRC staff found that releases of radioactive material and personnel exposures were all well within applicable regulatory limits. Based on this evaluation, the NRC staff concluded that continued operation of the reactor and the increase in the licensed maximum steady-state power level should not have a significant environmental impact.

I. Radiological Impact

Environmental Effects of Reactor Operations:

Gaseous radioactive effluents are discharged by the facility exhaust system via a stack adjacent to the reactor building, at a volumetric flow rate of approximately 3.5 cubic meters per second (7500 cubic feet per second). The only significant nuclide found in the gaseous effluent stream is Argon-41. The licensee performs continuous measurements of Argon-41 at the point

of release. Argon-41 releases reported in the licensee's annual reports average approximately 1445 Curies (Ci) for a typical year. According to the licensee's annual reports, these releases resulted in an annual average effluent concentration of 0.386E-8 microCuries per milliliter (μCi/ml). The NRC staff performed check calculations of Argon-41 releases and found the licensee's calculations to be reasonable. The calculated value is based on a dilution factor of 3,000 for gaseous effluents released from the facility exhaust stack. The licensee's application for license renewal contains a more realistic, and still conservative, dilution factor of 50,000. Based on this dilution factor, the annual average effluent concentration of Argon-41 would be 0.023E-8 μCi/ml. This concentration is less than three percent of the air effluent concentration limit of 1E-8 μCi/ml set by 10 CFR 20, Appendix B, Table 2. The potential annual radiation dose to a member of the general public resulting from this concentration is approximately 0.012 milliSieverts (mSv) (1.2 millirems (mrem)). As discussed later in this EA, the licensee's off-site dose measurements show a potential annual radiation dose from gaseous effluents of less than 0.01 mSv (1 mrem). These potential radiation doses demonstrate compliance with the dose limit of 1 mSv (100 mrem) set by 10 CFR 20.1301, and the air emissions dose constraint of 0.1 mSv (10 mrem) specified in 10 CFR 20.1101(d). The increase in maximum steady-state power level may increase the production of Argon-41 by 20 percent. Calculations by the licensee predict a maximum potential annual radiation dose to a member of the public of less than 0.02 mSv (2 mrem) given a 20 percent increase in Argon-41 production. The NRC staff performed check calculations of the maximum potential dose and found the licensee's calculations to be reasonable. The calculated potential dose is a small fraction of the regulatory limits discussed above. Because the licensee performs continuous monitoring of all airborne releases, the effluent concentrations at the increased power level will be measured to ensure that releases remain below the regulatory limits and as low as is reasonably achievable (ALARA).

Liquid wastes are generated at the MITR-II primarily as a result of sampling of the coolant, decontamination activities, and routine cleaning of the facility. Liquid wastes are stored in two above-ground tanks located in a dedicated structure equipped with leak detection and leak containment capabilities. The licensee disposes of liquid radioactive wastes primarily by discharge to the sanitary sewer. Liquid wastes may also be disposed of by use of ion exchangers, decay in storage, solidification, or transfer to an appropriate waste management facility. Discharge of liquid waste to the sanitary sewer requires the approval of the Reactor Radiation Protection Office (RRPO) to ensure that discharges meet the requirements of 10 CFR 2.2003. Prior to discharge, a waste sample is analyzed for gross alpha-beta, tritium, and isotopic content to ensure the concentrations of radionuclides in the liquid meet the limits in 10 CFR Part 20, Appendix B, Table 3 for releases to sewers. A sewer discharge pump is located within the restricted area for the discharge of liquid waste to the sewer system. The discharge path is from the liquid waste storage tanks into a filtration system, through a radiation monitor for continuous monitoring, and then to the sewer. Discharges reported in the licensee's annual reports indicate an annual average release of 0.08 milliCuries (mCi) of radionuclides other than tritium. Reported annual releases have not exceeded 0.21 mCi. This demonstrates compliance with the annual release limit of 1 Ci specified in 10 CFR 20.2003(a)(4) for radionuclides other than tritium. These radionuclides were discharged at an annual average concentration of 0.54E-8 μCi/ml, with no monthly average concentration exceeding 9.3E-8 μCi/ml. As mentioned above, the licensee performs appropriate sampling to ensure releases of liquid mixtures of radionuclides meet the release criteria in 10 CFR 20.2003. Tritium discharges reported in the licensee's annual reports indicate an annual average release of 240 milliCuries (mCi) at an average concentration of 1.91E-5 μCi/ml. The maximum monthly concentration released during the past 5 years was 2.19E-4 μCi/ml. These releases demonstrate compliance with the annual limit of 5 Ci specified in 10 CFR 20.2003(a)(4) and the

monthly average concentration limit of 1.0E-2 μCi/ml for disposal of tritium by releases to sewers specified in 10 CFR 20, Appendix B, Table 3. Due to the nature of the liquid waste sources, quantities of liquid wastes should not increase significantly as a result of the increase in maximum steady-state power level. Because the licensee samples all liquid wastes prior to discharge and continuously monitors the wastes during discharge, the licensee's liquid waste discharge program is adequate to ensure that all releases will remain within the applicable regulatory limits.

The licensee classifies solid low-level radioactive wastes generated at the MITR-II as either wet or dry waste. Wet waste includes filters and ion exchange resins. Dry waste includes ventilation filters and contaminated materials such as paper, cloth, metals, and other items used for routine facility operations. Solid waste may also include reactor components and experiment materials. Solid waste management is divided into four processes: collection, pretreatment, solidification, and packing. According to the licensee, volume reduction methodologies are applied to all processes and solid wastes are stored onsite for decay. After solid waste is processed, it is sent to a designated waste facility in accordance with all applicable regulations. Solid radioactive releases reported in the licensee's annual reports for the last 5 years totaled 1127 mCi.

The reactor fuel and heavy-water are supplied by the Department of Energy (DOE). The DOE is responsible for disposing of the spent fuel and the heavy-water. To comply with the Nuclear Waste Policy Act of 1982, MIT has entered into a contract with DOE that provides that DOE retain title to the fuel utilized at the MITR-II and that DOE is obligated to take the fuel from the site for final disposition. The licensee prepares the spent fuel for shipment in accordance with the applicable regulations in 10 CFR Parts 71 and 73, and U.S. Department of Transportation regulations. Heavy-water is likewise treated and stored in the facility until DOE transfers it to a DOE storage facility or to a processing facility.

Personnel exposures at the facility are well within the limits set by 10 CFR 20.1201, and ALARA. Doses to personnel are monitored under a program that meets the requirements of 10 CFR 20.1501. The RRPO records and tracks all personnel radiation exposures. Data reported in the licensee's annual reports indicates that most personnel receive an annual dose of less than 1 mSv (100 mrem), with many of the personnel doses being below the detectable level. Data reported in the licensee's annual reports indicates that the maximum personnel dose is typically less than 7.5 mSv (750 mrem) per year, and no personnel have received a dose greater than half the occupational limit of 50 mSv (5000 mrem) specified in 10 CFR 20.1201. The licensee maintains air sampling, area radiation monitoring, and bioassay programs to further monitor potential radiation hazards and exposures to personnel. The licensee does not expect the increase in reactor power level to cause a proportional increase in personnel doses. However, even with a 20 percent increase, personnel doses will remain well below the regulatory limit and the licensee's radiation protection program should continue to keep personnel doses ALARA.

The licensee conducts an environmental monitoring program to record and track the potential radiological impact of MITR-II operation on the surrounding environment. The RRPO administers the program and maintains the appropriate records in accordance with 10 CFR 20.2103. The program includes monthly exposure measurements at locations on the restricted area boundary and control locations. The program also includes quarterly exposure measurements and continuous monitoring using Geiger-Mueller tube detectors at five locations approximately 0.40 kilometers (0.25 miles) from the site boundary. The measurements are representative of potential public radiation doses from the release of gaseous effluents from the facility. Over the past five years, the environmental monitoring program indicated that radiation exposures at the monitoring locations were less than 0.01 mSv (1 mrem) per year. Based on the NRC staff's review of the past five years of data, the NRC staff concludes that the potential

radiological impact of operation of the MITR-II on the surrounding environment is a small fraction of the regulatory limits. Any changes in radiological impact due to the increase in reactor power are expected to be minimal, and the potential radiological impact will remain a small fraction of the regulatory limits.

Environmental Effects of Accidents:

Accident scenarios are discussed in Chapter 13 of the MITR-II SAR. The maximum hypothetical accident is the release of the fission products contained in four fuel plates to the reactor coolant, the containment building, and ultimately the uncontrolled environment. The licensee conservatively calculated doses to facility personnel and the maximum potential dose to a member of the public. NRC staff performed independent calculations to verify that the doses represent conservative estimates for the MHA. As discussed in the NRC staff's safety evaluation, the worst case fission product source term will not result in occupational doses or doses to members of the general public in excess of the limits specified by 10 CFR Part 20.

II. Non-Radiological Impacts

The MITR-II core is cooled by a light water primary system consisting of the reactor tank, a heat removal system, and a coolant cleanup system. Cooling occurs by forced or natural convection, with the heated coolant rising out of the core and into the bulk tank water. The primary system transfers heat to the secondary system via heat exchangers. The secondary system also contains heat exchangers to remove heat from other reactor systems at the MITR-II. The secondary system coolant is continuously monitored for radioactivity using redundant radiation detectors, and the coolant is sampled for radioactivity daily during reactor operation.

Losses of secondary coolant due to evaporation and system discharge to the sewer (blowdown) are replaced using water from the local city water supply. According to the licensee, daily secondary coolant losses are approximately 7000 gallons due to system

blowdown and an average of 30000 gallons due to evaporation during reactor operation. This is a small percentage of the approximate 2.7 million gallons used campus-wide by MIT per day. The increase in licensed power level may proportionally increase the facility water usage, but the total facility water usage will remain a small percentage of the campus-wide water usage. Given that the proposed action does not involve a significant increase in water usage, the NRC staff concludes that the proposed action will not have a significant impact on the local water supply.

Heat is transferred from the secondary system to the atmosphere via cooling towers rated at 10 MW(t) total heat dissipation capacity. During reactor operation at 6 MW(t), the heat dissipation would be comparable to that at local factories and other MIT laboratories. Neither extensive heat drift nor fog will occur at this heat dissipation rate. A small amount of heat may be discharged to the sewer during blowdown of the cooling towers. However, the small amount of heat dissipated in this manner is insufficient to raise average water temperatures in the surrounding environment. Based on the above considerations, the NRC staff concludes that the proposed action will not have a significant thermal impact on the surrounding environment.

National Environmental Policy Act (NEPA) Considerations:

NRC has responsibilities that are derived from NEPA and from other environmental laws, which include the Endangered Species Act (ESA), Coastal Zone Management Act (CZMA), National Historic Preservation Act (NHPA), Fish and Wildlife Coordination Act (FWCA), and Executive Order 12898 Environmental Justice. The following presents a brief discussion of impacts associated with these laws and other requirements.

I. Endangered Species Act

Federally- or State-protected species have not been found in the vicinity of the MITR-II. Effluents and emissions from the MITR-II have not had an impact on critical habitat.

II. Coastal Zone Management Act

The MITR-II is not located within any managed coastal zones, nor would the MITR-II effluents and emissions impact any managed coastal zones.

III. National Historic Preservation Act

The NHPA requires Federal agencies to consider the effects of their undertakings on historic properties. The National Register of Historic Places (NRHP) lists two historical sites located near the MIT campus, the North Avenue Congregational Church and the New England Confectionery Company Factory. According to the NRHP, the locations of these sites are approximately 100 meters (300 feet) from the MITR-II. Given the distance to these sites and that the proposed action does not involve any demolition, rehabilitation, construction, changes in land use, or significant changes in effluents from the facility, continued operation of the MITR-II will not impact any historic sites. Based on this information, the NRC finds that the potential impacts of license renewal would have no adverse effect on historic properties. The NRC staff informed the State Historic Preservation Officer (SHPO) of this finding, and the SHPO concurred with the NRC finding.

IV. Fish and Wildlife Coordination Act

The licensee is not planning any water resource development projects, including any of the modifications relating to impounding a body of water, damming, diverting a stream or river, deepening a channel, irrigation, or altering a body of water for navigation or drainage.

V. Executive Order 12898 – Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the relicensing and the continued operation of the MITR-II. Such effects may include human health, biological, cultural, economic, or social impacts. Minority and low-income populations are subsets of the general public residing in the vicinity of

the research reactor, and all are exposed to the same health and environmental effects generated from activities at the MITR-II.

Minority Populations in the Vicinity of the MITR-II — According to 2000 census data, 18.1 percent of the population (approximately 6,472,000 individuals) residing within a 50-mile radius of the MITR-II identified themselves as minority individuals. The largest minority group was Hispanic or Latino (approximately 438,000 persons or 6.8 percent), followed by Black or African American (approximately 397,000 persons or about 6.1 percent). According to the U.S. Census Bureau, about 16.4 percent of the Middlesex County population identified themselves as minorities, with persons of Asian origin comprising the largest minority group (6.9 percent). According to census data 3-year average estimates for 2006-2008, the minority population of Middlesex County, as a percent of total population, had increased to 20.1 percent.

Low-Income Populations in the Vicinity of the MITR-II — According to 2000 census data, approximately 106,300 families and 575,000 individuals (6.6 and 8.9 percent, respectively) residing within a 50-mile radius of the MITR-II were identified as living below the Federal poverty threshold in 1999. The 1999 Federal poverty threshold was $17,029 for a family of four.

According to Census data in the 2006-2008 American Community Survey 3-Year Estimates, the median household income for Massachusetts was $64,684, while 10.0 percent of the state population and 7.1 percent of families were determined to be living below the Federal poverty threshold. Middlesex County had a higher median household income average ($77,373) and lower percentages (7.4 percent) of individuals and families (4.9 percent) living below the poverty level, respectively.

Impact Analysis—Potential impacts to minority and low-income populations would mostly consist of radiological effects, however radiation doses from continued operations associated with the license renewal are expected to continue at near current levels, and would be well below regulatory limits.

Based on this information and the analysis of human health and environmental impacts presented in this EA, the proposed relicensing would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the MITR-II.

Environmental Impacts of the Alternatives to the Proposed Action:

As an alternative to license renewal, the NRC staff considered denial of the proposed action. If the Commission denied the application for license renewal, facility operations would end and decommissioning would be required. The NRC staff notes that, even with a renewed license, the MITR-II will eventually be decommissioning, at which time the environmental effects of decommissioning will occur. Decommissioning would be conducted in accordance with an NRC-approved decommissioning plan which would require a separate environmental review under 10 CFR 51.21. Cessation of reactor operations would reduce or eliminate radioactive effluents and emissions. However, as previously discussed in this environmental assessment, radioactive effluents and emissions from reactor operations constitute a small fraction of the applicable regulatory limits. Therefore, the environmental impacts of license renewal and the denial of the request for license renewal would be similar. In addition, denying the request for license renewal would eliminate the benefits of teaching, research, and services provided by the MITR-II. If the Commission denied the request for an increase in the licensed maximum steady-state power level, effluent releases and emissions would remain at the current levels. As discussed in this EA, the increase in power level should not result in a significant increase in effluent releases, and all releases will remain a small fraction of the applicable regulatory limits. Therefore, the environmental impacts of the increase in the licensed maximum steady-state power level and denial of the request are similar.

Alternative Use of Resources:

The proposed action does not involve the use of any different resources or significant quantities of resources beyond those previously considered in the issuance of Amendment No. 10 to Facility Operating License No. R-37 for the MITR-II dated July 23, 1975, which approved operation of a modified reactor core at a maximum power level of 5 MW(t).

Agencies and Persons Consulted:

In accordance with the agency's stated policy, on July 22, 2010, the NRC staff consulted with the State Liaison Officer regarding the environmental impact of the proposed action. The consultation involved a thorough explanation of the environmental review, the details of this environmental assessment, and the NRC staff's findings. The State official stated the he understood the NRC review and had no comments regarding the proposed action. The NRC staff also informed the SHPO of the potential impact of the proposed action on historic resources. As previously mentioned, the SHPO concurred with the NRC determination that license renewal and the increase in licensed power level would have no adverse effect on historic properties in the vicinity of the MITR-II.

Finding of No Significant Impact:

On the basis of the environmental assessment, the NRC concludes that the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the NRC has determined not to prepare an environmental impact statement for the proposed action.

For further details with respect to the proposed action, see the licensee's letter dated July 8, 1999 (ML080950435), as supplemented by letters dated February 10 (ML003683419, ML052900533, ML053190234, and ML053190384), and May 8, 2000 (ML081000625), January 29, 2004 (ML081000626), July 5 (ML061930319) and October 11, 2006 (ML063340716), January 26, 2007 (ML070320555), February 22 (ML081000627), May 29 (ML081560246),

August 15 (ML082350069), August 21 (ML082401050), August 26 (ML082470562), October 6 (ML082900488), October 7 (ML082910241), and December 1, 2008 (ML083430006), May 26 (ML091540202), August 27 (ML092450427), October 5 (ML092930273), October 9 (ML092930278), and November 19, 2009 (ML093290155), and March 30 (ML100970368), August 6 (ML102310032), and August 26, 2010 (ML102440122). Documents may be examined, and/or copied for a fee, at the NRC's Public Document Room (PDR), located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible electronically from the Agencywide Documents Access and Management System (ADAMS) Public Electronic Reading Room on the NRC Web site http://www.nrc.gov/reading-rm/adams.html. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC PDR Reference staff at 1-800-397-4209, or 301-415-4737, or send an e-mail to pdr@nrc.gov.

Dated at Rockville, Maryland, this 27th day of September 2010.

FOR THE NUCLEAR REGULATORY COMMISSION

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