



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 12, 2018

Mr. Alberto Queirolo, Director
of Reactor Operations
Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street, MS NW12-116A
Cambridge, MA 02139

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – REQUEST FOR
ADDITIONAL INFORMATION FOR NUCLEAR SAFETY SYSTEM UPGRADE
LICENSE AMENDMENT REQUEST(CAC NO. MF5003, EPID: L-2016-LLA-
0003)

Dear Mr. Queirolo:

The U.S. Nuclear Regulatory Commission (NRC) staff is continuing its review of the Massachusetts Institute of Technology (MIT) license amendment request (LAR) for Facility Operating License No. R-37, dated September 30, 2014, as supplemented by letters dated May 12, 2016, July 6, 2017, and December 14, 2017 (Agencywide Documents Access and Management System Accession Nos. ML14282A039, ML16139A786, ML17193A188, and ML17354A009, respectively), as part of the upgrade of the nuclear safety system for the MIT Reactor. During the NRC staff's review, questions have arisen for which additional information is needed. The enclosed request for additional information (RAI) identifies the information needed to continue the NRC staff's review. It is requested that MIT provide responses to the enclosed RAI within 60 days from the date of this letter, as requested by the licensee and granted by the NRC staff.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.30(b), "Oath or affirmation," MIT must execute its response in a signed original document under oath or affirmation. The response must be submitted in accordance with 10 CFR 50.4, "Written communications." Information included in the response that is considered sensitive or proprietary, that MIT seeks to have withheld from the public, must be marked in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Any information related to security should be submitted in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements." Following receipt of the additional information, the NRC staff will continue its evaluation of the LAR.

If you have any questions, or need additional time to respond to this request, please contact me at 301-415-3936 or by electronic mail at Patrick.Boyle@nrc.gov.

Sincerely,

/RA/

Patrick G. Boyle, Project Manager
Research and Test Reactors Licensing Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket No. 50-20
License No. R-37

Enclosure:
As stated

cc: w/enclosure: See next page

Massachusetts Institute of Technology

Docket No. 50-20

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Ms. Sarah M. Don, Reactor Superintendent
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SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – REQUEST FOR ADDITIONAL INFORMATION FOR NUCLEAR SAFETY SYSTEM UPGRADE LICENSE AMENDMENT REQUEST (CAC NO. MF5003, EPID: L-2016-LLA-0003) DATE: MARCH 12, 2018

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ADAMS Accession No. ML18059A236 *concurred via e-mail NRR-106

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OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

FOR THE LICENSE AMENDMENT REQUEST TO UPGRADE THE NUCLEAR SAFETY

SYSTEM AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY REACTOR

LICENSE NO. R-37; DOCKET NO. 50-20

By letter dated September 30, 2014, and as supplemented by letters dated May 12, 2016, July 6, 2017, and December 14, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML14282A039, ML16139A786, ML17193A188, ML17354A009, respectively), the Massachusetts Institute of Technology (MIT, the licensee) submitted a request to upgrade the nuclear safety system (NSS) portion of the Reactor Protection System and incorporated by reference letters dated November 18, 2013, and June 6, 2014 (ADAMS Accession Nos. ML13339A343 and ML14161A035, respectively).

The proposed upgrade of the NSS would replace the current six channels (three for reactor period and three for reactor power level, any one of which will trip the reactor). The new system would contain four channels each of which monitors both the reactor period and the reactor power level. During the review of the license amendment request (LAR) and after performing the audit at the MIT reactor in Cambridge, MA from July 24-26, 2017, several requests for additional information (RAI) were transmitted to MIT in a letter dated October 12, 2017 (ADAMS Accession No. ML17237B992). MIT provided the responses in a letter dated December 14, 2017 (ADAMS Accession No. ML17354A009). The responses included in this letter were supplemented by information included within Enclosures A through V, as referenced below. The responses were discussed with MIT during a phone call on January 31, 2018. The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the responses provided and identified that follow up questions were necessary to clarify some of the responses provided in the RAIs.

Regulatory Basis for the Request

The NRC staff reviewed the licensee's amendment application, as supplemented, to ensure that: (1) there is reasonable assurance that the health and safety of the public would not be endangered by operation in the proposed manner, (2) activities proposed would be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment would not be inimical to the common defense and security or to the health and safety of the public. The NRC staff considered the following regulatory requirements during its review of the proposed changes to the NSS:

- Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities," provides the regulatory requirements for licensing of non-power reactors.
- 10 CFR 50.34, "Contents of applications; technical information," paragraph (b)(6)(ii) requires that each applicant for a license to operate a facility include, in the final safety analysis report, a description of the managerial and administrative controls to be used to ensure safe operation. For non-power reactors, such managerial and administrative controls could include elements of a quality assurance (QA) program applied to the operation of structures, systems, and components of the facility.

Enclosure

- The regulations in 10 CFR 50.36, “Technical specifications,” require that each applicant for a license authorizing operation of a production or utilization facility include in this application proposed technical specifications.

The NRC staff also evaluated the MIT NSS LAR against applicable guidance. On November 16, 2015, the NRC published in the federal register (80 FR 70850) Draft Interim Staff Guidance (ISG) to Chapter 7, “Instrumentation and Control Systems,” of NUREG-1537, Part 1 and Part 2 (ADAMS Accession Nos. ML15134A484 and ML15134A486, respectively). This draft ISG updates and expands the content of Chapter 7 of NUREG-1537, Part 1 and Part 2 respectively, to provide guidance to the licensee in preparing a license application and to the NRC staff in evaluating the application for instrumentation and control systems.

Requests for Additional Information

Follow-up Question for RAI #1:

The NRC staff’s RAI #1 from letter dated October 12, 2017, requested that MIT provide a summary description of its QA program as applied to the NSS design modification and discuss how the MIT staff has implemented its QA program for this project. Specifically, MIT was asked to “[d]escribe the QA programmatic elements related to the design control and testing of the MIT-developed components of the NSS (e.g., independent QA approval of the design and testing procedures, and traceability of design changes and approvals during final development and testing).” In addition, it was requested that MIT “provide examples (e.g., records) that illustrate how its QA program was implemented.”

MIT’s December 14, 2017, response to RAI #1 included examples of its QA Requirements Checklist in Enclosures A and B. The dates identified in these examples are not in chronological order or consistent with the development activities. These examples do not demonstrate that MIT is adhering to the QA program.

RAI #12 Explain what the dates identified in the checklist represent and why they are not in chronological order.

Follow-up Questions for RAI #2:

The NRC staff’s RAI #2 from letter dated October 12, 2017, requested that MIT provide complete system descriptions and logic schematics that describe the function and operation of all components developed by MIT, as appropriate. In addition, during the audit, NRC staff identified incomplete information for MIT-developed components of the NSS.

MIT’s December 14, 2017, response to RAI #2, as supplemented by information included in Appendices A-M, describes the MIT-developed NSS components. However, in several instances the information contained within MIT’s response and associated appendices refers to bench testing and/or pre-operational testing without providing clear references to test procedures and results. Further, sometimes it is not clear if discussions related to testing are referring to bench testing or to pre-operational testing. Lastly, some descriptions use the future tense to refer to tests that have been identified as completed in Enclosure Q.

RAI #13 Clarify if bench testing and pre-operational testing have been performed and completed for NSS components. Also, clarify if the NSS components are currently installed and operating in parallel with the existing system. Finally, confirm what testing identified in Enclosure Q has been completed.

- RAI #14 The descriptions of NSS components provided in the enclosures were accompanied by drawings or logic schematics. These drawings did not include revision numbers. Provide the revision numbers to these drawings or explain why revision numbers are not necessary.
- RAI #15 In Enclosure D, MIT described the Signal Distribution Module. This description states that the <100 key switch module (KSM) is in NIM BIN 1 and receives power through the X14 connector. However, Enclosure D1 provided the Global Connection Diagram for the NSS, and this drawing does not show the KSM in NIM BIN 1, but instead installed in NIM BIN 2. Confirm the location of the KSM and the components installed in each NIM BIN.
- RAI #16 In Enclosure E, MIT described operation of the scram logic card (SLC). However, this description does not describe the use of the test switch necessary for surveillance testing. Describe the operation of the test switch that would be used for surveillance testing and calibration.
- RAI #17 In Enclosure E, MIT described the logic used to generate a scram signal. In the description for sub-circuit card 10, MIT stated that there are two independent outputs that go to the withdraw permit circuit (WPC) and the KSM. However, the Global Connection Diagram provided in Enclosure D1 does not show a connection from the SLC to the WPC. Describe how the WPC receives the scram signal from the SLC. Also, Explain if the WPC connect to the programmable logic controller (PLC).
- RAI #18 In Enclosure G1, MIT provided the logic schematic for the KSM. This schematic shows an output signal with the following label: "To safety system monitoring and status display PLC input (WPC status)." The safety significance of the output signal is not clearly identified. Explain what this output signal and label refers to.
- RAI #19 In Enclosure H, MIT described operation of the magnet power supplies module. This description includes a photo of the frontal view of the module. This photo shows two pairs of light emitting diodes (LEDs) that were not described nor included in the logic diagram provided in Enclosure H1. Describe operation and logic for these LEDs.
- RAI #20 In Enclosure K1, MIT provided the logic schematic for the blade drop timer interface. This schematic shows an input for the "Minor Scram Switch." The safety consequence of the switch is unclear. Describe how this signal is used in the logic for the blade drop timer.
- RAI #21 In Enclosure L, MIT described operation of the "Safety System Monitoring & Status Display PLC." This enclosure includes the internal logic, which shows the following inputs: "Timer Rest Push Button," and "Enable/Disable Hourly Reminder." The impact to safety of the operation of these components is unclear. Describe what these inputs are. Also, explain how the operator acknowledges and resets alarms/events in the PLC.

Follow-up Question for RAI #10:

RAI #10 from letter dated October 12, 2017, requested that MIT provide the console layout indicating where the NSS components would be located in the final design.

RAI #22 In Enclosure V, MIT described the console layout and the human factors considered for the NSS. This description states that if the DWK 250 neutron channels are not installed in the correct location, an alarm would be generated. However, this is inconsistent with the information provided in the response for RAI #10, which referenced the response to RAI #2, item c, in which MIT stated that this is not part of the proposed NSS. Clarify if the PLC would receive an alarm when a neutron channel is not placed in the correct location.