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

August 30, 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 NO. 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, December 14, 2017, April 20, 2018, and May 3, 2018 (Agencywide Documents Access and Management System Accession Nos. ML14282A039, ML16139A786, ML17193A188, ML17354A009, ML18120A115, and ML18128A200 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

cc:

City Manager
City Hall
Cambridge, MA 02139

Department of Environmental Protection
One Winter Street
Boston, MA 02108

Mr. Jack Priest, Director
Radiation Control Program
Department of Public Health
529 Main Street
Schrafft Center, Suite 1M2A
Charlestown, MA 02129

Mr. John Giarrusso, Chief
Planning and Preparedness Division
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

Test, Research and Training
Reactor Newsletter
P.O. Box 118300
University of Florida
Gainesville, FL 32611-8300

Ms. Sarah M. Don, Reactor Superintendent
Massachusetts Institute of Technology
Nuclear Reactor Laboratory
Research Reactor
138 Albany Street, MS NW12-116B
Cambridge, MA 02139

SUBJECT: MASSACHUSETTS INSTITUTE OF TECHNOLOGY – REQUEST FOR ADDITIONAL INFORMATION FOR NUCLEAR SAFETY SYSTEM UPGRADE LICENSE AMENDMENT REQUEST (CAC NO. MF5003, EPID-NO. L-2016-LLA-0003) DATE: AUGUST 30, 2018

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ADAMS Accession No. ML18218A447 ***concurred via e-mail** **NRR-106**

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DATE	8/9/2018	8/9/2018	8/30/2018	8/30/2018

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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, December 14, 2017, April 20, 2018, and May 3, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML14282A039, ML16139A786, ML17193A188, ML17354A009, ML18120A115, and ML18128A200 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 (RPS) 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). To support the changes to the facility systems, MIT staff proposed revisions to the impacted technical specifications (TSs). MIT provided replacement TS pages as part of its original application and supplements referenced above. The Nuclear Regulatory Commission (NRC) staff compared the replacement pages to the TSs appearing in the facility license to identify proposed changes to the current TSs.

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.

- 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 TSs.

- The regulations in 10 CFR 50.90, “Application for amendment of license, construction permit, or early site permit,” require that whenever a holder of a license desires to amend the license, the application for an amendment must fully describe the changes desired.

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

Contrary to the requirements in regulation 10 CFR 50.90, MIT provided several replacement pages for their TSs with little or no explanation of the desire for the change or an explanation why the change does not present an undue risk to the facility. The NRC staff reviewed the replacement pages and compared them to the TS pages in the license. A copy of the license and associated TSs through amendment no. 41 may be found in ADAMS (Accession No. ML18218A436). The NRC staff was able in many cases to determine the need for the change, however, some of the rationale for proposed revisions were uncertain. The NRC staff requests that MIT provide confirmation or identify why the change is desired and will not cause an undue risk to the facility.

1. TS replacement page 3-18 was submitted as part of the original application in a letter dated September 30, 2014, a revised replacement page was submitted as part of the supplement in a letter dated December 14, 2017. The NRC staff compared both of these replacement pages to the page in the license and could not identify any changes aside from the date on the bottom of the page.

   Identify what changes are desired for page 3-18 and provide a safety basis for that change or withdraw the request to replace page 3-18 from the amendment application.

2. TS replacement page 3-19 was submitted as part of the original application in a letter dated September 30, 2014, revised replacements were submitted as part of the supplements with the most recent version submitted in a letter dated May 3, 2018.

   The NRC staff compared the version submitted as part of the May 3, 2018, supplement to the page in the license to identify the proposed changes to the TS on page 3-19. Specifically the NRC staff compared the revised information in TS 3.2.3, Table 3.2.3-1, “Required Safety Channels,” to the license and identified changes that appear to be administrative in nature (renumbering or reordering of items) and changes that were technical in nature and required to support the modification of the NSS and associated RPS input.

   Discuss administrative changes and explain why the changes are administrative in nature.

3. Table 3.2.3-1, item 1, “Period,” the “Limiting Setpoint,” values appear to be unchanged. The “Min. [minimum] No. Required,” value was changed from two to three and superscript (5) was added. The desire to change the minimum number of channels from

two to three was stated in the letter dated May 3, 2018, and the rationale for the change was provided in the TS Basis replacement page 3-21. The provided Basis information did not specifically state the impact to safety for this change.

Provide a discussion of the impact to safety of changing the minimum number of required channels from two to three.

4. TS 3.2.3, Table 3.2.3-1, "Requires Safety Channels," item 2, "Neutron flux level," the "Limiting Setpoint," values appear to be unchanged. The "Min. [minimum] No. Required," value was changed from two to three, the superscript (1) was moved from column two and added to columns five, seven, and nine, a superscript (5) was also added. The desire to change the minimum number of channels from two to three was stated in the letter dated May 3, 2018, and the rationale for the change was provided in the TS Basis replacement page 3-21. The provided Basis information did not specifically state the impact to safety for this change.

   Provide a discussion of the impact to safety of changing the minimum number of required channels from two to three.

5. TS 3.2.3, Table 3.2.3-1 has a new item 3 "Low count rate." MIT proposed a limiting setpoint of 5 counts per second (CPS) value for 0, 1, or 2 primary pump operation. MIT failed to provide a safety related explanation or justification for the 5 CPS setpoint.

   Provide a safety basis supporting the "low count rate" limiting setpoint value.

6. MIT did not provide any discussion about the desire to change TS 3.2.3, Table 3.2.3-1, "Required Safety Channels," items 3 through 8. The NRC staff identified that items 3 through 8 have been renumbered as 4 through 9, respectively, and relocated to accommodate a new item 3 "Low count rate." The Channel/Parameter, Action, Limiting Setpoint, and Min. No, Required values all appear to be unchanged.

   Provide a discussion of the impact to safety resulting from the proposed changes.

7. MIT did not provide any description of the change to TS 3.2.3, Table 3.2.3-1, "Required Safety Channels," item 9, "Experiment scrams." The proposed TS appears to move item 9 to item 17 in TS Table 3.2.3-1 (Continued) "Required Safety Channels," on TS replacement page 3-20. Table 3.2.3-1 (Continued) varies from Table 3.2.3-1 (on page 3-19) in the number of columns present. Table 3.2.3-1 has a limiting setpoint column and minimum number of required channels for conditions based on zero, one, or two pumps operating. Table 3.2.3-1 (Continued) only has one column for setpoint and the minimum number of required channels. Considering the fact that item 9 as it appears in the license merges all of the columns for the limiting setpoint and minimum number of required channels, moving item 9 from Table 3.2.3-1 to Table 3.2.1-1 (Continued), does not change the requirements for item 9.

   Provide a detailed discussion of the impact to safety resulting from the proposed changes.

8. TS 3.2.3, Table 3.2.3-1, "Required Safety Channels," items 10, 11, and 12 do not appear to have any revisions, confirm the NRC staff understanding that no changes were intended for TS 3.2.3, Table 3.2.3-1, items 10, 11, and 12 or describe the desired

changes and provide a discussion of the impact to safety resulting from the requested changes.

9. On TS replacement page 3-19, footnote 1) discussing the “On-scale neutron flux level” has been replaced with a new footnote 1) discussing the “two out of four” scram logic. MIT provided a safety impact discussion of the change to the scram logic in Chapter 7 of the updated safety analysis report (SAR) submitted as part of the LAR dated September 30, 2014. A description of the change to footnote 1) and the safety impact of the change was not included in the SAR section, the cover letter, or any of the supplemental material. The change in the system response to a low flux level has been significantly impacted by the NSS upgrade. The upgraded NSS will create a scram condition if any two channels have a count rate of less than 5 counts per second (CPS), which prevents power from reaching the shim blade magnets. MIT did not provide an explanation regarding deletion of this footnote.

   Provide a description about the desire to change footnote 1) including the safety impact of the change.

10. TS replacement page 3-19 footnote 2), footnote 3), and footnote 4) appear to be unchanged from the license document.

    Confirm the NRC staff understanding that no changes are intended for footnote 2), footnote 3) and footnote 4) on TS page 3-19 or provide a description about the desire to change to the footnote(s) including the safety impact of the change.

11. The most recent replacement TS page 3-19 footnote 5) was provided in the supplement letter dated May 3, 2018. The supplement makes the statement that a brief but non-zero time limit prevents an instantaneous TS violation, however, contrary to the regulatory requirements in 50.36(c)(2)(i) MIT failed to provide a statement regarding the safety impact of the 15 minute delay time.

    Provide a safety statement regarding the impact of the 15 minute allowed action time. Include equipment reliability, additional indicators available for operator action, and other automatic safety features that could mitigate the consequences of a second component failure during the 15 minute action time or delete footnote 5) from the proposed TS changes.

12. Proposed TS page 3-20, TS 3.2.3, Table 3.2.3-1 (Continued) “Required Safety Channels,” item 13, “Period channel level signal off-scale,” no longer appears in Table 3.2.3-1 (Continued). New item 3 “Low count rate,” in TS 3.2.3, Table 3.2.3-1, “Required Safety Channels,” on page 3-19 was a proposed change to the TS in the supplement dated December 14, 2017. In the letter dated December 14, 2017, MIT stated that item 13 was no longer required because the minimum number of operable channels has been increased from two to three and the footnote explains the scram logic.

    Provide an explanation and a safety basis for the proposed change.

13. For TS 3.2.3, Table 3.2.3-1 (Continued), items 14 through 16, MIT did not provide any discussion about the desire to modify these items. The NRC staff identified that items 14 through 16 have been renumbered as items 13 through 16 respectively and relocated

to accommodate deletion of item 13, discussed above. The values in the Parameter, Action, Setpoint, and Min. No, Required columns all appear to be unchanged.

Provide a discussion of the impact to safety resulting from the proposed changes

14. TS replacement page 3-21 contains the Basis for TS 3.2.3. While bases are not considered to be part of the license per 10 CFR 50.36, bases shall be included with each specification. MIT provided a replacement page for the basis associated with TS 3.2.3, its associated tables, and changes supporting the modification to the facility.

    Confirm that MIT desires to replace TS page 3-21 with the version provided as an enclosure to the letter dated May 3, 2018, or withdraw the request to replace TS page 3-21.

15. TS replacement page 3-26 was submitted as part of the original application in a letter dated September 30, 2014. The replacement page 3-26 for TS 3.2.7 "Control Systems and Instrumentation Requirements for Operation," does not appear to have any changes to the Applicability, Objective, or Specification. The Basis for TS 3.2.7 is not on the replacement page 3-26 and TS 3.2.7, Table 3.2.7-1 "Required Instrumentation for Display" (from the existing TS page 3-27) is on the replacement TS page 3-26.

    Confirm the NRC staff understanding that no changes to the Applicability, Objective, or Specification for TS 3.2.7 are desired or describe the desired change and provide a detailed discussion of the impact to safety resulting from the proposed change.

16. On TS replacement page 3-26, TS 3.2.7, Table 3.2.7-1, "Required Instrumentation for Display," items 1, 3, 4, 5, 6, and 7 as well as footnotes (1) and (2) appear to be unchanged.

    Confirm that no changes are desired for TS 3.2.7, Table 3.2.7-1, "Required Instrumentation for Display," items 1, 3, 4, 5, 6, and 7 as well as footnotes (1) and (2) or identify the desired change and provide a discussion of the impact to safety resulting from the proposed change.

17. On the TS replacement page 3-26, TS 3.2.7, Table 3.2.7-1, "Required Instruments for Display," item 2, "Neutron Flux Level," contains a proposed revision that eliminates a) startup and b) linear power and replaces it with a new description of "(wide range)." Consistent with the regulatory requirements in 10 CFR 50.36(c)(3) "Surveillance requirements," TS 4.2.8 "Heat Balance," requires that the "linear power channel" is checked against a heat balance at least monthly ensuring that facility operation will meet the limiting condition for operations (LCO). Changing the term for "Neutron Flux Level" from "linear power" to "wide range" for the console display no longer ensures the surveillance requirements in 10 CFR 50.36(c)(3) will be met. The information provided in the updated SAR submitted as part of the LAR in the letter dated September 30, 2014, described in Section 7.4.1.2 (page 7-32) the intention to calibrate the NSS setpoint to the heat balance. The NRC staff noted that the analog DWK displays identified in figure 8 in letter dated December 14, 2017, for the wide range power indication are displayed on a logarithmic, not a linear, scale and the displays are not in front of the reactor operator (as part of the operator console display).

    Explain the relationship between the operator display for "linear" reactor power and describe how the proposed TSs ensure the LCO is assured with an appropriate

surveillance. Provide revised TSs if needed to meet this requirement or explain how the proposed TSs satisfy the regulatory requirements described above.

18. The proposed replacement TS page 3-27 contains the Basis that was on the existing license page 3-26. While bases are not considered to be part of the license per 10 CFR 50.36, bases shall be included with each specification. MIT provided a replacement page for the basis associated with TS 3.2.7, its associated tables, and changes supporting the modification to the facility.

    a. Are the new DWK displays intended to satisfy the reactor operator display requirements? If not, describe the display intended to be used by the console operator.

    b. Describe the intended final location of the DWK reactor power and period displays relative to the normal console operator position.

    c. Explain how the location of the reactor power level display is readily available to the console reactor operator.

19. TS replacement page 4-4 containing TS 4.2.4, “Scram and Power Measuring Channels,” was submitted as part of the original application in a letter dated September 30, 2014. The NRC staff compared the replacement page to the page in the license and could not identify any changes aside from a small grammatical change deleting the word “the” from the last line on the page. A second replacement page 4-4 was submitted as part of the RAI response in a letter dated December 14, 2017. The NRC staff compared the second replacement page to the page in the license and identified that the word “drive” was added to TS 4.2.2 in two places, 1) after the phrase “shim blade” and 2) after “regulating rod.” The addition of the word “drive” changes the meaning of the phrase and appears to exclude the reactivity insertion device (shim blade or regulating rod) itself. MIT failed to identify this apparent change and did not provide a safety basis for the change. Additionally, the addition of the word “drive” changes the surveillance requirement so that it no longer appears to meet the regulatory requirements of ensuring that the LCO (TS 3.2.2.1) will be met.

    Identify the desired changes for TS 4.2.2 on page 4-4 providing a safety basis for the changes and explaining how the proposed surveillance ensures TS 3.2.2.1 will be met or withdraw the request to replace page 4-4 in the TSs.

20. Replacement TS page 4-5 contains the continuation of TS 4.2.4, “Scram and Power Measuring Channels,” TS 4.2.5 “Channel Tests,” TS 4.2.6 a) through 4.2.6.i), and TS 4.2.7, “Thermal Power.” The only change made to the TSs on this page was a wording change to 4.2.6.i) changing “Period Channel Level Signal Off-Scale,” to “Nuclear Safety Channel Low Count Rate.” During its review the NRC staff confirmed that the proposed TS 4.2.6.i) was an appropriate surveillance requirement supporting the upgraded NSS. In a letter dated December 14, 2017, 4.2.6.i) was deleted in its entirety with no justification for the change.

    Provide the safety basis to support deletion of TS 4.2.6.i) from the group of instruments requiring calibration and trip point verification or propose an equivalent TS 4.2.6.i) that ensures the low count rate scram occurs at or before its required value of 5 CPS.

21. The proposed replacement TS page 4-6 contains Table 4.2-1 “Surveillance of Scram and Power Measuring Channels,” this table appears on the existing license TS page 4-8. MIT failed to provide a request to relocate the table and did not describe any of the changes to Table 4.2-1. The NRC staff compared the information from the proposed TS 4.2, Table 4.2-1 to the information in the license and identified the following information:

    - Item 1 “Period(1)” the only change appears to be the addition of a superscript (1) which references a footnote identifying the scram logic.

    - Item 2 “Neutron Flux Level(1)” the only change appears to be the addition of a superscript (1) which references a footnote identifying the scram logic.

    - Items 3 through 10 do not appear to have any proposed changes.

    - Items 11 through 13 appear to have the “*” replaced by a superscript (2). The footnote (2) reads the same as the footnote for the “*” which appears to be a direct replacement for clarification between the existing footnote and the added footnote referring to the scram logic.

    - Item 14 appears to be unchanged.

    - Item 15 “Period Channel Level Signal Off Scale” now reads “Nuclear Safety Channel Low Count Rate(1).” This appears to be a direct replacement with the superscript (1) referring to the footnote for the scram logic.

    - Items 16 and 17 appear to be relabeled as items 18 and 19 respectively with no changes to the content of these items.

    - New item 16 “Nuclear Safety Channel in Test(1)” appears to be a new scram associated with the upgraded NSS reflecting a scram output from the Mirion system with the superscript (1) referring to the footnote for the scram logic.

    - New item 17 “Nuclear Safety Channel Fault(1)” appears to be a new scram associated with the upgraded NSS reflecting a scram output from the Mirion system with the superscript (1) referring to the footnote for the scram logic.

    For each item in TS 4.2.4, Table 4.2-1, “Surveillance of Scram and Power Measuring Channels,” identify if no change from the license version is desired, if an administrative type change is desired (reordering or renumbering), or the item is new. For each modified or new item in the table provide a rationale for the change, identify the impact to safety for the item, and explain the relationship between the item and the upgraded NSS.

22. TS replacement page 4-7 contains the LCOs from license TS page 4-6 for TS 4.2.8, “Heat Balance,” TS 4.2.9, “Control Device Inspection,” TS 4.2.10 “Control System Interlocks,” and the beginning of the Basis for TS 4.2. The NRC staff compared the TSs on TS replacement page 4-7 to the TSs on the license page 4-6 and did not identify any proposed changes to TSs 4.2.8, 4.2.9, and 4.2.10.

    Confirm the NRC staff understanding that the LCOs for the TSs from page 4-6 remain unchanged and provide an administrative change request, supporting the relocation of

the TS LCOs from page 4-6 to the proposed TS page 4-7 or withdraw the request to change TS page 4-7.

23. Replacement page 4-8 contains part of the Basis for TS 4.2, “Reactor Control and Safety System.” The Basis for TS 4.2 appears on the license TS pages 4-6, 4-7, and 4-9. Bases are not considered to be part of the license per 10 CFR 50.36, however, MIT provided replacement pages for the Basis associated with TS 4.2, its associated tables, and changes supporting the modification to the facility. The NRC staff reviewed the Basis information on the proposed TS pages 4-7 and 4-8 and determined that all of the Basis information for TS 4.2 appears on the two replacement pages. License page 4-9 contains part of the bases information for TS 4.2. No replacement for this page was provided by MIT. The information on page 4-9 appears on page 4-8 creating duplication of the information on page 4-9.

    Provide an administrative change request, supporting the relocation of the TS 4.2 Basis information from page 4-9 or provide alternative replacement pages that do not require TS pages 4-8 or 4-9 to be replaced in order to eliminate the duplication of information that would result from the proposed changes.