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

February 4, 2020

Dr. Partha Chowdhury, Director
Nuclear Radiation Laboratory
University of Massachusetts-Lowell
One University Avenue
Lowell, MA 01854

SUBJECT: UNIVERSITY OF MASSACHUSETTS LOWELL - REGULATORY AUDIT RE: THE RENEWAL OF FACILITY OPERATING LICENSE NO. R-125 (EPID NO. L-2015-RNW-0001)

Dear Dr. Chowdhury:

By letter dated October 20, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16042A015), as supplemented, the University of Massachusetts Lowell applied for renewal of Facility Operating License No. R-125 for the University of Massachusetts Lowell Research Reactor. The requested licensing action would renew the facility operating license for a period of 20 years.

The U.S. Nuclear Regulatory Commission (NRC) staff will conduct a regulatory audit beginning February 10, 2020, and continuing as necessary, to gain a better understanding of the application. The audit may include review of documentation, observation of the facility, and discussions with facility personnel and management. The enclosed audit plan provides additional details of the objective and scope of the audit. To facilitate an efficient audit, please provide ready access to working space, requested documentation, and areas of the facility, as necessary.

Following completion of the audit, the NRC staff will provide an audit summary. The summary will include a description of any information identified during the audit that will need to be docketed to supplement the application and allow the NRC staff to continue its review.

If you have any questions, please contact me at (301) 415-4067 or by electronic mail at Edward.Helvenston@nrc.gov.

Sincerely,

/RA/

Edward M. Helvenston, Project Manager
Non-Power Production and Utilization
Facility Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-223
License No. R-125

Enclosure:
As stated

cc: See next page

cc:

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Lowell, MA 01852

Mr. Leo Bobek
Reactor Supervisor
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Jack Priest, Director
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Ms. Samantha Phillips, Director
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Test, Research and Training
Reactor Newsletter
Attention: Ms. Amber Johnson
Dept. of Materials Science and Engineering
University of Maryland
4418 Stadium Drive
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SUBJECT: UNIVERSITY OF MASSACHUSETTS LOWELL - REGULATORY AUDIT RE: THE RENEWAL OF FACILITY OPERATING LICENSE NO. R-125 (EPID NO. L-2015-RNW-0001) DATED: FEBRUARY 4, 2020

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OFFICE OF NUCLEAR REACTOR REGULATION

REGULATORY AUDIT PLAN

REGARDING RENEWAL OF

FACILITY OPERATING LICENSE NO. R-125

UNIVERSITY OF MASSACHUSETTS LOWELL

UNIVERSITY OF MASSACHUSETTS LOWELL RESEARCH REACTOR

DOCKET NO. 50-223

Background

The U.S. Nuclear Regulatory Commission (NRC) staff is continuing its review of the University of Massachusetts Lowell (UML) Research Reactor (UMLRR) license renewal application (LRA), dated October 20, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16042A015), as supplemented. This regulatory audit is intended to assist the NRC staff in its review of the LRA.

Regulatory Bases for the Audit

The purpose of this audit is to determine if the licensee's LRA requesting renewal of Facility Operating License No. R-125 for 20 years meets all the applicable regulatory requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) and addresses applicable guidance provided in NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," Part 1, "Format and Content," and Part 2, "Standard Review Plan and Acceptance Criteria" (ADAMS Accession Nos. ML042430055 and ML042430048, respectively). The NRC guidance for technical specifications (TSs) is provided in NUREG-1537, Part 1, Appendix 14.1, "Format and Content of Technical Specifications for Non-Power Reactors," and this guidance relies significantly on American National Standards Institute/American Nuclear Society (ANSI/ANS)-15.1-2007, "The Development of Technical Specifications for Research Reactors."

Regulatory Scope for the Audit

The NRC staff will conduct initial teleconference and/or video conference supported discussions with UML. As facilitated in part by the online portal discussed below, the NRC staff will also audit basis documents to determine whether the information included in the documents supports the LRA and/or is necessary to conduct NRC staff review of the LRA. Additionally, NRC staff will visit and tour (as necessary) the UMLRR facility in Lowell, Massachusetts, to gain further understanding of the LRA, review the UMLRR safety analysis report (SAR) design bases and TS requirements that help to ensure safe operations, and review processes and procedures for the safe operation of the UMLRR facility.

This audit will provide information necessary to complete the NRC staff's evaluation of the LRA. In addition, the regulatory audit may identify additional information that will be required to be docketed to support the basis of the licensing decision and will allow NRC staff to more efficiently gain insights on the license renewal.

To improve the efficiency of the review, UML and NRC staff discussed the use on an online reference portal, established by UML, that would allow NRC staff limited read-only access to the basis documents and other reference materials cited in the LRA. Use of the online reference portal is acceptable provided that UML establishes measures to limit access to specific NRC staff (e.g., based on NRC e-mail addresses or the use of passwords which will only be assigned to NRC staff directly involved in the LRA review on a need-to-know basis), and to make the documents view-only (i.e., prevent NRC staff from saving, copying, downloading, or printing any documents). The conditions associated with the online reference portal must be maintained throughout the UML LRA review process. The three NRC staff who should be granted access to the portal are those listed in the "Audit Team" section below.

Information Needed for the Audit

During a possible site visit, a copy of the LRA, as supplemented, including the request for additional information (RAI) responses and updated proposed TSs submitted by letter dated March 5, 2019 (ADAMS Accession No. ML19064B373), should be readily available to the NRC staff. Other UMLRR documents including the Physical Security Plan, Emergency Plan, Operator Requalification Program, and Operating Procedures should also be available during a site visit.

Additionally, UML should be prepared to provide supporting documents and reports, calculations, and computer code verification, as applicable, to support the analysis documented in the SAR, as supplemented, bases for TSs, or rationale for any required plans and procedures. The NRC staff may request that UML make these additional materials available on the online reference portal discussed above and/or during a site visit.

On the online reference portal discussed above and/or during a site visit, UML should also specifically make available the following documents, which are referenced in UML's RAI responses submitted by letters dated October 18 and 24, 2019 (ADAMS Accession Nos. ML19291C293 and ML19297F433, respectively), related to the instrumentation and control (I&C) systems, including the General Atomics (GA) NMP1000 and Thermo Fisher Scientific (TFS) Wide Range Log Period Power Module (PPM) it proposes to install:

- Scram circuit diagram (Appendix A is not legible) [Ref. response to RAI-7.1.b]
- OPTO22 Quality Management Plan (QMP) [Ref. response to RAI-7.2.a]
- T3401000-1UMB, NMP1000 user manual [Ref. response to RAI-7.4.a and RAI-7.4.b]
- LPC E117-1017 Revision 1, NMP1000 operations and maintenance manual [Ref. response to RAI-7.4.a and RAI-7.4.b]
- Neutron Flux Monitoring Systems Instruction Manual 1126 for UML [Ref. response to RAI-7.4.d]
- Quality Assurance Program Manual Revision 22 [Ref. response to RAI-7.4.d]
- PPM Certificate of Conformance [Ref. response to RAI-7.4.d]
- PPM Configuration Record [Ref. response to RAI-7.4.d]
- Test Reports for the PPM [Ref. response to RAI-7.4.d]
- T9S900D970-CMP, TRIGA INL Software Configuration Management Plan [Ref. response to RAI-7.5.a]
- TT9S900D970-SWP-2A, TRIGA INL Channels Software Development Plan [Ref. response to RAI-7.5.a]
- TS900SQAP-B, Software Quality Assurance Plan [Ref. response to RAI-7.5.a]

- TFS PPM testing and surveillance documents [Ref. response to RAI-7.6, RAI-7.12.b, and RAI-7.12.c]
- Evidence of UML's configuration management program [Ref. response to RAI-7.7, RAI-7.8.a, and RAI-7.8.b]
- UMLR calibration procedure for the TFS PPM [Ref. response to RAI-7.6]
- Updated Figure 7-9 of UMLR SAR showing annunciator configuration [Ref. response to RAI-7.10.a(i)]
- Evidence of validating NMP1000 and TFS PPM are suitable for UMLR (e.g. procurement documents) [Ref. response to RAI-7.12.a]
- Evidence to support GA vendor statements for NMP1000 installed at UML (e.g., electronic communications) [Ref. responses to RAI-7.13 and RAI-7.15]

During a site visit, in addition to making documents available for review and discussion, UML staff should be prepared to support the NRC staff with a comprehensive tour of the facility, as necessary.

Audit Team

The NRC staff performing this audit will be:

- Edward Helvenston (Project Manager, Audit Leader, and Technical Reviewer; Edward.Helvenston@nrc.gov)
- Duane Hardesty (Technical Reviewer; Duane.Hardesty@nrc.gov)
- Greg Casto (Branch Chief; Greg.Casto@nrc.gov)

Audit Team Logistics

The audit will initiate on February 10, 2020. The audit will continue as necessary until NRC staff have adequate understanding of issues to be addressed to complete the review of the LRA. Audit activities may be conducted as onsite review meetings and teleconference and video conference supported activities, as appropriate and efficient to the gathering of information by the NRC staff. For the initial meeting, a teleconference will be scheduled. Following one or more teleconferences, an onsite review meeting may be planned (on a mutually agreeable date or dates), including a tour of the facility (as necessary) and a review of the information described above. The audit period may be reduced or extended, dependent on the NRC staff and licensee progress in addressing audit questions. Additional audit activities may be planned in advance, as necessary, to support the understanding of information necessary to complete the review of the LRA. It is expected that more interaction will be needed to identify information requests to support LRA review activities.

Deliverables

At the completion of the regulatory audit the NRC staff will prepare a regulatory audit summary, which will be issued within 90 days after the audit. The regulatory audit summary will include the documents reviewed, the audit activities, and any RAIs that will be issued based on the audit, as applicable.

Proposed Onsite Audit Schedule

Day 1

8:00 AM	Arrive at UML
8:30 AM	Entrance meeting, introductions, and project status
9:00 AM	Begin Audit
12:00 PM	Break for lunch
1:00 PM	Resume Audit
5:00 PM	End for the day

Day 2

8:00 AM	Resume Audit
12:00 PM	Break for lunch
1:00 PM	Resume Audit
2:30 PM	Exit Meeting
3:00 PM	Conclude Audit

Notes: If an onsite audit is planned, the duration may be reduced to one day, depending on the expected time needed to complete audit activities. Also, the timing and duration of a facility tour, if necessary, during the onsite audit can be moved as needed to accommodate UMLRR operations and NRC staff information needs.

Audit Questions: Technical Specifications

(Note: Except where noted otherwise, these questions refer to the UMLRR license renewal TSs and RAI responses submitted by letter dated March 5, 2019 (ADAMS Accession No. ML19064B373), in response to the NRC staff's RAI dated November 5, 2018 (ADAMS Accession No. ML18253A088).

1. General: Some of the TS bases appear to need to be updated further to properly reflect the revised TSs and information in the SAR, as supplemented.

2. TS definition of "Core Configuration": RAI-14.1.2 does not appear to be fully addressed because the definition does not include all components that are or could be potentially located in the UMLRR core grid, for example, radiation baskets, lead void boxes, and grid plugs. Additionally, there is an apparent typographical error in that "rod/" should be "rod".

3. TS definition of "Excess Reactivity": RAI-14.1.3 does not appear to be fully addressed because the definition refers to "regulating devices" and "the maximum reactive condition" instead of the facility-specific "regulating rod" and "fully withdrawn position," respectively. Additionally, UML added "and with all installed experiments in their most reactive condition" to the definition, which does not appear to be appropriate or necessary because UML always needs to continue to meet the TS 3.1.1(1) excess reactivity requirement for any condition or configuration of experiments.

4. TS definition of "Reactor Secured": Item (2)(a) does not appear to be facility-specific because it does not specifically state that all 4 control blades (required by TS 3.2.1(1)) are fully inserted, and because the language "or other safety devices are in shutdown position"

does not appear to be applicable to the UMLRR. Additionally, item (2)(d) appears to include an unnecessary "<".

5. TS definition of "Research Reactor": RAI-14.1.9 does not appear to be fully addressed because the definition does not specify that the terms "research reactor" and "reactor" are used interchangeably. Additionally, the definition appears to contain a typographical error in that "-A" should be "- A".

6. TS definition of "Research Reactor Facility": The definition does not state that "reactor facility," which is used in the TSs, is also equivalent to "research reactor facility" and "facility".

7. TS definition of "Shutdown Margin": RAI-14.1.7 does not appear to be fully addressed because the definition appears to use "in the most reactive positions" instead of the facility-specific "fully withdrawn".

8. TS definition of "Surveillance Time Intervals": The language "[a]ny extension of these intervals shall be occasional and for a valid reason" would appear to allow extension of the maximum allowable intervals. This language should be justified or deleted.

9. TS 2.2.2: RAI-14.2.2 does not appear to be fully addressed because there appear to be typographical errors in that "Limited" in TSs 2.2.2(1), 2.2.2(2), and 2.2.2(3) should be "Limiting".

10. TS 3.1.1: The title and applicability of TS 3.1.1 do not appear to encompass all items included in TSs 3.1.1(1) through 3.1.1(6).

11. TS 3.1.1(2): The TS appears to use the term "regulating blade," but "regulating rod" is the term defined in the TS definitions.

12. TS 3.1.1(4): The TS appears to indicate that UMLRR natural convection operation is at power levels of less than 100 kilowatts-thermal (kWt), but the UMLRR can operate in natural convection mode at steady-state power levels of less than or equal to 100 kWt.

13. TS 3.2.2(3): RAI 14.3.14 does not appear to be fully addressed because the TS states that only one control blade shall be withdrawn at a time, but does not clearly indicate that only one control blade shall be able to be withdrawn at a time (i.e., requiring operability of the interlock preventing withdrawal of more than one blade).

14. TS 3.2.3, Table 3.2.3-1, item 2: The TS does not appear to clearly indicate (e.g., with an asterisk or note) that one of the two required power level scrams must come from the log power level (i.e., Log PPM) channel, consistent with the TS 3.2.5 requirement that the log power level channel be one of the operable power level channels.

15. TS 3.2.3, Table 3.2.3-1, item 11: The specific setpoint has been removed from the TS, but this does not appear to be acknowledged in the TS submittal. Discuss why the specific setpoint no longer needs to be in the TS and clarify whether the information in SAR Section 3.4 related to the specific setpoint UML uses and the basis for this setpoint is still accurate.

16. TS 3.2.3, Table 3.2.3-1, item 12: The bridge movement scram is required during both forced and natural convection mode operation, but the requirement for this scram during natural convection operation appears to conflict with the basis for TS 3.2.3, and SAR Table 7-5, which indicates that this scram only occurs during forced convection operation.

17. TS 3.2.3, Table 3.2.3-1, item 13: It does not appear be clear from the TS or information in the SAR, as supplemented, which specific alignment limit switches are subject to this TS requirement.

18. TS 3.2.4, Table 3.2.4-1, item 2: The TS requires the beam port chamber door scram to be operable during any reactor operation, but this appears to conflict with SAR Section 7.7.9, which states that this scram only occurs when the reactor is operating above 1 kWt.

19. TS 3.2.5: The TS requires that the reactor channels in Table 3.2.5-1 be operable but does not appear to require that the channels be operating, as needed to ensure parameters are continually being measured and information made available to the reactor operator during reactor operation. Additionally, the numbering of the eight items listed in Table 3.2.5-1 appears to be incorrect.

20. TS 3.3: TSs 3.3(1) through 3.3(3) are applicable only during reactor operation, but this does not appear to be appropriate for these TSs given the need to prevent corrosion and detect excess radioactivity in the pool water (from fuel, cobalt-60, or other sources) during any reactor conditions (this also appears to conflict with TS 4.0.A, which does not allow surveillances for TSs 3.3(1) through 3.3(3) to be deferred during reactor shutdown). Additionally, TS 3.3(3) states that if the radionuclide concentration limit is exceeded, “the source of the radionuclide(s) should be identified and corrected,” but the applicability of this portion of TS 3.3(3) (i.e., if it is applicable only during reactor operation, or during any conditions) is not clear.

21. TS 3.3(4): TS 3.3(4) is applicable only during reactor operation, but it appears that this TS should also be applicable for 3,947 seconds following reactor operation, to ensure the validity of UML’s loss of coolant accident (LOCA) analysis in the SAR, as supplemented. (However, UML should consider whether a revised TS 3.3(4) prohibiting the pool divider gate from being in position to separate the bulk and stall pools for 3,947 seconds following reactor operation would need to permit UML flexibility to put the gate in position during that period of time to mitigate an actual LOCA.)

22. TS 3.4: UML’s response to RAI-14.3.22 states that a TS for the reactor building vacuum relief valve is no longer necessary given the proposed re-designation of the building as a confinement. Additionally, UML’s response to RAI-6.1, submitted by letter dated March 31, 2017 (ADAMS Accession No. ML17090A350), describes the conditions under which the emergency exhaust system would operate following the proposed re-designation but does not appear to indicate whether or when the system automatically shuts off to prevent excessive building under-pressure. Given that UML proposes to eliminate the relief valve TS clarify how excessive building under-pressure from emergency exhaust system operation would be avoided (e.g., by the system automatically shutting off when building differential pressure drops back to negative 0.10 inches of water or some other value).

23. TS 3.4.1(1): Requiring confinement whenever the reactor is not secured appears to exceed the recommendations in ANSI/ANS-15.1, Section 3.4.1, items (1), (3), and (4), but may be too restrictive given the equipment that is required by other TSs 3.4.2, 3.5, and 3.6.1 when

any of the conditions in TS 3.4.1 are met (i.e., when confinement is required), and UML's potentially limited ability to maintain required equipment such as the main intake fan or certain radiation monitors operable and/or operating when the reactor may not be secured, in a condition such as a loss of offsite power. (The NRC staff notes that if TS 3.4.1(1) is revised to be more consistent with ANSI/ANS-15.1, Section 3.4.1, items (1), (3), and (4), it may be appropriate to modify the ANSI/ANS-15.1 recommended TSs to be specific to the UMLRR and the analyses in the SAR, as supplemented.)

24. TS 3.5(1): RAI-14.4.20 does not appear to be fully addressed because it is not clear that the TS 3.5(1) requirement (or another TS requirement) includes the operability of "valve F" (see SAR Section 6.2) which automatically opens (upon reactor building isolation) to allow air from the main intake fan to dilute the emergency exhaust system air leaving the stack. (See also audit item 49.)

25. TS 3.5(2): The TS requires that fans capable of maintaining negative pressure be operable, but does not appear to require that the fan(s) actually be operating to maintain negative pressure, consistent with analyses in the SAR, as supplemented (or consistent with surveillance TS 4.4(2), which requires verification of negative building pressure).

26. TS 3.6.1(1): RAI-14.3.23 does not appear to be fully addressed because the TS does not clearly require that the TS-required radiation monitors individually have control room alarm indicators, such that the operator would be immediately alerted and could take appropriate action if any single required radiation monitor reached its setpoint (the SAR, as supplemented, also does not appear to describe individual alarms for all TS-required monitors, or what actions operators would take based on such alarms). RAI-14.3.23 also does not appear to be fully addressed because it is not clear whether local alarms and/or readouts for TS 3.6.1(1)-required radiation monitors are necessary to ensure safety and should be in the TSs. When the reactor is secured, but other activities that require radiation monitor(s) (and confinement) are in progress, it is not clear that a reactor operator or other individual would necessarily be in the control room to take appropriate actions (e.g., alerting facility staff and/or isolating normal ventilation) if a required radiation monitor reaches its setpoint.

27. TS 3.6.1(1), item a.: The TS appears to contain a typographical error in that "particulates" should be "particulate".

28. TS 3.6.1(2): RAI-14.3.23 does not appear to be fully addressed because it is not clear whether the TS is intended to require area radiation monitors near (outside of) each gamma irradiation facility, or inside the facilities. Additionally, RAI-14.3.23 does not appear to be fully addressed because it is not clear whether local alarms and/or readouts for TS 3.6.1(2) required radiation monitors are necessary to ensure safety and should be in the TSs (the NRC staff notes that, when the reactor is secured, but other activities that require radiation monitor(s) are in progress, a reactor operator or other individual would not necessarily be in the control room to take action if a required radiation monitor reaches its setpoint). (See also audit item 65.)

29. TS 3.6.1(3): The TS would state that operations may continue if the monitor can be repaired or replaced, but would not clearly require that operations only continue if the monitor is actually repaired or replaced. Additionally, RAI-14.3.24 does not appear to be fully addressed because the TS does not specify whether a replacement monitor may be a portable monitor, and if so, a maximum time that the replacement can serve for.

30. TS 3.6.1(4): RAI-14.3.26 does not appear to be fully addressed because TS 3.6.1(4) does not appear to have a corresponding surveillance requirement.

31. TS 3.6.2(1): The TS appears to contain a typographical error in that “sewage” should be “sewerage”.

32. TS 3.6.2(2): The TS appears to contain a typographical error in that “into the unrestricted area” should be “released into the unrestricted area”. Additionally, the TS may be overly restrictive as written if the argon-41 concentration could potentially exceed 10 CFR Part 20, “Standards for Protection against Radiation,” Appendix B, effluent concentration limits at the point of release (i.e., the top of the stack), before any atmospheric dilution occurs.

33. TS 3.7.1: RAI-14.3.29 does not appear to be fully addressed because the wording “sum total absolute value of reactivity worth” (TS 3.7.1(2)), “sum total absolute reactivity worth” (TS 3.7.1(4)), or “sum absolute value of reactivity worth” (TS 3.7.1(5)) does not clearly indicate that the limits are limits on sums of the absolute values of reactivity worth’s (see recommended wording in ANSI/ANS-15.1, Section 3.8.1, item (2)).

34. TS 3.7.2: It is not clear that the language “[e]xperiments irradiated with either neutrons from the reactor or gamma rays from the Co-60 sources” encompass all experiments that may be conducted at the UMLRR, and that could fall under the TS definition of “Experiment”.

35. TS 3.8(1): RAI-14.3.18 does not appear to be fully addressed because the TS is applicable during reactor operation, but not during the 3,947 seconds following reactor operation. Additionally, it is not clear from the TS wording that when a beam port shutter is open, it is the shield plug from that same beam port which shall not be removed.

36. TS 3.8(2): RAI-14.3.18 does not appear to be fully addressed because the TS uses the language “does not” instead of “shall not” to denote a requirement.

37. TS 3.8(3): The wording of the TS does not appear to clearly indicate that for any condition (i.e., regardless of whether the beam ports are being “access[ed]”), the reactor shall be positioned in the bulk pool if a beam port lead shutter is in the up position while that beam port’s shield plug is also removed.

38. TS 4.0, item A.: The TS appears to contain an incorrect TS reference in that “4.1(7)” should be “4.1(8)”. Also, the TS lists surveillance requirement TSs that may not be deferred during shutdown, but the NRC staff notes that there are other surveillance requirements which may also be inappropriate to defer during shutdown, e.g., TSs 4.4, 4.5, and 4.6(1), because they relate to equipment required during activities such as fuel movement that could occur during an extended reactor shutdown. Additionally, the TS states that surveillance TS 4.3 in its entirety may not be deferred during shutdown, but the NRC staff notes that UML may be able to defer TS 4.3(4) given that it is only required prior to a reactor startup.

39. TS 4.0, item B.: The TS appears to contain a typographical error in that “considerable” should be “considered”.

40. TS 4.1(1): The wording “excess reactivity above reference core condition” does not appear to be consistent with the TS definition of “excess reactivity” because it is not clear that this means the excess reactivity at the (or in the) reference core condition. Additionally, it is not

clear that TS 4.1(1) requires that excess reactivity be verified following any regulating rod change.

41. TS 4.1(3): The TS appears to contain a typographical error in that “positions” should be “position”.

42. TS 4.1(4): The TS does not appear to be consistent with its corresponding limiting condition for operation (LCO) TS 3.1.1(4) because TS 3.1.1(4) requires that “[n]o more than five (5) of the radiation baskets […] be without flow restricting devices,” but TS 4.1(4) requires verification that “all but 5 of the radiation baskets contain flow restricting devices”. Additionally, the TS appears to indicate that UMLRR natural convection operation is at power levels of less than 100 kWt, but the UMLRR can operate in natural convection mode at steady-state power levels of less than or equal to 100 kWt.

43. TS 4.1(6): RAI-14.3.18 does not appear to be fully addressed because TS 4.1(6) does not provide appropriate surveillance for LCO TS 3.8(3); a beam port shutter could be opened and plug removed when the reactor is not operating.

44. TS 4.1(7): In its response to RAI-7.14.a, submitted by letter dated October 18, 2019 (ADAMS Accession No. ML19291C293), subsequent to its March 5, 2019, TS submittal, UML stated that TS 4.1(7) would be deleted in a future TS revision. (If TS 4.1(7) is deleted, TS 4.1(8) should be renumbered appropriately.)

45. TS 4.2.2: TS 4.2.2(1) appears to contain a typographical error in that “following any significant core configuration” should be “following any significant core configuration change”. Additionally, TS 4.2.2(2) appears to contain a typographical error in that “verify only control blade” should be “verify only one control blade”.

46. TSs 4.2.3(2) and 4.2.3(6): The wording “prior to each day’s operation, or prior to each operation extending more than one day” (used in both TSs) does not appear to be consistent with the “surveillance time intervals” listed in the TS definitions.

47. TS 4.2.3(5): RAI-14.4.9 does not appear to be fully addressed because TS 4.2.3(5), item d. uses the language “[p]rimary coolant inlet temperature,” but this is inconsistent with the LCO TS 3.2.3 and 3.2.5 language “Pool Inlet Temperature”.

48. TS 4.4(1): It is not clear that the surveillance is sufficient to ensure continued operation of the main intake fan during prolonged reactor operation (or other prolonged operations when the fan is required).

49. TS 4.4(3): The language “functionally tested” appears to be inconsistent with the TS definition of “operable” to denote a component or system that is capable of performing its intended function. It is also not clear whether TS 4.4(3) is an appropriate surveillance for TS 3.4.2(2) because TS 3.4.2(2) allows isolation valves to be inoperable if they are in the closed position; TS 4.4(3) requires confinement system testing but does not clearly require that valves be verified operable or closed. Additionally, RAI-14.4.20 does not appear to be fully addressed because it is not clear whether TS 4.4(3) (or another surveillance TS) encompasses verification of the operability of “valve F” (see audit item 24).

50. TS 4.5(1): The language “or following any maintenance or modifications that could affect the operability of the system” appears to be redundant to, and inconsistent with, the general requirement for surveillance testing after maintenance in TS 4.0, item B.

51. TS 4.5(2): The SAR, as supplemented, does not appear to discuss what the testing required by this TS entails.

52. TS 4.6(1): The SAR, as supplemented, does not appear to specify whether the required channel tests are source checks, or whether the channels are tested using another method. Additionally, TS 4.6(1) requires testing of monitors required by TS 3.6.1(1), but TS 4.6(1) (or other TSs) do not appear to require testing of monitors required by TS 3.6.1(2), which may not necessary also be required by TS 3.6.1(1). Also, it is not clear that the language “prior to each day’s operation” encompasses all operations for which radiation monitors are required in accordance with TS 3.6.1 (i.e., irradiations, fuel handling, etc., as well as reactor operation).

53. TS 4.6(2): It is not entirely clear whether this surveillance TS only applies to the LCO-required radiation monitors, or all installed monitors.

54. TS 5.1(2): RAI-14.5.2 does not appear to be fully addressed because the TS uses the language “[t]he facility is the area…” instead of “the facility shall be the area…” to denote a requirement. Additionally, the TS specifies that the reactor building shall be the restricted area, but the NRC staff notes that this may not allow UML appropriate flexibility to expand the restricted area to other areas within the licensed boundary if necessary.

55. TS 5.2(2): The language “single cooling loop” is not clear because the UMLRR has both primary and secondary cooling loops.

56. TS 5.2(3): The revised language “which may include stainless steel components” in the March 5, 2019, TS submittal does not appear to appropriately constrain the heat exchanger materials, given the TS definition of “may”. Additionally, the purpose and justification for the revised language in the March 5, 2019, TS submittal does not appear to be discussed in the SAR, as supplemented.

57. TSs 5.3(2) and 5.3(4): The bases for the maximum fuel element limit (26, per TS 5.3(2)) and the maximum partial fuel element limit (2, per TS 5.3(4)) do not appear to be clearly stated in the SAR, as supplemented.

58. TS 5.3(6): The requirement that the analysis be reviewed and approved by the reactor safety subcommittee (RSSC) appears to be inconsistent with UMLRR Administrative Controls TSs (Section 6.0 of the TSs), which only require RSSC review of facility changes, experiments, etc.

59. TS 5.3(7): It is not clear whether the TS limits average fission density over the entire core, or the average fission density in each fuel element.

60. TS 5.4(1): If the restricted area may be expended beyond the reactor building (see audit item 56), it may not be appropriate to specify the entire restricted area as the fuel storage area.

61. TS 5.4(2): TS 5.4(2) states that the considerations of the container apply but does not appear to clearly indicate that the requirements of TS 5.4(1) do not apply where a licensed shipping container is used.

62. TS 5.4: Given that the revised TS 5.4 in the March 5, 2019, TS submittal no longer limits fuel storage only to the reactor pool and licensed shipping containers, it is not clear whether UML plans to store quantities of fissionable material outside of the pool or licensed containers that would cause UML to be subject the requirements of 10 CFR 70.24, "Criticality accident requirements."

63. TS 6.1.2(1): The TS does not appear to explicitly state that the Level 1 individual is responsible for the UMLRR license.

64. TS 6.1.2(3): RAI-14.6.2 does not appear to be fully addressed because the TS refers to safe operation of the reactor, but not the entire facility.

65. TS 6.1.3(1): The TS does not appear to require specific facility staffing when the reactor is secured but gamma irradiation facilities are in use, and it is not clear from the SAR, as supplemented, what staffing the UMLRR would have in this scenario. (See also audit item 28.)

66. TS 6.1.4(2): Although the TS references the 2007 revision of ANSI/ANS-15.4, "Selection and Training of Personnel for Research Reactors," the NRC staff notes that the most current revision of this document is dated 2016. Additionally, the NRC staff notes that because the TS states that UML "shall" (denoting a requirement) comply with the most current version of ANSI/ANS-15.4, if ANSI/ANS-15.4 were revised subsequent to the issuance of a renewed UMLRR license, this could constitute an effective change to the TS requirements without NRC approval.

67. TS 6.2 (introductory text): RAI-14.6.2 does not appear to be fully addressed because the TS states that the RSSC shall review reactor operations but does not clearly state that the operations of the entire facility shall be reviewed.

68. TSs 6.2.1 and 6.2.2(2): In TS 6.2.1, it is not clear what is meant by "…shall not have line responsibility for operation of the reactor," e.g., whether this excludes any Level 1, 2, 3, or 4 individual in the UMLRR organizational structure, only individuals at certain levels, or something else. Similarly, in TS 6.2.2(2), it is not clear what is meant by "…the reactor staff does not constitute a majority." RAI-14.6.2 also does not appear to be fully addressed for TS 6.2.1 because the referenced portion of TS 6.2.1 refers to "operation of the reactor," rather than operation of the facility.

69. TS 6.2.3(1), item e.: It is not clear whether "having safety significance" refers only to "violations of internal procedures," or to "violations of technical specifications or license," as well.

70. TS 6.2.4(2): The TS appears to contain a typographical error in that "audit" should be "audits". Additionally, the TS does not appear to contain a requirement to audit the physical security plan, consistent with the guidance in NUREG-1537, Appendix 14.1, Section 6.2.4.

71. TS 6.2.4(2), item c., and TS 6.2.4(3): RAI-14.6.2 does not appear to be fully addressed because TS 6.2.4(2), item c., and TS 6.2.4(3), both state “affect reactor safety” rather than referring to affecting facility safety. Additionally, TS 6.2.4(3) appears to contain a typographical error in that there is an extra “.” following the first sentence.

72. TS 6.3(1): Although the TS references the 2009 revision of ANSI/ANS-15.11, “Radiation Protection at Research Reactor Facilities,” the NRC staff notes that the most current revision of this document is dated 2016.

73. TS 6.4(1): RAI-14.6.1 does not appear to be fully addressed because the TS uses “should not preclude” instead of “shall not preclude” to denote a requirement.

74. TS 6.4(1), items c., d., and f.: RAI-14.6.2 does not appear to be fully addressed for these items because they use the term “reactor” where “facility” may be more appropriate.

75. TS 6.4(1), item e.: This item does not appear to encompass all personnel radiation protection procedures used at the UMLRR. Although UML’s response to RAI-14.6.15 states that other general personnel radiation protection procedures that do not fall under item e. are campus-wide procedures that are not necessarily reviewed or approved by the RSSC and UMLRR Reactor Supervisor, the NRC staff notes that any procedure used at the UMLRR is subject the review requirements of 10 CFR 50.59, “Changes, tests and experiments.”

76. TS 6.4(1), item g.: The item appears to contain an editorial error in that the “for” is redundant to the introduction to TS 6.4(1).

77. TS 6.4(2): It is not entirely clear that “[d]eviations from procedures” refers specifically to temporary deviations from procedures required by TS 6.4(1). Additionally, if general personnel radiation protection procedures are added to the TS 6.4(1) list of required procedures (see audit item 75), it may be appropriate to specify that deviations may alternatively, be made by members of the health physics staff, and reported to the Radiation Safety Officer, as applicable.

78. TS 6.5: The TS does not appear to specify that approved experiments shall be carried out in accordance with established and approved written procedures (which are subject to the requirements of UMLRR TS 6.4), in accordance with the guidance in NUREG-1537, Appendix 14.1, and ANSI/ANS-15.1.

79. TS 6.5(1): The TS appears to contain a typographical error in that “class” should be “classes”.

80. TSs 6.6.1(3) and 6.6.1(5): Both TSs refer to TS 6.7.2, but it is not entirely clear which specification of TS 6.7.2 (TS 6.7.2(1) or another part). Additionally, TS 6.6.1(5) states that a safety limit violation report shall be approved by the RSSC, but this appears to be inconsistent with TS 6.6.2(2), item e., and the guidance in ANSI/ANS-15.1.

81. TS 6.6.2(1), item a.: Given that UML proposed in its March 5, 2019, TS submittal to expand the reactor licensed boundary beyond the reactor confinement building, it may be appropriate to designate any release of radioactivity into unrestricted areas (not necessarily limited to a release from the confinement building) as a reportable occurrence.

(Additionally, TS 6.6.2(1), item a., appears to be inconsistent with TS 6.7.2(1), item b., which does specify “release of reactivity to unrestricted areas”.)

82. TS 6.6.2(1), item c.: It is not clear what “unless prompt remedial action is taken as specified in Section 3” is referring to.

83. TS 6.6.2(1), item g.: The language “could have caused” does not appear to be adequately comprehensive or consistent with the language “causes or could have caused recommended in ANSI/ANS-15.1, Section 6.7.2(1), item (c)(vi). Additionally, RAI-14.6.2 does not appear to be fully addressed because the item refers to operation of the reactor, rather than the entire facility.

84. TS 6.6.2(2), items d. and e.: Item d. refers to TS 6.7.2, but it is not entirely clear which specification of TS 6.7.2 (TS 6.7.2(1) or another part). Additionally, in item e., it is not entirely clear if the report referred to is the same report required to be submitted in accordance with TS 6.7.2(2), or something else.

85. TS 6.7.1(4): RAI-14.6.27 does not appear to be fully addressed because the TS does not require that the list of changes include a summary of evaluations, consistent with ANSI/ANS-15.1, Section 6.7.1(4), and 10 CFR 50.59(d)(2).

86. TS 6.7.2(1): The language “and followed by a written report […] Washington, DC 20555,” added in the March 5, 2019, TS submittal, appears to be redundant to TS 6.7.2(2). Additionally, TS 6.7.2(1) appears to contain 2 typographical errors in that “Operation” should be “Operations,” and “and sent” (if not deleted) should be “and is sent”.

87. TS 6.7.2(1), item b.: This TS appears to be redundant to TS 6.6.2(1), item a., because release of reactivity is already a reportable occurrence defined in TS 6.6.2. Additionally, the wording of TS 6.7.2(1), item b., is not entirely consistent with TS 6.6.2(1), item a. (see audit item 83).

88. TS 6.7.2(2): TS 6.7.2(2) references TS 6.6.2(2) as listing the information required for follow-up reports, but it appears that TSs 6.6.1(4) and 6.6.2(2) both contain information required for follow-up reports. Additionally, it is not entirely clear which part of TS 6.6.2(2) is being referenced (item e. or another item).

89. TS 6.7.2(3), item a.: The TS appears to contain a typographical error in that “1or” should be “1 or”.

90. TS 6.8.1(2): The TS appears to be less broad than the recommended language in ANSI/ANS-15.1, Section 6.8.1, and it is also not clear if “nuclear safety” refers to the safety of the entire facility or only the reactor.

91. TS 6.8.3: RAI-14.6.1 does not appear to be fully addressed because TS 6.8.3 does not include a “shall” to denote a requirement. Additionally, TS 6.8.3(5) appears to contain a typographical error in that “conditions” should be “condition”.

Audit Questions: Other Topics

92. The SAR states that that the control blade active region consists of BORTEC material. However, as discussed in the UMLRR annual reports for 2014-2015, 2015-2016, and 2016-2017 (ADAMS Accession Nos. ML15243A028, ML16224A324, and ML17209A491, respectively), the old blades (which are boron carbide in an aluminum matrix clad with aluminum) were still in the process of being replaced with the new BORTEC blades. It is not clear whether the replacement of these blades is complete, such that the currently-installed control blades when a renewed license is issued will be consistent with the descriptions in the SAR.

93. It is not clear from the LRA, as supplemented, whether UML requests that its license conditions for a renewed license allow it to separate byproduct material produced in non-fueled experiments.

94. Discuss whether UML requests that a renewed license allow a delayed implementation of its renewal TSs and license, beyond the actual date of issuance (i.e., effective date) of a renewed license.

95. RAI-12.1 does not appear to be fully addressed because it is not entirely clear how UML's startup procedures will provide confirmation of modeling and/or analysis predictions for cores containing aluminide fuel (e.g., by verifying similarity of calculated and measured parameters).

96. SAR Section 6.2.3 states that, in the event of a general reaction in the ventilation system (GRVS), the main exhaust fan ceases to operate, while the main intake fan continues to operate, except for the case where electrical power is lost. SAR Figures 8-2 and 8-3 appear to indicate that the main intake fan (fan AC-2) is on the emergency power distribution switchboard, but the main exhaust fan is not supplied by emergency power. SAR Section 13.2.7 states that one of the principal purposes of the UMLRR emergency power system is to provide backup power for the main exhaust fan. Based on the information in the SAR, it is not clear whether the main intake and exhaust fans are supplied by the emergency power system.

97. The NRC staff transmitted RAIs to UML by letter dated July 19, 2019 (ADAMS Accession No. ML18092B090), to which UML provided a response by letters dated October 18, October 24, December 19, and December 20, 2019 (ADAMS Accession Nos. ML19291C293, ML19297F433, ML19353C523, and ML19354A610, respectively) (UML's complete response to RAI-7.4.c and RAI-7.5.a is still pending). However, documentation referenced in some UML responses to the I&C RAIs were not included and the bases for some statements in RAI responses are not clear. For example:

    a. UML's response to RAI-7.4.d states that the documents related to the Thermo Fisher Scientific PPM are incorporated by reference into the UMLRR SAR, but these documents do not appear to be in ADAMS, nor do they appear to be commercially-available documents.

    b. UML's responses to other Section 7 I&C RAIs reference vendor documentation, correspondence, communications, etc. to substantiate the suitability of the UMLR I&C systems. However, the referenced information does not appear to be in ADAMS, nor was it made available to the NRC staff during previous audits.

c. UML's responses to RAIs cite UMLRR documentation, such as acceptance checklists, pre-critical checkout procedures, calibration procedures, acceptance tests, and a UML configuration management program. However, these updated documents do not appear to be in ADAMS, nor were they made available to the NRC staff during previous audits.