University of Massachusetts Lowell Response to NRC Audit letter dated 09/01/20
Lic. No. R-125, Docket No. 50-223.

Audit Questions and Responses: Technical Specifications

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.

   UML Response
   The corrections and updates to the technical specifications (TS) and TS bases are noted in the enclosed copy of the TS with marked revisions and comments. An unmarked version of the TS is also attached.

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".

   UML Response
   The technical specification has been revised.

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"regulating devices" and "the maximum reactive condition" instead of the facility-specific "regulating rod" and "fully withdrawn position," respectively.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.

   UML Response
   The technical specification has been revised.

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 "<".

   UML Response
   The technical specification has been revised.

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".

   UML Response
   The technical specification has been revised.

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".

UML Response
The technical specification has been revised.

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”.

   UML Response
   The technical specification has been revised.

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.

   UML Response
   The technical specification has been revised.

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”.

   UML Response
   The technical specification has been revised.

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

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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).

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised. In addition, a revision to SAR 7.4.1.1.5 has been uploaded to the portal for review.

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.

UML Response
UML acknowledges the removal of the setpoint from the TSs, and confirms that the information in SAR Section 3.4 is still accurate. The specific setpoint does not need to be in the TS since it is a nominal value and the scram can continue to serve its purpose without a specific TS-required setpoint. It is relevant to note that the UMLRR is one of only a few research reactors in the U.S. having a seismic trip.

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.

UML Response
The technical specification has been revised. The information in the SAR will be corrected in future update.

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.

UML Response
The technical specification has been revised.

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.

UML Response
SAR 7.7.9 will be revised in a future update to be consistent with the TS and indicate that this scram occurs during any reactor operation.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

    Conductivity and pH may occasionally and briefly exceed the specified values immediately following regeneration of the water purification system. Operating experience since 1974 has shown the conductivity and pH values return to the allowable values typically within a few days post-regeneration. The current license Technical Specifications allows one month averaging. No corrosion issues have been identified with the fuel, Co-60, or the core structural materials since operations began in 1974. The second sentence of TS 3.3(3) was deleted as redundant since TS 6.6.2 already has requirements for determining cause and making corrective actions for LCO violations.

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.)

    UML Response

    The LCO time restriction would establish an administrative requirement that could decrease the effects of a LOCA under the following highly unlikely scenario: the reactor has operated at full power for an infinite amount of time (i.e., continuously for approximately 30 days), a beam tube shutter is up and its corresponding tube plug has a 4-in diameter opening, the reactor is shutdown, the pool divider gate (SAR 4.3) is placed on the stall pool side (a very rare occurrence, see below), and the beam tube as configured is sheared off inside the pool. To illustrate how unlikely and difficult it is for beam tube shearing event to occur, the thick steel reactor bridge platform (SAR 4.2.5) spans the stall pool side-to-side thereby providing direct overhead protection of the

beam tubes from a vertically falling object. A projectile capable of shearing a beam tube would need to be large, heavy, and be propelled (not inadvertently dropped) at a precise horizontal angle to enter the pool underneath the reactor bridge and continue traveling the 25-ft underwater distance to impact the beam tube. In addition, per procedure, heavy loads (e.g., using the overhead crane) are not moved over the stall pool. Given the design of the UMLRR, and its operational practices, the complete shearing of a beam tube that would allow the stall pool to be drained through a beam tube is an extremely unlikely event.

There are only two purposes for which the pool divider gate is used – to purposefully drain one side of the pool or for a LOCA mitigation. If the gate is placed on the bulk pool side, the stall pool can be purposefully drained or a leak in the stall pool can be mitigated. In either case, the reactor would be placed in the bulk pool side and would remain covered by water under this configuration. It should be noted that this configuration is the one most often used for maintenance or other purposes. If the gate is placed in the stall pool side, the bulk pool can be purposefully drained or a leak in the bulk pool can be mitigated. In either case, the reactor is in the stall side and remains covered by water. This configuration is very rarely done and has occurred purposefully only once since the facility began operation in 1974.

A revision to the TS 3.3(4) incorporating a time limit associated with the LOCA analysis would create a difficult to manage administrative requirement, specifically because the specification would be in effect <u>for any reactor operation</u> including low-power, short duration operations creating an unnecessary operational restriction.

An equally or more effective administrative control is a revision to the pool drain procedure to add a step requiring the beam tube shutters be placed in the down position prior to moving the divider gate onto the stall side for draining of the bulk pool. This would mitigate the consequences of a LOCA from a highly improbable beam tube rupture occurring on the stall side at the same time. The procedure shall be revised to include this step prior to implementation of the renewed license.

It also should be noted that TS 6.6.2 requires the same actions and reporting whether an LCO is violated or an inadequacy in the implementation of procedural control causes or could have caused the existence or development of an unsafe condition.

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).

<u>UML Response</u>
While the technical specification for a vacuum relief valve has been removed, the valve is still a physical structure of the building which is designed for containment, but under the new technical specifications will be treated as confinement. SAR 6.2.7 provides a

brief analysis that shows that even under the condition where air intake is isolated and the main exhaust fan (15,000 CFM) remains operating, the vacuum relief valve is adequate to compensate for the negative pressure. In response to the emergency exhaust system (320 CFM) creating excessive negative pressure, the proposed changes to emergency exhaust system operation will only change when the system turns on, and not when it shuts off. The system will continue to automatically shut off when building pressure drops to or below approximately negative 0.25 inches of water.

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.)

UML Response
The technical specification has been revised.

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.)

UML Response
The technical specification has been revised.

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).

UML Response
The technical specification has been revised.

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.

UML Response
The TS 3.6.1(1)-required radiation monitors do not currently have individual remote audible alarms in the control room. All TS 3.6.1(1)-required monitors currently have readouts in the control room, but for the stack and continuous air monitors, the only readout is on the ARMS computer screen. UML will make changes to its radiation monitoring system (during the implementation period of a renewed license and TSs, or sooner). The changes will consist of adding additional ratemeters for the stack gas and particulate monitors that provide independent readouts and individual audible alarms in the control room. The existing ratemeters for TS-required area monitors will be configured to provide for individual audible alarms in the control room (these ratemeters already provide readouts and visible alarm indicators). UML does not plan to make any changes related to the TS-required pool level continuous air monitor, as this monitor is near the control room, has a loud local audible alarm that is easily heard by the operator (even with the control room door closed), and also produces a visible (bright light) alarm that is easily visible to the operator, a new control room alarm is not necessary for this monitor. The stack monitor and continuous air monitor each also have local readouts.

The proposed configuration shall be sufficient to ensure the operator is immediately alerted and can evaluate the situation and take appropriate action if any single TS-required radiation monitor reaches its setpoint. Current procedures already require operator evaluation of a high level on any radiation monitor channel.

Regarding local readouts or alarms for TS 3.6.1(1)-required monitors, specific TS requirements for these are not necessary. Typically, an operator in the control room would be alerted to elevated radiation levels and could alert other staff in the facility as necessary. Although there could be situations when radiation monitors are required by TS 3.6.1(1) but an operator would not be required to be in the control room because the reactor is secured (such as during radioactive material handling activities), there are multiple redundant fixed local area monitor alarms, and the local continuous air monitor alarms (discussed in the SAR, as supplemented) which could alert facility staff to a radiation hazard and allow them to take appropriate actions. Additionally, portable survey meters are used by personnel per procedures to supplement fixed monitors in evaluating local radiological conditions.

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

UML Response
The technical specification has been revised.

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.)

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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)).

UML Response
The technical specification has been revised.

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”.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised to include the term "corresponding".

A revision to the TS 3.8(1) incorporating a time limit associated with the LOCA analysis would create a difficult to manage administrative requirement. In addition, the specification would be in effect for any reactor operation including low-power, short duration operations creating an unnecessary operational restriction. Per TS 3.8, in order to open a beam tube plug while the corresponding beam tube shutter is also open, the reactor must not only be shutdown but also moved to the bulk pool. If the shutdown reactor were in the stall pool and a beam tube were damaged, any drainage would be limited to a 4 inch diameter round opening (similar to the 4.5 inches used in UML's LOCA analysis) per the TS 3.8(2) limit on the size of any opening in a beam tube plug. If the shutdown reactor were in the bulk pool, a beam tube damage scenario could potentially cause drainage through an 8 inch diameter round opening if both a beam tube plug and the corresponding shutter were open. Although the LOCA analysis only assumes that drainage occurs through a 4.5 inch diameter opening, the assumptions in the analysis are extremely conservative, including that the reactor has been operated at full power for an infinite period of time, and that pool drainage starts immediately upon reactor shutdown. In actuality, even without a TS requiring a certain amount of wait time after shutdown to open a beam port plug and shutter, it would take some time to move the reactor to the bulk pool (as required by TS 3.8(3)), and actually perform the beam tube reconfiguration. This time would allow for some decay following shutdown. Additionally, given the design of, and operational practices at the UMLRR, the complete shearing of a beam tube that would allow the reactor pool to be drained through an 8 inch diameter opening is an extremely unlikely scenario (see also response to item #21). Per procedure, heavy loads are not moved or handled (e.g., using the overhead crane) over the stall pool (in which the beam tubes are located), regardless of the position of the reactor in the pool. Furthermore, even if beam tube shearing event somehow did occur, the pool drainage can be mitigated. The pool divider gate (SAR 4.3) provides the means to isolate the reactor in the bulk pool. Positioning of the pool divider gate can be accomplished within a few minutes and well before the pool could drain to the level of the reactor even with an 8 inch break. Since the reactor would already be in the bulk pool, isolating the bulk pool would prevent the reactor from becoming uncovered. The pool divider gate is positioned using the overhead crane by personnel located to the side of the pool which minimizes any potential direct radiation exposure from fuel (in the core or storage racks) or the cobalt-60 sources in the pool that may occur, depending on the volume of water lost. In addition, the loss of water through the sheared beam tube can be mitigated by closing the beam tube shutter by similarly using the overhead crane and minimizing any potential direct radiation exposure to personnel from the pool. Closing the shutter would effectively stop the pool drainage since the heavy lead shutter would block the beam tube (see SAR 10.2.1).

SAR Section 10.2.1.1 will be revised to indicate that beam tube shutters are typically opened and closed using the overhead crane, rather than a manual crane.

The following additional information is provided relative to fuel storage in the pool. Fuel storage racks are hung on the pool wall via "j" hooks welded to the pool liner (SAR 9.2.1). There are 9 storage locations in the pool, with an upper and lower set of j-hooks at each location. Currently, there are 9 storage racks available in the pool, 7 of which are currently located at lower positions. The UMLRR fuel handling procedures do not specifically designate where types of fuel with various activity and radiation levels (e.g., fresh fuel, lightly irradiated fuel, and more heavily irradiated fuel) are to be stored (e.g., the lower racks that are at approximately the height of the core, or the upper racks that are above the core). Higher-activity fuel is typically stored in the lower racks as a best practice. Fuel storage configurations and methods are intended to provide adequate cooling both for normal conditions, and abnormal conditions such as a possible LOCA.

The fuel storage descriptions in SAR Section 9.2.1 shall be clarified and revised as follows in a future revision to the SAR. The references to fuel elements in SAR Section 9.2.1 refer to the entire length of the elements, including the end boxes (see SAR 4.2.1). When fuel elements are in the racks, roughly one-third of the entire length of an element protrudes out of the top of the rack. The 22.25 inch overall rack height provided in SAR Section 9.2.1 is an error. The correct height is 26 inches. The number of stated racks is also incorrect. The UMLRR pool contains 9 racks capable of holding up to 9 elements each. Additionally, regarding the location of the lower racks, the vertical centerline of the lower storage racks is 1.5 inches above the core centerline.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.)

UML Response
The technical specification has been revised.

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".

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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".

    UML Response
    The technical specification has been revised. In addition, references to "primary coolant inlet" in the SAR will be revised to "pool inlet" for consistency.

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).

    UML Response
    The technical specification has been revised.

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).

    UML Response
    The technical specification has been revised.

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.

    UML Response

The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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).

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

60. TS 5.4(1): If the restricted area may be expended beyond the reactor building (see audit item [54]), it may not be appropriate to specify the entire restricted area as the fuel storage area.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.”

    UML Response
    The requirements of 10CFR 70.24(a) shall apply for special nuclear material stored, handled, or used outside the reactor pool. This statement has also been included in the bases.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.)

UML Response
Gamma irradiation facility operators are trained individuals with unescorted access to the UMLRR facility. Individuals trained in UMLRR gamma facility operation are present for the setup and termination of gamma irradiations (including when gamma sources are being moved into or out of place for irradiations). Procedures require two individuals to be present when Co-60 sources are being moved. However, ongoing static irradiations may continue during periods when there is no personnel present at the UMLRR facility (e.g., overnight). Because the reactor may be secured when gamma irradiation facilities are in use, there is not necessarily anyone in the control room during gamma irradiation facility operation (including setup and termination of irradiations), so an operator would not necessarily be able to monitor radiation conditions from the control room and alert personnel to radiation hazards. However, the gamma irradiation facilities have multiple fixed radiation monitors with local alarms that can alert personnel to radiation hazards, including monitors that are both connected to, and independent of, the ARMS. Additionally, portable radiation monitors are used when personnel enter irradiation facilities (per procedures) to supplement fixed monitors. Per audit item 28, UML has revised TS 3.6.1(2) to require local area radiation monitors that will alert personnel when a gamma irradiation source is in use.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised for the typographical error. While NUREG-1537 includes a provision for an audit of the Physical Security Plan (PSP) by the oversight committee, ANSI/ANS 15.1 does not. Notably this is because NUREG-1537 was drafted and approved pre-9/11, whereas ANSI/ANS 15.1 was drafted and approved after in 2007. The NRC has required that PSPs for certain strategic materials be categorized as Safeguards Information which restricts information in the plan to personnel having a background investigation per 10 CFR Part 73, and also having "need-to-know". The NRC approved PSP for the UMLRR has an annual audit requirement which is performed and documented by the Reactor Supervisor.

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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 [to] the review requirements of 10 CFR 50.59, "Changes, tests and experiments."

    UML Response
    The technical specification has been revised. TS 6.4(2) has been added to allow the RSO to approve radiation safety procedures (see TS for MURR). As with the MURR TS, this is a reasonable allowance as the RSO has the highest proficiency in these matters compared to the Reactor Supervisor.

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).

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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.

    UML Response
    The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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 [radioactivity] to unrestricted areas”.)

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised. Also added is the reference to the action statement added to TS item 3.5(1).

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.

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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).

UML Response
The technical specification has been revised.

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".

UML Response
The technical specification has been revised.

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 [radioactivity] 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).

UML Response
The technical specification has been revised.

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).

UML Response
The technical specification has been revised.

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

UML Response
The technical specification has been revised.

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.

UML Response
The technical specification has been revised.

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".

UML Response
The technical specification has been revised.

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.

UML Response
As of this date, the fourth of three original BORAL control blades has not been replaced with BORTEC. As indicated in the February 18, 2020 teleconference with NRC, the last BORAL control blade was to be installed in June 2020. However, due to the COVID-19 health emergency, this task could not be accomplished.

Due to the complexities involved, this task cannot be accomplished until COVID health emergency is at a condition where the entire UMLRR staff is allowed to the UMLRR full-time. The UMLRR will revise the SAR to describe both BORAL and BORTEC control blades as being usable in the reactor core.

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.

UML Response
The UML requests that it's the renewed license conditions allow it separate byproduct material 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.

UML Response
The UML requests a 60 day delayed implementation period to allow for time to make facility changes and procedure changes, and conduct operator training, consistent with the new license and TSs.

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).

UML Response
For the initial startup of the reactor with aluminide fuel in the core, UML will perform comparisons to verify the similarity of calculated and measured reactor parameters (e.g., reactivity and critical blade height), to help confirm modelling and analysis predictions for cores containing aluminide fuel. As with any new fuel configuration, even with the same type of fuel, UML performs measurements of reactor parameters not just to ensure compliance with TSs, but also to verify reasonable consistency with expected parameter values for the new configuration.

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.

UML Response
An update to the SAR shall include a description stating the main intake fan is on emergency power, but the main exhaust fan is not. The main intake fan will shut off for a brief period of time while the emergency generator automatically starts. The main intake fan will normally restart once the emergency generator is online and providing electrical power to the fan motor.

Audit Questions and Responses: Instrumentation and Controls

97.c.iii: The NRC staff noted that in the UMLRR license renewal TSs and RAI responses submitted by letter dated March 5, 2019 (ADAMS Accession No. ML19064B373), TS 4.2.3(3) refers to "Log-N," but "Log PPM" may be more consistent and appropriate given UML's proposal to install the TFS PPM.

UML Response
The technical specification has been revised.

97.c.iv: In the 2017 audit, UML stated that the draft linear power channel installation plan required the addition of a section for the 100 kWt mode (i.e., natural circulation mode). The NRC staff noted that the latest version of the plan submitted as Appendix C to UML's response to RAI-7.6 still does not contain a 100 kWt mode section. The NRC staff also questioned references in the procedure for testing the watchdog timer to verify pulsing has stopped and started on the "NLW."

UML Response
The following will be accomplished once the license renewal, including the linear power channel upgrades, is approved, but prior to the implementation. The NMP1000 Installation Plan including the 100 kW_t mode changes shall be finalized. A UMLRR engineer shall complete the modification of the channels to accommodate dual-mode operations using the instruction provided by GA, per the [Gen-2] NMP-1000 Linear Power Channel Installation Plan. The "NLW" references in the plan were errors that shall be corrected.

97.c.xiv: During the 2017 audit, UML confirmed that GA had stated that the NMP-1000 procured by UML was the same build and model as the NMP-1000 documented in the INL SRS, SYR and FMEA (see items 2.a. through 2.n. under the 2017 audit document list). On February 28, 2020, in response to the NRC staff request, UML uploaded to the online audit portal additional documentation for the applicability of

the GA documentation to the UMLRR NMP-1000 (document No. 12 in item i, above).

UML Response
The requested documents in item 97i.12 are being submitted to the docket as part of this audit response. In addition, General Atomics has confirmed in a proprietary communication that the architecture of the proposed (Generation 2) NMP-1000 is fundamentally the same as all previous (Generation 1) NMP units.

97.c.xvi: The NRC staff noted that in the UMLRR license renewal TSs and RAI responses submitted by letter dated March 5, 2019 (ADAMS Accession No. ML19064B373), the TS definition of "reactor secured" refers to the "console key switch." However, SAR Section 7.3.3 and SAR Figure 7-8 appear to indicate that this switch (the key-operated master control switch) is located on the control room instrumentation panel, rather than the console.

UML Response
The technical specification has been revised.

97.c.xvii: Although SAR Section 7.4.1.3 discusses the startup channel and SAR Section 7.6.1.9 discusses the startup counter drive indicators, the NRC staff noted that the SAR, as supplemented, does not appear to include any detailed discussion of the startup counter drives. The NRC staff noted that the 1985 UMLRR SAR (Section 4.4.10) appears to contain more detailed information regarding the startup counter drives, but it is not clear if that information is still valid or if more detailed information should be included in the 2015 renewal SAR, as supplemented.

UML Response
Information on the start-up counter drive, similar to that provided in the 1985 SAR, shall be included in a revision to the 2015 SAR.

97.c.xix: SAR Table 1-2 indicates that the withdrawal rate of the UMLRR regulating rod is 55 inches per minute. However, SAR Section 3.5.2 states that the nominal speed of the regulating rod is 78 inches per minute, and SAR Section 4.2.2.3 states that the maximum speed of the regulating rod is 78 inches per minute. Clarify which regulating rod speed is correct.

UML Response
The revision to the 2015 SAR shall provide the present nominal value for each reference to the regulating rod speed in the SAR.