UNIVERSITY OF
MARYLAND
DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

Building 090
College Park, Maryland 20742-2115
301.405.5207 TEL 301.314.2029 FAX

January 31, 2011

Document Control Desk
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Reference: University of Maryland, Maryland University Training Reactor ("MUTR"), Docket No. 50-166, License No. R-70 Request for Additional Information ("RAI") Regarding Remaining Technical Specifications

The University of Maryland herewith submits further clarifications to certain remaining technical specifications as requested by the NRC during a site visit the week of December 20, 2010. The University submitted initial responses to the NRC's request for clarifications to some 16 remaining technical specifications by email on November 22, 2010. The NRC advised the University in a December 9, 2010, email that the NRC had additional requests for clarifications that it wished to discuss during a site visit to the University. On December 14, 2010, the University requested an extension of time until January 31, 2011, to submit those clarifications because it would not learn what information the NRC desired until the site visit occurred (subsequently scheduled for the week of December 20, 2011) and because the University would be closed from December 23, 2010 through January 2, 2011. By e-mail of January 21, 2011, the NRC informed the University that the NRC had that day mailed a letter approving the University's request for an extension of time to January 31, 2011.

If there are questions about the information submitted, please write to me at: Department of Materials Science and Engineering, University of Maryland, College Park, MD 20742-2115 or email me at mohamad@umd.edu. Please copy Prof. Robert Briber on any such correspondence: Department of Materials Science and Engineering, University of Maryland, College Park, MD 20742-2115; rbriber@umd.edu.

I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

Mohamad Al-Sheikhly
Professor and Director
Maryland University Training Reactor

cc: Robert Briber
Enclosure

A020
NRR

OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

MARYLAND UNIVERSITY TRAINING REACTOR

LICENSE NO. R-70; DOCKET NO. 50-166

We are continuing our review of the Application for Renewal of Facility Operating License No. R-70, Docket No. 50-166 for the University of Maryland (UMD). The application was submitted on May 12, 2000, as supplemented by letter dated December 18, 2006, to include revised technical specifications (TS).

During our review of the revised proposed TS, questions have arisen for which we require additional information and clarification.

NUREG-1537, Part 1, states that the format and content of the technical specifications (TSs) discussed in Appendix 14.1 follow the format of the 1990 revision of the American National Standards Institute/American Nuclear Society (ANSI/ANS)-15.1, "The Development of Technical Specifications for Research Reactors". The current version of the standard is dated 2007 (ANSI/ANS-15.1-2007). The basis for the questions below is the 2007 version of the standard with applicable modifications based on NUREG-1537.

1. TS 1.0. Definitions: ANSI/ANS-15.1-2007, Section 1 provides definitions for key terminology utilized in TSs. Please include definitions of Core Configuration, and Shall, Should, and May, in Maryland University Training Reactor (MUTR) TS 1.0 Definitions, or provide a basis for not defining these terms.

   Definitions of Shall, Should, and May will be added to TS 1.0. The definition of core configuration in TS 1.0 will be changed to conform to the ANSI standard.

2. TS 1.0, Definitions: ANSI/ANS-15.1-2007, Section 1 defines key terminology. Please evaluate MUTR TS against the standard definitions in ANSI/ANS-15.1-2007 for the below listed TS items. Propose changes to meet ANSI/ANS-15.1-2007 or justify your definitions:

   a. TS 1.1 – "in this part" should refer to "in 10 CFR Part 20"

      Wording in TS 1.1 will be changed from 'in this part' to 'in 10 CFR Part 20'.

   b. TS 1.3 – if your confinement is designed to limit release of effluents, this needs to be included in your definition

By controlling airflow, the MUTR confinement is designed to limit effluent release. Wording in TS 1.3 will be changed to include this detail.

c. TS 1.4 – "reactivity control devices" should be replaced with control rods

Wording in TS 1.4 will be changed from 'reactivity control devices' to 'control rods'.

d. TS 1.8 – use either fuel element or fuel rod terminology consistently in the TSs

The term 'fuel element' will be used in all technical specifications. Changes will be made as needed.

e. TS 1.22 – U. S. Nuclear Regulatory Commission (NRC) licenses operators, we do not certify operators, please update to reflect NRC terminology

Wording in TS 1.22 will be changed from 'certified' to 'licensed by the NRC'

f. TS 1.24.d - replace "the maximum value allowed for a single experiment, or one dollar, whichever is smaller" with the smaller of the two reactivity values

Wording in TS 1.2.4.d will be changed to indicate which of the two is smaller.

g. TS 1.25 – The NRC staff has proposed modifications to the definition for reactor shutdown given in ANSI/ANS-15.1-2007 as follows:

"The reactor is shut down if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments included and the following conditions exist:

(a) No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods;

(b) No experiments are being moved or serviced that have, on movement, a reactivity worth exceeding the maximum value allowed for a single experiment, or one dollar, whichever is smaller."

Please adopt the NRC-modified definition or discuss why your proposed definition continues to be acceptable.

TS 1.25 will be changed to conform to the ANSI definition.

h. TS 1.27 – conform to Section 6.7.2(1)(c) of ANSI/ANS 15.1-2007; remove "which occurs during reactor operation."

The wording 'which occurs during reactor operation' will be deleted from TS 1.27.

i. TS 1.27(3) – remove "or periods of reactor shutdown"

'or periods of reactor shutdown' will be deleted from TS 1.27.3

j. TS 1.27(5) – change containment to confinement
'Containment' will be replaced with 'confinement' in TS 1.27.5

k. TS 1.27(5) – remove "exceeding prescribed radiation exposure limits."

The phrase 'exceeding prescribed radiation exposure limits' will be deleted in TS 1.27.5

l. TS 1.28: The definition of Rod-Control should match what physically exists at the UMTR facility.

The words 'or fuel' will be deleted from the definition of rod control in TS 1.28

m. TS 1.34: NRC licenses operators, we do not certify operators, please update to reflect NRC terminology.

The word 'certified' will be changed to 'licensed by the NRC' in TS 1.34

3. TS 3.1.2: ANSI/ANS-15.1-2007, Section 3.1(2) provides guidance for establishing a Limiting Condition for Operation (LCO) for shutdown margin. In MUTR TS 3.1.2, the LCO specifies that the "shutdown margin shall not be less than \$0.50." Please discuss whether the following conditions should also be specified for the measurement of shutdown margin

a. Reference core condition,

b. Non-secured experiments in their most reactive state,

c. Most reactive control rod being withdrawn

Please discuss how TS 3.1.2 should be revised to determine the shutdown margin under the most limiting conditions or justify why these conditions are not needed.

TS 3.1.2 will be revised to read:

The shutdown margin shall not be less than \$0.50 with:

a. The reactor in the reference core condition
b. Total worth of all in-core experiments in their most reactive state; and
c. Most reactive control rod fully withdrawn

4. TS 3.1.4: Please define fuel damage. ANSI/ANS-15.1-2007, Section 3.1(6) indicates that limits shall be established for fuel inspections. Please discuss how MUTR inspects fuel elements and under which conditions is fuel considered damaged.

Fuel damage is defined as a clad defect that results in fission product release into the reactor coolant.

General Atomic published a report (GA-A16613) in 1981 which details an investigation of fuel damage found in the Texas A&M reactor. The reactor has a maximum power level of 1 MW and can pulse. Over approximately a three year period (June 1973 to September 1976), the core operated 287 MWd in steady state and pulsed 725 times. The maximum pulse insertion was $2.70, with a corresponding peak core temperature rise of 883° C. During a loading operation in September 1976, four 'somewhat deformed' (terminology from the report) fuel elements were seen. These fuel elements were in the closest proximity to the transient rod throughout their operating history. Inspection of fuel elements in the next lower flux region showed no damage.

Pulsing operations were subsequently suspended, and no additional fuel damage was noted. The report concludes that the damage was due to pulsing, and the steady-state history of the fuel is not a factor.

The report noted that fuel inspection at the University of Wisconsin and Washington State University reactors, each with pulsing capability, showed no fuel damage.

Routine inspection of MUTR fuel has never been required. As a conversion TRIGA, an inspection of a fuel element would require mechanical disassembly of the four fuel element assembly.

MUTR is low power (250 kW), cannot pulse, and typical burnup is about 1 MWd per year. Based on the assessment of the Texas A&M fuel damage, and the conclusions reached in the GA report, a routine fuel inspection is not required. As noted, if fuel damage (cladding defect) occurs, fission products would be released into the reactor coolant, and these would be detected in the pool water gamma analysis (TS 4.3.1).

5. TS 3.2: The applicability statement of the TS needs to be labeled. Minimum channels needed for operation appear to be missing from the TS. Please address. In Table 3.2 clarify the log power level and explain the interlock.

'APPLICABILITY' will be added above the first sentence in TS 3.2. A new table (Table 3.5) will be added which lists minimum channels required for operation. Minimum channels required for operation are listed in Table 3.1. In table 3.2, the 'function' description of the log power level will be changed to indicate the interlock functions of the channel.

6. TS 3.3: ANSI/ANS-15.1-2007, Section 3.3(9) indicates that limits shall be established for water chemistry requirements. MUTR TS 4.3.5 includes pH and conductivity values, which are considered LCO limits and should be moved to TS 3.3. Please discuss whether the LCO conditions in TS 4.3.5 should be placed in TS 3.3 and also include an LCO for gross gamma measurements or justify why it is not needed. Should an LCO be established for maximum pool water temperature? The numbering of the water (coolant) specifications and their bases should be made consistent.

   The pH and conductivity LCO values will be deleted from TS 4.3.5 and added to TS 3.3. An LCO for gross gamma measurement will be added. This LCO will be 'a gross gamma measurement that is more than two times greater than historical data measurements'.

   MUTR is designed and licensed as a natural circulation system (SAR 4.6). At all power levels, fuel is cooled via natural circulation and the heat is convected from the pool to the reactor building atmosphere. Therefore, there is no requirement for an LCO based on coolant water temperature.

   The numbering of the coolant specifications and bases will be revised for consistency.

7. TS 3.3.2: Should this be part of the radiation protection TSs in section 3.6? Please move or justify the continued placement of this information in TS 3.3.2.

   TS 3.3.2 will be moved to TS 3.6.

8. TS 3.4 or 3.5: ANSI/ANS-15.1-2007, Section 3.4 provides guidance for the operations which require confinement and the equipment required to establish confinement. Please discuss whether any equipment, such as the ventilation system is required for confinement. The objective is stated as ensuring that sufficient confinement volume is available for the dilution of radioactive releases. Is this the only purpose of the confinement? There is no reference to the need for controlled air flow and discharge. Please explain. The bases state that the release conditions are similar to these assumed in the safety analysis report (SAR). Please explain.

   No equipment is required to establish confinement. As noted in TS 3.4.2, confinement is established by closing the door leading to the balcony on the top floor, the exterior doors, and the ground floor door to the reception area. The purpose of confinement is to provide sufficient volume for dilution of any radioactive releases.

   During operation, the only pathway to the outside environment is if the fans are operating. Closing of the doors, noted above, ensures minimal air exchange to other interior spaces of the building.

Control of air flow and discharge to the outside environment is provided by automatic shutdown of the ventilation system (if operating) if either the bridge monitor or exhaust monitor indicates abnormal radiation levels. This is addressed in TS 3.5. Chapter 13 of the Safety Analysis Report calculates the maximum dose to a member of the general public under the assumption that the ventilation system does not shut down. The calculation shows that the maximum dose is well below allowable.

9. TS 3.4.1: ANSI/ANS-15.1-2007, Section 3.4 provides guidance for the operations and equipment required to establish confinement while Section 5 includes design features related to the site and facility. Please discuss whether TS 3.4.1 is a facility design feature that should be included in Section 5 or justify your placement.

   TS 3.4.1 will be moved to TS 5.1, Site Characteristics

10. TS 3.4.2: The description of the confinement does not address limiting the release of effluents and the need for controlled air flow. Please explain. See request for additional information 2.b.

    As noted in the response to RAI 9, confinement is established by closing of the doors. Limiting release of radioactive materials and the need for controlled air flow is addressed in TS 3.5. With the doors closed (required for confinement) and the exhaust fans shut down and louvers closed, there is no forced air pathway to either the building or the outside environment.

11. TS 3.4.3: Explain whether establishing confinement is a requirement. If it is, "must" should be replaced by "shall". Please review your proposed TSs in their entirety to ensure that requirements are "shall" statements.

    Establishing confinement is a requirement. 'Must' will be replaced by 'shall' in TS 3.4.3.

12. TS 3.5.1: Does this TS mean that the reactor confinement is airtight? If not, please explain airflow pathways to the atmosphere during operation and emergency conditions. Please revise the TS to reflect the operation of the system.

    The reactor confinement is not airtight. During normal operation, if the ventilation fans are running, there is a pathway to the outside. If high radiation levels are detected, the ventilation fans automatically shut down and the louvers close, which minimizes release to the outside environment. Additionally, the confinement design limits any release to other occupied spaces in the building. There are no ventilation fans that exhaust from the reactor confinement into the building, and the doors into the reactor confinement area are required to be closed during operation. TS 3.5.1 will be revised to reflect these conditions.

13. TS 3.5.3: Explain the automatic operation of securing the forced air ventilation. Securing is interpreted as turning off the fans and other components. What are the preset radiation levels for securing ventilation? How are facility personnel protected by

securing the forced air ventilation?

Fans are turned off and louvers closed to secure the system. Preset levels are 37 mR/hr (alert), 50 mR/hr (scram) for the bridge monitor and 8 mR/hr (alert), 10 mR/hr (scram) for the exhaust monitor. Securing the forced air ventilation is not designed to protect facility personnel, but rather to minimize uncontrolled radioisotope release to the outside environment.

14. TS 3.6.1 and Table 3.5: ANSI/ANS-15.1-2007, Section 3.7 provides guidance for the radiation monitoring system. TS 3.6.1 appears to require both monitors to be in operation but Table 3.5 seems to say only 1 of the 2 is needed. Please clarify the number of radiation monitors required for operation.

    One of two, as indicated in Table 3.5, is needed. Wording of TS 3.6.1 will be revised.

15. TS 3.6.3. The NRC staff agrees that specific alarm set points (e.g., 1,500 cpm) need not be TSs because of the potential for the value to change with equipment aging or maintenance. However, the bases for the alarm should be TS specifications. Please add alarm set point bases to the TSs or discuss why they are not needed.

    The alarm setpoints for the for the bridge monitor are 37 mR/hr (alert) and 50 mR/hr (scram). The basis for the scram setpoint is a radiation field 50% of 100 mR/hr (high radiation area). For the exhaust monitor, the setpoints are 8 mR/hr (alert) and 10 mR/hr (scram). The exhaust monitor is located near the exhaust ventilation fan, and an indicated radiation level above background would indicate that there has been a release of radioactive material into the reactor area. The basis for the exhaust monitor setpoint is a radiation field 10% of a high radiation area (100 mR/hr). If the 10 mR/hr setpoint is reached, the reactor scrams and the ventilation fans (if in operation) shut down and the louvers close, which minimizes release to the outside environment.

    TS 3.6.3 will be revised to include the setpoint values and bases.

16. TS 3.7: Why does TS 3.7 have six specifications and seven bases? The numbering of specifications and bases should be made consistent.

    Revised TS 3.7.3 will be revised to include seven specifications and seven bases.

17. TS 3.7.3: Failure of experiments that release materials may damage reactor fuel or structural components. Physical inspection would allow a determination if damage occurred and necessary corrective actions. Please propose TS changes to require reactor structural and component inspection on experiment failure or justify why it is not needed.

    An additional specification will be added, stating that in the event of an experimental failure that releases materials that could damage the reactor, physical inspections will be required. The basis for this specification will be 'Inspection of reactor structures and components will be performed in order to verify that the experimental failure did not cause damage. If damage is found, appropriate corrective actions will be taken.'

18. TS 3.7.4: This specification states in part that explosive materials in quantities less than 25 mg TNT may be irradiated provided the pressure produced upon detonation of the explosive has been calculated and/or experimentally demonstrated to be less than the design pressure of the containment. Section 10.3 of the UMTR SAR states that calculations must show that the pressure produced if detonation occurs is less than the failure pressure of the container. Since the container design pressure should have a safety factor of two (Regulatory Guide 2.2), the failure pressure should be half the design pressure. Therefore, TS 3.7.4 should be modified accordingly. Moreover, there are no example calculations in the SAR comparing the detonation pressure to the failure pressure. Please provide an example calculation for a container that demonstrates compliance with the factor of 2 margin or justify not including a calculation in the SAR.

    This specification is now TS 3.7.5 (in the revised version). The statement 'The failure pressure of the container is one half of the design pressure.' will be added after '....less than the design pressure of the container'

    A discussion and analysis (attached) will be added in the MUTR SAR. This is taken from the Oregon State University reactor SAR.

19. TS 3.7.5: The occupational dose is addressed. However, the dose to the public is not addressed. Please explain.

    This specification is now TS 3.7.6. The phrase '...., the airborne concentration… 10 CFR Part 20.' will be deleted and replaced by '…the quantity and type of material in the experiment shall be limited such that the airborne radioactivity in the reactor room or outside environment will not result in exceeding the applicable dose limits in 10 CFR 20.'

20. TS 4.0: General surveillance requirements for actions after system or component modifications, replacement or maintenance are not clearly defined. Please propose TS changes addressing the requirements for system testing after modifications, replacement or maintenance or justify why it is not needed.

    The statement 'Any system or component that is modified, replaced, or had maintenance performed will undergo testing to ensure that the system/component continues to meet performance requirements' will be added to TS 4.0

21. TS 4.1: ANSI/ANS-15.1-2007, Section 4.1 provides guidance for surveillance requirements for core configuration changes. Please propose TS changes to include a surveillance requirement addressing TS 3.1.3 and TS 3.1.5, which contain LCOs related to core and fuel configuration or justify why there is no need for such TS requirements.

Licensed core configuration is verified prior to the first startup of the day. This will be added as a surveillance requirement in TS 4.1. Also, annual burnup reports will be used as the surveillance requirement for TS 3.1.6 (requirement for <50% burnup).

22. TS 4.2: There does not appear to be a LCO for TSs 4.2.7 and 4.2.8 requiring 3 operable control rods. Please add an LCO or explain why it is not needed.

TS 3.1.3.d will be added: 'The reactor shall only be operated with three operable control rods.'

23. TS 4.2.4. The TS refers to the calibration of scram channels. There appears to be no calibration required for the instrumented fuel element which measures fuel temperatures. Please add a surveillance requirement or explain why it is not needed.

A surveillance requirement for the IFE will be added to TS 4.2.4. Calibration will be done using coolant temperature as the reference value (once the system has reached equilibrium with the reactor shut down).

24. TS 4.3: The numbering of water (coolant) specifications and bases should be made consistent. For example there is no specification 4.3.3. It appears that specification 4.3.3 has been numbered 4.3.4. Please verify. See also related comments in TS 3.3

The numbering of specifications and bases in TS 4.3 will be made consistent.

25. TS 4.3.1: Pool gross gamma activity is measured. However, there is no LCO as to what is acceptable. Explain why an LCO is not needed or establish one. Provide a justification for the frequency of measuring the gross gamma activity. Discuss the need for a more detailed measurement of pool water activity by isotope.

As noted in the response to RAI 6, a gross gamma LCO will be added to TS 3.3. The frequency of measurement (monthly, not to exceed six weeks) is historical.

The routine gross gamma count is sufficient for indication of high activity in the pool water, and a more detailed routine measurement by isotope is not necessary.

If the gross gamma count is high (more than twice historical data measurements), gamma spectroscopy would be performed on the water sample in order to determine specific isotopes. This requirement will be added to TS 4.3.

26. TS 4.4: It is not clear what "isolation" means. Please define. Does it mean closing of doors, louvers to the outside, etc? What is the operating status of fans, isolation valves, and other components?

Isolation refers to confinement, which is defined in TS 3.4 and refers to closing of two doors – the upstairs door to the west balcony area, and the downstairs door to the reception area.

A definition of isolation will be added to TS 1.0.

During operation, the exhaust fans can be operating and, if operating, the louvers would be open. In the event that high radiation levels are detected by the radiation monitoring system, electric power to the fans is terminated, the fans shut down, and the louvers close (SAR 6.0).

27. TS 4.5: If the ventilation system is required to establish confinement including its operability as per TS 3.4 and TS 3.5, then verification of its operation is also required. Please propose a TS change to address the surveillance and operability requirements of the ventilation system or justify why it is not needed.

Operability of the ventilation system is verified prior to the first startup of the day. The ventilation system automatically secures if radiation levels exceed a preset level. System shutdown is verified prior to the first startup of the day. These will be added to TS 4.5 as surveillance requirements.

28, TS 4.6.1 states "The objective of these specifications is to ensure operability of each radiation area monitoring channel as required by section 3.4..." The radiation monitoring system is addressed in Section 3.6. Please explain this discrepancy. The specification discusses Table 3.2. Should this be Table 3.5? The reactor scrams and the ventilation system secures with high radiation. Please explain where the surveillance requirement is for this action.

'3.4' will be changed to '3.6', which is correct. 'Table 3.2' will be changed to 'Table 3.5', which is correct. As noted in the response to RAI 27, securing of the ventilation system and reactor scram due to high radiation is verified prior to the first startup of the day.

29. TS 4.6.2: This appears to be part of verification of TS 3.6.5. Please explain. It is expected that LCO and surveillance requirement sections will correspond in the TSs Please address this discrepancy.

TS 3.6 will be changed to read 'Radiation Monitoring Systems and Effluents.
The current TS 3.6 will be renumbered as TS 3.6.1 Radiation Monitoring Systems
TS 3.6.2, Effluents will be added.

> Applicability: This specification applies to limits on effluent release
>
> Objective: The objective is to ensure that release of radioactive materials from the reactor facility to unrestricted areas do not exceed federal regulations.
>
> Specification: All effluents from the MUTR shall conform to the standards set forth in 10 CFR Part 20
>
> Basis: The intent of TS 3.6.2 is to ensure that the, in the event that radioactive

effluents are released, the dose to the general public will be less than that allowed by 10 CFR Part 20.

With this renumbering, the surveillance requirements specified in TS 4.6.2 correspond to TS 3.6.2.

30. TS 4.7: Surveillance requirements appear to be missing for TS 3.7.1, 3.7.2, 3.7.3, 3.7.4, 3.7.5 and 3.7.6. Should TS 6.5.4 be moved into TS 4.7? Please explain and address.

Surveillance requirements for TS 3.7.1 – 3.7.6 will be added.

TS 6.5.4 refers to the review and approval of experiments, so it should remain as is.

31. TS 5.0: ANSI/ANS-15.1-2007 Section 5.0 provides guidance for design features including the reactor core. Please propose TS changes to include specifications for the reactor core and control rods or justify why they are not needed.

Additional data, such as fuel element dimensions, will be added to TS 5.0.

32. TS 5.4.1: Requirements for fissionable material need to consider all conditions of reflection. Are these addressed under moderation? Please explain.

When not in the reactor core, the only storage of fuel is in the thirteen storage racks located on the reactor tank. The racks are 13 feet below the surface of the pool Each of the racks could potentially contain a single fuel assembly..

As stated in Section 9.2.1 of the SAR, a TWOTRAN calculation was performed assuming that all of the racks contained a fuel assembly. The calculation showed that the multiplication factor for this configuration was less than 0.4.

33. Section 6.0 contains "will" and "must" statements. This is also true for other Sections of the TSs. Replace by "shall" statements as appropriate.

'Will' and 'Must' will be replaced by 'Shall' where appropriate

34. TS 6.1.3.1 contains minimum staffing requirements when the reactor is not in a secured condition. TS 6.1.3.1.b contains requirements when the reactor is operating. These two conditions are different. Please explain.

Wording in TS 6.1.3.1 will be changed to 'when the reactor is operating'. This change will make TS 6.1.3.1 consistent with TS 6.1.3.1a and TS 6.1.3.1b.

35. TS 6.1.4 addresses the selection and training of personnel. It states in part that this selection shall be in conjunction with the guidelines in set forth in ANSI/ANS-15.1 and 15.4. Considering that these are guidance documents, a "should" statement would also be acceptable.

'Shall' will be replaced with 'should' in TS 6.1.4.

36. TS 6.2.2: ANSI/ANS-15.1-2007, Section 6.2.2 contains requirements for the charter (or directive) and rules of the review and audit committee. Please compare TS 6.2.2 against ANSI/ANS-15.7-2007, Section 6.2.2 and make appropriate changes to the TS or explain why changes are not needed. TS 6.2.2.2 states that a quorum has at least three members. ANSI/ANS-15.1-2007 states that the quorum is not less than half of the voting membership. TS 6.2.1 requires the committee to have a minimum of five persons. If the university chooses to have more than five persons on the committee, TS 6.2.2.2 may not meet the ANSI/ANS-15.1-2007 recommendation of at least half the voting membership be a quorum. Please address.

    TS 6.2.2.2.2 will be changed to 'A quorum of the RSC will be not less than half of the committee members, one of whom must be the Campus Radiation Safety Officer (or designated alternate)…'

37. TS 6.2.3.1 requires the RSA to determine that changes do not involve an "unreviewed safety question." With revisions to 10 CFR 50.59, the term "unreviewed safety question" is not longer used. Please propose TS changes to conform to 10 CFR 50.59 or justify why it is not needed.

    TS 6.2.3.1 will be revised to remove the term 'unreviewed safety question'

38. TS 6.2.3: ANSI/ANS-15.1-2007, Sections 6.2.3 and 6.2.4 provide guidance for review and audit functions including dissemination of reports, findings, and recommendations. Please propose TS changes to address the distribution of review and audit reports, findings, and recommendations or justify why these are not needed.

    The wording of TS 6.2.3 and 6.2.4 will be changed to conform to the wording and reporting requirements as specified in the ANSI standard.

39. TS 6.2.3.4 and TS 6.2.3.5 refer to "charter". The appropriate term for MUTR is "license", which is already included in the statements. The term "charter" should be eliminated or a justification for it remaining should be provided.
    The word 'charter' will be deleted in TS 6.2.3.4 and 6.2.3.5.

40. TS 6.4: This section should state that changes to procedures shall be made in accordance with Title 10 of the Code of Federal Regulations (10 CFR) Section 50.59, or justify why this is not required.

    Wording in TS 6.4 will be changed to: 'Substantive changes to…Reactor Safety Committee and will be made in accordance with 10CFR50.59.'

41. TS 6.4.2: ANSI/ANS-15.1-2007, Section 6.4.2 provides guidance on required written procedures including procedures for fuel handling operations such as fuel movement

within the reactor. Please propose TS changes to address the need for a written procedure for fuel movements within the reactor or justify why it is not needed.

MUTR is licensed to operate with only one core configuration, which precludes fuel movements within the reactor. Therefore, there is no need for a procedure for in-reactor fuel movement.

42. TS 6.4.2: Remove the statement "experiment approval" or justify its meaning and inclusion in the TS.

'Experiment approval' will be deleted from TS 6.4.2.

43. TS 6.4.4: ANSI/ANS-15.1-2007 Section 6.4.4 provides guidance to develop written procedures for surveillance checks, inspections, and calibrations as specified by the TS. MUTR TS 6.4.4 specifies surveillance of reactor instrumentation and safety systems and area monitors, but may not address all TS surveillance requirements. Please propose TS changes to address procedure for all TS surveillance requirements or justify why these are not needed.

TS 6.4.4 will be changed to 'Periodic surveillance checks, calibrations, and inspections required by these Technical Specifications or those that may have an effect on reactor safety.' to reflect the wording in the ANSI standard.

44. TS 6.4.6: ANSI/ANS-15.1-2007, Section 6.4 (6) provides guidance to develop written procedures for administrative controls for operations, maintenance, and experiments that could affect reactor safety. Please propose TS changes addressing the procedures for administrative controls related to these items or justify why these are not needed.

TS 6.4 will be rewritten to conform exactly to ANSI 6.4

45. ANSI/ANS-15.1-2007, Section 6.4(8) is missing from the TSs. Is byproduct material used under the reactor license? If so, please add a requirement for procedures or justify why procedures are not needed.

Byproduct material is used under the reactor license. TS 6.4 will be modified to include the requirement for procedures for the use of byproduct material.

46. TS 6.5: Routine experiment, modified routine experiment and special experiment are not defined. Please define. TS 6.5 should follow the recommendations of ANSI/ANS-15.1-2007, Section 6.5. Please address or explain why changes to TS 6.5 are not needed.

Routine, modified routine and special experiments are defined in Section 1.5. Routine experiments are experiments that have been performed previously. TS 6.5 as written allows these experiments to be performed with the approval of the duty senior reactor operator (ANSI Level 3). This is in accordance with ANSI 6.5.2.

Modified routine experiments are experiments which have only minor changes from routine experiments. TS 6.5 as written requires that modified routine experiments be reviewed and approved in writing by the facility director or designated alternate (ANSI Level 2). Requiring Level 2 approval for modified routine experiments exceeds the requirements of ANSI 6.5.2, which states that minor changes to experiments can be approved by Level 3.

Special experiments are new experiments or previously approved experiments that have substantive changes (i.e. not modified routine experiments). TS 6.5 as written requires that special experiments be reviewed by the Reactor Safety Committee and approved in writing by the facility director or designated alternate (Level 2). This is in accordance with ANSI 6.5.2.

47. TS 6.6.1: This section should follow ANSI/ANS-15.1-2007, Section 6.6.1, or a justification for not following it should be provided.

    TS 6.6.1 as written contains the actions in the ANSI standard, although the wording is different. We'll re-write the section to exactly conform with the standard.

48. TS 6.6.2: ANSI/ANS-15.1-2007, Section 6.6.2 provides guidance on special event reporting and conditions for resuming operation of the facility including authorization by reactor management. MUTR TS 6.6.2 assigns the authorization function to the Reactor Safety Committee and not to the reactor management. Please discuss the role of reactor management in the authorization to resume operation of the facility after the occurrence of special events.

    TS 6.6.2 will be changed such that the Reactor Director, not the RSC, authorizes operations to resume. The report will be reviewed by the RSC at its next meeting.

49. TS 6.7.1: Sending the annual reports only to Document Control Desk is acceptable.

    The second sentence in TS 6.7.1 will be changed to read 'This report shall be submitted by September 30 of each year to the NRC Document Control Desk.

50. TS 6.7.1.2: ANSI/ANS-15.1-2007, Section 6.7.1.1 provides guidance on the content of the operating report to include operating experience. Please propose changes in TS 6.7.1.2 to include a summary of operating experience or justify why this is not needed.

    TS 6.7.1.1 will be changed to 'A brief narrative summary of reactor operations and results of surveillance tests and inspections…'. TS 6.7.1.2 fulfills the energy production reporting requirement.

51. TS 6.7.3: ANSI/ANS-15.1-2007, Section 6.7.2.2 provides guidance on providing special reports to the licensing authority due to significant changes at the facility or the facility analyses. The written report required to be submitted to the NRC per MUTR TS 6.7.3

should be addressed to the NRC Document Control Desk. Please amend your TS or justify why it is not required.

TS 6.7.3 will be changed to 'A written report shall be forwarded within 30 days to the NRC Document Control Desk, with a copy…..'.

52. Regulation 10 CFR 55.59(c)(5)(i) requires that the facility licensee shall retain operator requalification documentation records until the operator's license is renewed. In addition, Section 6.8.2 of ANSI/ANS 15.1-2007 contains the recommendation that training records for reactor operators be maintained at all times the individual is employed or until the certification is renewed. MUTR TS 6.8.2 specifies that operator requalification records are maintained for a training cycle, which usually does not coincide with the operator license renewal cycle. Please discuss whether TS 6.8.2 meets the criteria in 10 CFR 55.59(c)(5)(i) and ANSI/ANS-15.1-2007,Section 6.8.2. Please amend your TS as needed or justify why it is not required.

TS 6.8.2 will be changed to 'Retraining and requalification records of current licensed operators shall be maintained at all times that an operator is employed or until the operator's licensed is renewed.'

MUTR SAR REVISION

Discussion and Analysis for Experiments Utilizing Explosive Materials

Projected damage to the reactor from experiments involving explosive materials depends on the quantity of explosives being irradiated and the location of the explosives relative to reactor components and safety systems. If the material is in the reactor tank, the MUTR Technical Specifications limit the amount of explosive material to less than 25 mg of TNT equivalent. The Technical Specifications also states that the pressure produced on detonation must be less than one half of the design pressure of the container in which the material is placed. The following discussion and analysis shows that the irradiation of explosives up to 25 mg could be safely performed if the container is properly chosen.

A 25 mg quantity of explosives releases approximately 25 calories (104.6 joules) of energy upon detonation, with the creation of 25 cm^3 of gas. The density of the explosive TNT is 1.654 gm/cm^3, so a 25 mg quantity has a volume of 0.015 cm^3. If the assumption is made that the energy release on detonation occurs as an instantaneous change in pressure, then the total forc on the encapsulation material is the sum of two pressures. For a 1 cm^3 volume, the energy release of 104.2 joules represents a pressure of 1032 atmospheres. The instantaneous change in pressure due to gas production in the same volume adds another 25 atmospheres. Therefore, the total pressure with the 1 cm^3 capsule is 1057 atmospheres for the complete reaction of 25 mg of explosive material.

Typical materials used for capsules are stainless steel, aluminum, and polyethelene. The mechanical properties for these materials are listed in the table below.

Material	**Yield Strength ($\times 10^3$ psi)**	**Ultimate Strength ($\times 10^3$ psi)**	**Density (gm/cm^3)**
Stainless Steel (Type 304)	35	85	7.98
Aluminum (Alloy 6061)	40	45	2.739
Polyethylene	1.7	1.4	0.923

Analysis of the capsule materials determines the material stress limits that must exist to confine the reactive equivalent of 25 mg of explosives. The stress limit in a cylindrical container with thin walls is one-half the pressure times the ratio of the capsule diameter-to-wall thickness. This is the hoop stress. Hoop stress is two times the longitudinal stress and, therefore, hoop stress is limiting. Thus:

$$\sigma_{max} = \frac{p\,d}{2\,t}$$

where:

σ_{max} = maximum hoop stress in container wall
p = total pressure within container
d = diameter of the container
t = container wall thickness

When evaluating an encapsulation material's ability to confine the reactive equivalent of 25 mg of explosives, the maximum stress in the container wall is required to be less than or equal to the yield strength of the material. With a safety factor of two, the design stress is ½ of the yield stress. Therefore:

$$\frac{p\,d}{2\,t} \leq \sigma_{design}$$

where σ_{design} is the design (maximum) stress, and $\sigma_{design} = \sigma_y/2$. Solving this equation for d/t provides a simple method of evaluating an encapsulation material:

$$\frac{d}{t} \leq \frac{2\,\sigma_{design}}{p}$$

Assuming an internal pressure of 1057 atmospheres (15538 psi), maximum values of d/t for the three materials are shown in the table below.

Material	**d/t**
Stainless Steel (Type 304)	2.25
Aluminum (Alloy 6061)	2.57
Polyethelene	0.11

As a result of this analysis, a limit of 15 mg of TNT-equivalent explosive material is considered to be a safe limitation for irradiation in the reactor, provided that proper container material (e.g. stainless steel, aluminum) with appropriate diameter and wall thickness is used.