June 25, 2012

Dr. Steven Biegalski, Director
Nuclear Engineering Teaching Laboratory
The University of Texas at Austin
10100 Burnet Rd, Bldg 159
Austin, Texas 78758

SUBJECT: UNIVERSITY OF TEXAS AT AUSTIN - REQUEST FOR ADDITIONAL INFORMATION REGARDING THE LICENSE RENEWAL REQUEST FOR THE NUCLEAR ENGINEERING TEACHING LABORATORY TRIGA MARK II NUCLEAR RESEARCH REACTOR (TAC NO. ME7694)

Dear Dr. Biegalski:

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for renewal of Facility Operating License No. R-129, for the University of Texas at Austin, dated December 12, 2011, as supplemented on January 17, 2012 (two letters) and February 21, 2012 (available on the NRC's public website, www.nrc.gov, in the Agencywide Documents Access and Management System [ADAMS], Accession Nos. ML12156A097, ML12156A196, ML12030A102, and ML12061A009).

During our review of your license renewal request, questions have arisen for which we require additional information and clarification. Please provide responses to the enclosed request for additional information within 90 days of the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* Section 50.30(b), your response must be executed in a signed original document under oath or affirmation. Your response must be submitted in accordance with 10 CFR 50.4, "Written Communications." Information included in your response that is considered security, sensitive, or proprietary, that you seek to have withheld from the public, must be marked in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding."

Enclosure

If you have any questions regarding this review, please contact me at (301) 415-3841 or by electronic mail at Jason.Lising@nrc.gov.

Sincerely,

/RA/

A. Jason Lising, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-602

cc w/encl: See next page

cc:

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If you have any questions regarding this review, please contact me at (301) 415-3841 or by electronic mail at Jason.Lising@nrc.gov.

Sincerely,

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A. Jason Lising, Project Manager
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OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

REGARDING LICENSE RENEWAL REQUEST FOR

THE UNIVERSITY OF TEXAS AT AUSTIN

TRIGA MARK II NUCLEAR REACTOR

LICENSE NO. R-129; DOCKET NO. 50-602

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for renewal of Facility Operating License No. R-129, for the Nuclear Engineering Teaching Laboratory (NETL) TRIGA Mark II Nuclear Research Reactor (the facility) owned by the University of Texas at Austin (UT, the licensee), dated December 12, 2011, as supplemented on January 17, 2012 (two letters) and February 21, 2012 (available on the NRC's public website, www.nrc.gov, in the Agencywide Documents Access and Management System [ADAMS], Accession Nos. ML12156A097, ML12156A196, ML12030A102, and ML12061A009).

During this review of your license renewal request for the NETL TRIGA Mark II Nuclear Research Reactor (herein referred to as UT TRIGA), questions have arisen for which we require additional information and clarification.

Technical

1. The guidance in NUREG-1537 Section 1.8, "Facility Modifications and History," requests that the licensee provide descriptions of any changes to the facility that have been made, including changes made under Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.59. The UT safety analysis report (UT SAR) Section 1.6 provides brief information concerning two changes without indicating how they were accomplished. Please provide a list of all changes to the facility accomplished under 10 CFR Section 50.59 since the issuance of your current license.

2. The guidance in NUREG-1537 Section 4.2.1, "Reactor Fuel," requests that the licensee provide a description of the fuel elements in use at the facility. NUREG-1282, "Safety Evaluation Report on High-Uranium content, Low-Enriched Uranium-Zirconium Hydride Fuels for TRIGA Reactors," August 1987 (ADAMS Accession No. ML050480199) provides a basis for the approved use of certain TRIGA fuel types.

    2.1 UT SAR Section 4.2.1 discusses TRIGA fuel in general terms and refers to high enrichment fuel, fuel structures, and fuel stoichiometries but does not clearly state what fuel is to be used in UT TRIGA. Please identify the fuel that will be used under the renewed license. Clarify what fuel element types are allowed in the design features of the technical specifications (TS), and identify the geometries that are applicable.

Enclosure

2.2 UT SAR Section 4.2.1 provides Figure 4.1 which relates TRIGA fuel phases to fuel temperature. A previously NRC-accepted diagram is from the Simnad Report (E-117-833, May, 20, 1986) which is the underlying basis for the TRIGA fuel SER (NUREG-1282). The Simnad diagram is significantly different from the one presented in the UT SAR. Please confirm that the UT SAR statements and conclusions are either based upon NUREG-1282 or provide a basis, methodology, and analysis for any differences.

2.3 UT SAR Section 4.2.1 provides a statement on page 4-7 regarding the explosive potential of hydrogen resulting from reactions of zirconium with water. Please provide a discussion that confirms this potential does not exist for the UT TRIGA reactor under normal operations or accident conditions.

2.4 UT SAR Section 4.2.1 provides Figures 4.2A and 4.2B. The source of this information is not referenced nor is their applicability to the particular operating conditions and fuel depletion of UT TRIGA demonstrated. Please demonstrate the applicability of these figures to the UT TRIGA.

3. The guidance in NUREG-1537 Section 4.2.2, “Control rods,” requests that the licensee provide a description of the control rods in use at the facility.

3.1 UT SAR Section 4.2.2 provides these descriptions; however, the absorber material is described as boron carbide. Typically in TRIGA control rods this material is boron carbide powder having a significantly different effective density that is based upon the particle size and packing fraction. Please confirm the type of absorber material used in the UT TRIGA control rods.

3.2 UT SAR Section 4.2.2 states that the control rod geometries and constituents are provided for both stainless steel and aluminum cladding. The design features in the UT SAR TS, Section 5, “Design Features,” do not clearly indicate the types of control rods allowed for use in UT TRIGA. Please clarify what control rod types are allowed in the design features section of the technical specifications, and identify the geometries applicable to each of the four control rods in UT TRIGA.

4. The guidance in NUREG-1537 Section 4.2.5, “Core Support Structure,” requests that the licensee provide design information pertaining to the core support structure. UT SAR Section 4.2.5 provides some information, but does not address suitability for continued use. Please confirm whether there is any visual evidence of cracking, corrosion, or deformation of the core support structure, and state whether the structure is appropriate for continued use for the operating period being requested.

5. The guidance in NUREG-1537 Section 4.3, “Reactor Tank or Pool,” requests that the licensee provide a description of the reactor tank and associated components including how those components will perform their intended functions to prevent possible leakage associated with chemical interactions, penetration, and weld failures. The UT SAR does not provide sufficient information. Please confirm whether there is any visual evidence of cracking, corrosion, or deformation of the reactor pool liner, connected pipes or beam ports and provide a discussion of preventative measures employed to monitor and maintain the integrity of the connected primary coolant system over the life of the facility.

6. The guidance in NUREG-1537 Section 4.4, “Biological Shield,” requests that the licensee provide a description of the biological shield and how it assures acceptable control of personnel exposure. UT SAR Section 4.4 includes a statement, “One goal of

the design is a radiological exposure constraint of 1mrem/hour for accessible areas of the pool and shield system." Please describe methods used to demonstrate acceptable radiological exposure.

7. The guidance in NUREG-1537 Section 4.5, "Nuclear Design," requests that the licensee provide a detailed description of analytical methods used in the nuclear design, including computer codes used to characterize technical parameters pertaining to the reactor. UT SAR Section 4.5 states that the "characteristics and operating parameters of this reactor have been calculated and extrapolated using experience and data obtained from existing TRIGA reactors as bench marks in evaluating the calculated data." Please provide comprehensive analysis of UT TRIGA behavior. Please describe the methods used for steady state neutronic (steady-state and kinetics) and thermal-hydraulic analysis and include comparisons with UT TRIGA measurements that demonstrate that those methods are appropriate to analyze the limits imposed by the UT TRIGA TS.

8. The guidance in NUREG-1537 Section 4.5.1, "Normal Operating Conditions," requests that the licensee define the limiting core configuration (LCC) which defines the highest power densities and temperatures achievable.

   8.1 UT SAR Section 4.5.1 discusses an "operational core of 85 fuel elements, 3 fuel followed control rods, and one air followed control rod is to be arranged in 5 rings." The NRC staff notes that elsewhere in the UT SAR, references are made to core configurations of 90 (page 4-36), 116 (page 4-55), 109 and 114 (page 4-57), 81 (page 13-7), 83 (page 13-2), 85 (pages 13-26 and 13-29), and 100 (page 13-33) fuel elements. For the UT TRIGA licensed power of 1,100 kW, please identify the LCC. Please provide schematic drawings showing the location of fuel elements, control rods, and other components installed in the lettered-and-numbered lattice positions. For fuel elements provide a cross reference to fuel element serial numbers and their accumulated burnup. Please provide all technical parameters and conclusions supplied for normal operation, accident analysis, and dose estimates using the LCC.

   8.2 Please provide analyses that quantify the effects of fuel burnup, plutonium buildup, and the effect of fission products on the UT TRIGA LCC.

   8.3 Please provide the technical parameters including analysis of "reactor kinetic behavior, basis reactor criticality, control rod worth, definition of the limiting core configuration (LCC), [etc.]" (NUREG-1537, Section 4.5.1). State whether the comparison of calculated and measured values demonstrates acceptable model development.

9. The guidance in NUREG-1537 Section 4.5.2, "Reactor Core Physics Parameters," requests that the licensee define the reactor core physics parameters. UT SAR Section 4.5.2, Table 4.14 includes numbered footnotes, but those numbers do not correspond to the footnotes provided. UT SAR Section 4.5.3 refers to calculations made by General Atomics (GA) and the calculations are said to be applicable to UT TRIGA core parameters because of their similarity. The GA-4361 unit cell parameters are displayed and compared with UT TRIGA core parameters. Please provide the technical parameters that are applicable to UT TRIGA.

10. UT SAR Table 4.21, "Limiting Core reactivity," displays Reference and Current control rod worths. In Table 4.14, please explain the origin of the values listed under the

"Reference" column. Given the difference between the "Reference" and "Current" values of excess reactivity and shutdown margin, which values are being used in the UT TRIGA TS.

11. The guidance in NUREG-1537 Section 4.5.3, "Operating Limits," requests that the licensee define the operating limits for its facility. However, the UT SAR does not provide sufficient information in this regard. Therefore:

    11.1 Please describe any limits or conditions on the evaluation of excess reactivity contributors, such as those due to temperature variations and poisons (e.g., xenon and samarium). Please provide calculations of full power reactivity defects for power, xenon, and samarium.

    11.2 Please provide calculations for excess reactivity and control rod worths, and evaluate whether they are in agreement with the analytical model and with UT TRIGA performance. Provide a discussion that describes the evaluation of these calculations to demonstrate acceptable reactor shutdown and shutdown margin. Include consideration of experiment reactivity.

    11.3 Please provide "a transient analysis assuming that an instrumentation malfunction drives the most reactive control rod out in a continuous ramp mode," (NUREG-1537, Section 4.5.3) of the reactor using a rate of withdrawal consistent with proposed UT TRIGA TS values of the maximum control rod withdrawal speed, reactivity rate, and the control rod scram time including uncertainties.

    11.4 Please provide all other applicable technical parameters, "excess reactivity, control rod worth, temperature coefficients, [etc.]" (NUREG-1537, Section 4.5.3).

12. UT SAR Section 4.5.4, Subsection B provides Figure 4.22 for the power within a fuel element. The NRC staff notes that the power distribution in the figure continues to the center of the fuel element indicating that this curve is not applicable to stainless steel-clad fuel that has a zirc rod in the center. Please confirm and revise accordingly.

13. UT SAR Section 4.5.4, Subsection C describes the use of the Bernath correlation which is typical for TRIGA analysis, but later UT SAR Section 4.6 states that the Biasi correlation is actually used for the evaluation of the DNBR. Please confirm that the Bernath correlation is used to characterize DNBR for UT TRIGA, or demonstrate the applicability of Biasi correlation to UT TRIGA analysis.

14. The guidance in NUREG-1537 Section 4.5.2, "Reactor Core Physics Parameters," states that the supplied analysis should show that reactivity coefficients are sufficiently negative to prevent or mitigate any reactor transients. UT SAR Section 4.6 states, "Limits on reactivity are based not on the peak pulse power level, but on the final equilibrium power level associated with the reactivity." It also provides a series of statements on page 4-46 regarding pulse reactivity acceptability.

    14.1 The analysis provided in UT SAR, Section 4.6 is based upon Figure 4.21 which is said on page 4-34 (UT SAR) to display the fuel element reactivity coefficient. This figure does not display the fuel element reactivity coefficient. A version of this coefficient, believed to be from GA-7882, is displayed in Figure 4.2B. However, the applicability of this figure to UT TRIGA has not been established (e.g., there is no consideration of power level, burnup, etc.). Please provide clarification as to the relationship of the reactivity coefficient with the analysis provided in UT SAR Section 4.6.

14.2 The basis for TS 3.2 “Pulsed Mode Operation,” states that the reactivity limits are established so as to meet fuel temperature limits. However, this is inconsistent with the statements in UT SAR Section 4.6 as described above. Please revise the discussion in UT SAR Section 4.6 to support the UT TRIGA TS.

14.3 UT SAR, Section 4.6 (p. 4-46) provides a series of statements regarding pulse reactivities and responses that are not supported by analyses. Please provide analysis supporting these statements in sufficient detail so that a confirmatory analysis can be performed.

15. The guidance in NUREG-1537 Section 4.6, “Thermal-Hydraulic Design,” requests that the licensee provide information and analyses of thermal-hydraulic conditions in its reactor demonstrating that sufficient heat removal capacity exists for steady-state or pulsing operation at the maximum licensed power level. The fuel element and coolant conditions should be conservatively calculated, the DNBR correlation should be properly defined, and the resulting steady state DNBR at licensed power should be greater than 2.0.

15.1 UT SAR Section 4.5.4 states that the TRACE analysis of the UT TRIGA DNBR used the Bernath correlation and determined that the DNBR is 5.9 for a 45 kW fuel element occurring at an elevation of 87 percent of the active fuel element height. However, typical analysis of TRIGA DNBR indicate that the power corresponding to DNBR of 1 is approximately 50 kW. Please review and revise these calculations, or provide the detailed results that confirm the calculated DNBR of UT TRIGA. Please describe the analytical methods used to determine the DNBR, including the core inlet and exit conditions assumed and other assumptions and correlations employed. This analysis should describe the parameters determined from the LCC such as peaking factors and limiting coolant inlet temperature and that the inlet temperature used for DNBR is a limiting value by showing how it corresponds to the primary pool water temperature measuring channel value.

15.2 NUREG-1537, Section 4.6 describes that the licensee provide detailed “analyses for a pulsing reactor containing descriptions of the core configurations; the bases of the feedback coefficients; the calculational model and assumptions; the thermal-hydraulic evolution during a pulse; core, transient rod, and fuel characteristics that determine the shape and magnitude of a pulse; and the safety considerations that establish limits to pulse sizes." The UT SAR Appendix 4.1 provides a discussion of phenomenology; however, it does not demonstrate the acceptability of pulsing in UT TRIGA using parameters of importance that are demonstrated to be fully applicable to UT TRIGA. Please provide a comprehensive description of the calculational methods and the results that demonstrate the acceptability of design assumptions and TS for pulsing at UT TRIGA (e.g., the LCC, the approved power level, the pulse of reactivity inserted by the transient rod as allowed by TS, the value of the fuel temperature coefficient, the effective delayed neutron fraction, the prompt neutron lifetime, etc.). The analysis should demonstrate reactor overall behavior (e.g., power vs. time and fuel element temperature vs. time, etc.) and compliance of the leading fuel element in the LCC to safety limits (SL) as stated in the TS.

16. The guidance in NUREG-1537 Section 5.2, "Primary Coolant System," requests that the licensee provide a description of the reactor primary coolant system, including information to substantiate the removal of heat from the fuel during maximum licensed power operation and decay heat when the reactor is shutdown. UT SAR Sections 5.1 and 5.2 identify the principal cooling system as the reactor pool, the pool cooling, and the pool cleanup subsystems.

    16.1 The pool dimensions of a “tall tank formed by the union of two half-cylinders with a radius of 6½ ft. (1.9812 m) with 6½ feet separating the half-cylinders,” appears to be inconsistent with the stated tank nominal water volume of 40.57 cubic meters. Please confirm and revise accordingly.

    16.2 The coolant flow rates cited in UT SAR Table 5-1 for the tubes and shell side of the primary coolant heat exchanger appear to be in error. Please confirm and revise accordingly.

17. The guidance in NUREG-1537 Section 5.2, "Primary Coolant System," requests that the licensee provide information regarding the coolant system control and safety instrumentation, including the location and functions of sensors and instruments; the SCRAM or interlock functions that prevent exceeding the safety limits should be shown and discussed. UT SAR Section 5.3.4 provides a summary of the control system, but does not include information on the pool low-level scram setpoint referred to in UT SAR, Section 13.6.2 and the UT TRIGA TS 3.4, Table 2. In addition, it does not describe actions that are needed, or should be taken, should pressure at the chilled water outlet rise above the pressure at the pool inlet to the heat exchanger. Please confirm and revise accordingly.

18. The guidance in NUREG-1537 Section 5.4, “Primary Coolant Cleanup System,” requests that the licensee include both the electrical conductivity and the pH of the primary coolant as part of the design basis and functional requirements in the UT SAR. The reactor pool water conductivity is measured per UT TRIGA TS 4.8.2. However, the UT TRIGA TS do not require pH testing. Please provide a pH testing TS or provide a justification for not doing so.

19. The guidance in NUREG-1537 Section 9.1, “Heating, Ventilation and Air Conditioning System,” requests that the licensee provide a description on how air exhaust systems or stacks are designed to reduce the radiological impact on the unrestricted environment. UT SAR Section 9.2.3 provides details on the operational analysis and safety function of reactor bay HVAC system.

    19.1 The licensee cites a correlation that determines effective release height above the building exhaust stack due to effluent momentum from the purged air system or the ventilation system. Please confirm that the correct form of the correlation is $\Delta H = D\ (V_s/\mu)^{1.4}$ and not as it is stated in the UT SAR.

    19.2 The licensee uses two different stack exit diameter values for the stack ($0.4012\ m^2$ on UT SAR, p. 9-6 and 45.72 cm on UT SAR p. 9-2). Please explain this discrepancy.

    19.3 Ensure the impact of the above changes on offsite doses for both normal operation and accident conditions are considered and revised accordingly.

20. The guidance in NUREG-1537 Section 9.2, “Handling and Storage of Reactor Fuel,”

requests that the licensee provide assurance that subcriticality is maintained under all conditions of fuel handling and storage.

20.1 During a site visit, the NRC staff noted that fuel elements are stored in what appears to be a non-standard rack for which no analysis is provided in the UT SAR. Please identify all locations covered by the license where fuel elements are stored, identify the types and numbers of fuel elements that are stored, provide details concerning the storage rack or bin geometry, and analysis that demonstrates that such racks or bins provide adequate conditions for storage.

20.2 Describe any measuring systems used to confirm that acceptable reactivity levels are maintained in storage locations, how those systems are controlled by procedures or UT TRIGA TS, and how they are calibrated.

20.3 UT SAR Section 9.4.5 states that fuel elements are required to be stored in a configuration with k_{eff} less than 0.8. This is inconsistent with the statement in UT SAR Section 5.2.3 of the proposed UT TRIGA TS, which states, “The k_{eff} of all fuel elements or fueled devices in storage is less than 0.9.” Please explain this discrepancy.

21. The guidance in NUREG-1537 Section 9.2, “Handling and Storage of Reactor Fuel,” requests that the licensee provide a discussion of the handling and storage of new, spent, and failed fuel elements.

21.1 UT SAR Section 9.4.3 states that a top loading fuel transfer cask is used and that there is “no potential for failure or mishandling as exists in a bottom loading cask.” Please describe how the use of such a cask eliminates the potential for such accidents.

21.2 UT SAR Section 9.4.2 states, “A 5-tonne crane is used in conjunction with fuel handling tool and the transfer cask to allow remote handling of irradiated fuel.” Please describe the physical or administrative precautions employed to minimize the potential for fuel or core damage due to malfunction, such as loss of electrical power, or dropped loads.

22. The guidance in NUREG-1537 Section 11.1.1, "Radiation Sources," requests that the licensee include airborne dose information for characterization of ^{41}Ar, including providing best estimates of the maximum annual dose and the collective dose for the major radiological activities for the full range of normal operations for facility staff and members of the public.

22.1 In the process of confirming the dose calculations in UT SAR Section 11.1.1.1.1 the NRC staff finds that the beam tube volume cited should be in units of cm^3. Please confirm.

22.2 UT SAR Section 11.1.1.1.1 describes the production of ^{41}Ar and provides very conservative estimates of the concentration, but does not provide values for the occupational dose. Please provide the ^{41}Ar occupational exposure including stay times and the effect of ventilation, and how these compare to the limits of 10 CFR Part 20 and the commitments of the UT TRIGA ALARA program.

22.3 UT SAR Section 11.1.1.1.1 does not describe the whole body dose to facility staff. Please provide a discussion of facility worker doses, and whether these doses are ALARA.

22.4 UT SAR Section 11.1.1.1.2 provides a conservative estimate of offsite ^{41}Ar air concentrations using an equation for ground level concentration at the building center. Please provide a reference for the equation cited, and a discussion of its suitability for providing dose calculations for members of the public and their location.

22.5 UT SAR Section 11.1.1.1.2 provides a discussion of use of the CAP88-PC computer program to estimate the dose to the maximally exposed individual. However, no information is provided regarding the location of this individual, whether the location represents the nearest residence, or whether the location is at a location of special interest. Please provide a complete description of the maximally exposed individual calculation, including how the estimates compare to the limits in 10 CFR Part 20 and the commitments of the UT TRIGA ALARA program.

22.6 UT SAR Section 11.1.1.1.2 provides conservative dose estimates for the maximally exposed individual of 66 mrem per year using the CAP88-PC computer code. UT TRIGA TS 3.5.3(D) indicates that releases of ^{41}Ar from the reactor bay to an unrestricted environment SHALL NOT exceed 100 Ci per year, and provides CAP88-PC model results indicating that 100 Ci per year release of ^{41}Ar would result in a maximally exposed individual dose of 0.142 mrem per year. Please resolve this discrepancy between the maximally exposed individual doses in the UT SAR and those provided in the TS.

22.7 UT SAR Section 11.1.1.1.2 provides a discussion of the maximally exposed offsite individual, but does not provide doses to members of the public. Please provide a discussion of potential public doses.

23. The guidance in NUREG-1537 Section 11.1.1.2, "Liquid Radioactive Sources," requests that the licensee describe liquid radioactive effluents. UT SAR Section 11.1.1.2 describes the major liquid radioactive source term as being the primary coolant, but does not describe if there are any liquid effluents, their point of discharge, and whether the effluents are within the limits of 10 CFR Part 20. Please describe the liquid effluents providing this detail.

24. The guidance in NUREG-1537 Section 11.1.5, "Radiation Exposure Control and Dosimetry," provides guidance on radiation exposure control and dosimetry, indicating that exposure limits should be administratively established for all accessible locations of the facility, including exposure limits to visitors. The UT SAR does not provide a description of exposure limits to visitors, or the dosimetry provided to determine compliance with those limits. Please provide a description of how UT meets NUREG-1537 Section 11.1.5.

25. The guidance in NUREG-1537 Section 11.1.5, "Radiation Exposure Control and Dosimetry," requests that the licensee consider of all groups (including embryos and fetuses, declared pregnant women, minors, and students) when establishing dose limits. The UT SAR does not mention these groups, or whether they were considered in establishing dose limits. Please confirm that these considerations are included in your radiation protection procedures or elsewhere.

26. NUREG-1537 Section 11.2.3, "Release of Radioactive Waste," provides guidance on the release of radioactive waste. UT SAR Section 11.2.2.3 provides an estimate of the

annual average generation of solid waste of 25 cubic feet, while Table 13.1 in UT SAR Section 11.1.1.3 states that annual solid waste volume is typically less than 2 cubic feet. Please discuss this discrepancy.

27. The guidance in NUREG-1537 Section 13.1.1, "Maximum Hypothetical Accident," requests that the licensee provide a maximum hypothetical accident (MHA) and demonstrate that it bounds all potential credible accidents at the facility. Under this guidance the MHA for TRIGA reactors is the failure of one fuel element in the air with the release of gaseous fission products. The purpose of this analysis is to ensure that this accident would not lead to unacceptable radiological consequences to the occupational and non-occupational workers and the environment.

27.1 UT SAR Section 13.3 analyzes a fuel element failure in the open air of the reactor bay. The analysis provides fission product inventory for a rod power of 3.5 kW which is not consistent with using a saturated inventory in the hottest rod for 1.1 MW operation. Please provide an analysis of the MHA for the UT TRIGA including doses to the workers and to the individuals in the non-restricted areas that bounds all other accident analyses. Please describe all assumptions, the operating conditions of the HVAC system, and the sequence of events used in calculating the potential radiological consequences and discuss how those consequences are less than the applicable limits in 10 CFR Part 20. Please provide sufficient detail to allow independent confirmation of these results.

27.2 UT SAR, Section 13.3 provides a discussion of the atmospheric dispersion employed and identifies the various parameters and assumptions used to determine the concentrations of nuclides at the nearest site boundary. For the case when the reactor bay ventilation is secured and the auxiliary purge system is used to discharge the reactor bay effluent, the UT SAR describes an elevated release through the building stack.

27.2.1 UT SAR, Section 13.3 (p. 13-19), the building stack is located on the roof of the reactor building and its exit is at about 14 feet above the roof leading to a total height of about 63 feet above the ground level that surrounds the facility. The calculations are then performed for distances from 10 to 100 meters from the building. Because, the reactor building is both tall and wide, any release from the stack could be accumulated in the building wake. Therefore, the applicability of the assumption of elevated release is appears inaccurate. Please justify the use of the elevated release values for dose estimates at nearby distances from the facility.

27.2.2 In addition, if there is an error in the correlation used for the plume rise (see RAI 19.1), the estimated plume rise above the stack height may be inaccurate. Please confirm and revise accordingly.

27.3 For the determination of effluent leakage around doors and HVAC duct vents the licensee employs complicated discussions and assumptions that are not supported or justified. Please revise the discussion and calculations using applicable assumptions for building overpressure.

27.4 For the dispersion calculations of ground releases using RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear

Power Plants," Regulatory Position 1.3.1, the licensee uses a building wall cross section area, which appears to be 432 m^2. UT SAR page 3-7 states that the reactor bay is about 18.3 m on each side, with a total of 4575 m^3 of volume. This leads to a wall cross section area of about 250 m^2, which is in-line with the value of 234 m^2 given in the original application for licensing safety analysis report in 1991 (1991 SAR). Please confirm the building wall cross section area and revise accordingly.

27.5 For the offsite public dose calculations, in the UT SAR it does not appear consistent with the potential for ground release of the reactor bay air content, similar to that evaluated in the 1991 SAR (Assumption f on page 11-28 of the 1991 SAR).

27.6 UT SAR Appendix 13.1, SCALE 6.1 input file, cites an input value 1.6 for the weight fraction of the $ZrH_{1.6}U$ fuel. Is this input value for the weight fraction of hydrogen in the fuel? Please confirm and revise accordingly.

28. The guidance in NUREG-1537 Section 13.1.2, "Insertion of Excess Reactivity," requests that the licensee provide an analysis of reactivity insertion events.

28.1 The UT SAR Section 13.4 provides results showing fuel temperature increase for a series of reactivity insertion scenarios using Fuchs-Nordheim model. This model calculates average temperature rise in the fuel. The licensee also provides peak fuel temperature rise for the same scenarios. It appears that the UT SAR does not provide sufficient information on the peaking factors and other assumptions used to estimate the maximum fuel temperature rise as listed in UT SAR Tables 13.20 and 13.21. Please provide sufficient additional information to allow confirmatory analysis.

29. The guidance in NUREG-1537 Section 13.1.3, "Loss of Coolant," requests that the licensee provide analysis that assures that doses to the public that could result from a loss of coolant accident (LOCA) do not exceed 10 CFR Part 20 dose limits. UT SAR Section 13.5 provides a discussion of a potential LOCA and its consequences in terms of the maximum fuel temperature and resultant radiation levels from the uncovered core.

29.1 Confirmatory analysis using the stated initial conditions and assumptions do not reproduce the fuel temperature results cited. Furthermore, the results presented in the 1991 SAR, provides fuel temperatures for a series of operating power levels per fuel element and decayed cooling times before the LOCA event. However, the initiating conditions listed in the UT SAR are significantly different. Please provide a LOCA analysis that represents the current licensed power level for the UT TRIGA in sufficient detail to allow confirmatory analysis.

29.2 A review of the maximum fuel temperatures identifies that the power density after shutdown correlation uses a peak to average power ratio of 1.3, that is significantly lower than is typical in TRIGA analysis. This factor directly affects the estimated residual decay heat and the calculated maximum fuel temperature. Please confirm that the LOCA analysis uses peaking factors that are consistent with the LCC and revise the analysis accordingly.

29.3 UT SAR Section 13.5.8, "Results and Conclusion," states that the maximum fuel temperature in a LOCA event after "long-term operation at full power of 2000 kW is 750°C." Please provide the analysis that supports this temperature.

30. The guidance in NUREG-1537 Section 13.1.6, “Experiment Malfunction,” requests that the licensee provide analysis of an experiment malfunction event. UT SAR, Section 13.8.2.C includes an analysis of fueled experiment fission product inventory to estimate the allowable limit on production of iodine and strontium in an experiment based on a 2-hour DAC limit; the analysis uses fission yield data from uranium-235. Please clarify the source of the activation materials for producing iodine, and identify actions needed if it is not ^{235}U. In addition, please show that the limits for the iodine and strontium are less than the values that could be released in an MHA and the doses to the public from such releases are within the 10 CFR Part 20 limits.

31. The guidance in NUREG-1537 Section 13.1.9, “Mishandling or Malfunction of Equipment,” requests that the licensee provide an accident analysis assuming equipment mishandling or malfunction. The UT SAR does not identify any potential effects from movements of heavy loads using the 5-tonne crane. Please identify potential incidents, including loss of power or dropped loads, related to the operation of the crane and discuss the consequences.

32. The "Interim Staff Guidance for the Streamlined Research Reactor License Renewal Process," (ISG) identifies ANSI/ANS-15.1-2007 and the corresponding regulatory positions in NUREG-1537, Appendix 14.1 are the guidance documents for the review of technical specifications. The guidance in ANSI/ANS-15.1-2007 Section 1.3, "Definitions," recommends definitions commonly used in Research and Test Reactor TS. The TS definitions noted below were either missing, were not consistent with guidance, or were lacking recommended details. (Note: capitalization for this sequence of RAIs follows the style of the proposed UT TRIGA TS.)

    32.1 The proposed UT TRIGA TS definitions section 1.0 does not describe definitions for: core configuration; license; licensee; protective action; reactivity worth of an experiment; reactor operator; reactor operating; responsible authority; safety limit; scram time; senior reactor operator; shall/should/may definitions (only the definition for “shall” is provided); true value; unscheduled shutdown. Please provide definitions for the above or provide justification for not using them.

    32.2 The following definitions are not consistent with the guidance: channel calibration, excess reactivity; experiment, confinement; movable experiment; secured experiment. Please revise accordingly or provide justification for the deviations.

    32.3 The TS defines the term “immediate” as, “Without delay and not exceeding one hour” and includes an attached note which states “IMMEDIATE permits activities to restore required conditions for up to one hour; this does not permit or imply either deferring or postponing the action.” Please revise to the following: when IMMEDIATELY is used as a COMPLETION TIME, The REQUIRED ACTION should be pursued without delay and in a controlled manner.

    32.4 ANSI/ANS-15.12007 defines reactor shutdown as, “being subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments included.” The proposed UT TRIGA TS definition of REACTOR SHUTDOWN only requires the reactor to be subcritical by $0.29. Please explain the discrepancy in using the value of an abnormal condition (shutdown margin) for a normal condition, i.e., the definition of Reactor Shutdown.

32.5 The regulatory guidance of NUREG-1537 Appendix 14.1 states that all control rods must be inserted to achieve REACTOR SECURED MODE. The proposed UT TRIGA TS definition of REACTOR SECURED MODE requires that 3 of the 4 control rods be fully inserted. Please either provide analysis demonstrating the acceptability of the insertion of 3 out of 4 rods or revise the definition to require insertion of all 4 control rods in order to satisfy the requirements of this mode.

33. The guidance in ANSI/ANS-15.1-2007 Section 2.1, "Safety limits," requests that TS state the basis for the SL. The basis provided in support of the TS 2.1 references Chapter 4, Section 4.2.1 Z which does not exist. Please discuss this error and/or revise accordingly.

34. The guidance in ANSI/ANS-15.1-2007 Section 2.2, “Limiting safety system settings,” (LSSS) requests that TS establish the LSSS. Some deficiencies and differences are noted with the proposed UT TRIGA TS:

34.1 The basis provided in support of the UT TRIGA TS 2.2 references Chapter 4 Section 4.6 B which does not exist. Please provide a basis for the LSSS.

34.2 UT TRIGA TS 2.2.The REQUIRED ACTION, B.1 and B.2, which support condition B seem to be reversed and the completion times are both labeled B.2. Please discuss this error and/or revise accordingly.

34.3 UT TRIGA TS 2.2, B.2 refers to the statement "verify the measurement value is not correct." Please describe how this is verified.

35. The guidance in ANSI/ANS-15.1-2007 Section 3, "Limiting conditions for operations," provides guidance and recommendations for the specifications pertaining to the limiting conditions for operation (LCO). This guidance is supplemented by NUREG-1537 Appendix 14.1. Some deficiencies and differences with the proposed UT TRIGA TS are described below. Please discuss these deficiencies and differences and revise accordingly.

35.1 Section 3.1 of the guidance describes having specifications for fuel burnup, core configurations, and reactivity coefficients (if such coefficients establish required conditions). Such specifications are not present in the proposed UT TRIGA TS.

35.2 Section 3.1 of the guidance describes that limits be placed on core excess reactivity and the corresponding regulatory interpretation includes provisions that account for experiment worth. Proposed UT TRIGA TS 3.1 “Core Reactivity,” Specification A excludes consideration of experiments having positive reactivity.

35.3 Section 3.1 of the guidance describes that limits be placed on the shutdown margin and states that this value "should be large enough to be readily determined experimentally, for example, ≥0.5% Δk/k or ≥0.50 dollar." Please provide an analysis and evaluation that demonstrates the ability to repeatedly measure core reactivity with sufficient accuracy to justify this small value of the shutdown margin.

35.4 Section 3.2 of the guidance describes that a limit be established for the maximum control rod reactivity insertion rate for non-pulsed operation. The proposed UT TRIGA TS do not provide such a specification. This rate, and the control rod scram times, are typically justified through the analysis of an uncontrolled, control rod withdrawal transient.

35.5 Section 3.2 of the guidance describes a specification for permitted bypassing of channels for checks, calibrations, maintenance, or measurements. Proposed UT TRIGA TS 3.3, “Measuring Channels,” does not specify when it is permitted to bypass channels for checks, calibrations, maintenance or measurements.

35.6 Proposed UT TRIGA TS 4.3 “Measuring Channels,” contain Surveillance Requirements for the Fuel Temperature Channel and the Upper Level Radiation Monitor. However, there are no associated LCO specifications.

35.7 Section 3.3 of the guidance describes specifications for leak or loss of coolant detection and a secondary coolant activity limit. No such specifications are found in the proposed UT TRIGA TS.

35.8 Section 3.8.2 of the regulatory interpretations states that containers for experiments containing known explosive materials shall be designed such that the design pressure of the container is twice the pressure the experiment can potentially produce. Proposed UT TRIGA TS 3.6 “Limitations on Experiments,” does not include such a specification.

36. ANSI/ANS-15.1-2007 Section 3, "Limiting conditions for operations," requests that the licensee provide LCOs for constraints and operational characteristics that shall be adhered to during operation. The ISG states that the applicable TSs should explain why the TSs, including their bases, are acceptable. The following deficiencies and differences are noted with the proposed UT TRIGA LCOs: Please confirm and revise accordingly, or explain why such changes are not necessary.

36.1 The list of measuring channels presented in Table 1 of proposed UT TRIGA TS 3.3 “Measuring Channels,” does not include the data acquisition and control (DAC) and control system computer (CSC) which are listed as SCRAM channels in UT SAR Table 4.6.

36.2 The setpoint stated for condition B for Specification B in proposed UT TRIGA TS 3.3, “Measuring Channels,” is stated as 2mW. However, the neutron count rate should be stated in terms of neutrons per unit time.

36.3 The basis for propose UT TRIGA TS 3.3 contains a statement “According to General Atomics, detector voltages less than 80% of required operating value do not provide reliable…….” Please explain how this statement applies to UT TRIGA and how the required conditions for safe operation are ensured by your TS. Such information should be discussed in the SAR and then utilized in the TS basis.

36.4 Proposed UT TRIGA TS 3.4 Table 2 does not provided the scram setpoints for the Reactor Power Level, Fuel Temperature, and Pool Water Level SAFETY SYSTEM CHANNELS.

36.5 Proposed UT TRIGA TS 3.5 “Gaseous Effluent Control,” Specification A does not establish the conditions that determine HVAC OPERABILITY (e.g., conditions or positions for the fans/louvers/doors); a basis statement is not provided for the stated value of 10,000 cpm; such information should be discussed in the SAR and then utilized in the TS basis. Also, there are more COMPLETION TIMEs for Specification A than there are REQUIRED ACTIONs.

36.6 Proposed UT TRIGA TS 3.5 “Gaseous Effluent Control,” Specification B does not provide a basis statement for the stated limit of 10,000 cpm; such information should be discussed in the SAR and then utilized in the TS basis. Also, there is a missing COMPLETION TIME for REQUIRED ACTION B.3.

36.7 Proposed UT TRIGA TS 3.5, “Gaseous Effluent Control,” Specification D does not provide a basis statement for the stated limit of 100 Ci/yr; such information should be discussed in the SAR and then utilized in the TS basis.

36.8 The basis for the proposed UT TRIGA TS 3.7 “Fuel Integrity,” does not provide an appropriate basis statement to support the limits in Specification C. Specification B is missing the word "not" in the REQUIRED ACTION. The second occurrence of CONDITION B should be CONDITION C.

36.9 TS 3.8, “Reactor Pool Water” has no specification for maintaining an acceptable pH level.

37. ANSI/ANS-15.1-2007 Section 3, "Limiting conditions for operations," allows reactor operation to deviate from LCO conditions as long as the TS include appropriate action statements. The proposed UT TRIGA TS do not consistently or correctly employ these expectations. Please confirm the issues noted below and revise the TS accordingly, or explain why such changes are not necessary. The NRC staff has included an illustration of the use of action statements in TS as an annex to these RAIs.

37.1 Proposed UT TRIGA TS 3.2 “Pulsed Mode Operation,” the COMPLETION TIME listed for the REQUIRED ACTION is "immediate." Please consider the COMPLETION TIME to be "prior to commencement of pulsing operation."

37.2 Proposed UT TRIGA TS 3.3 “Measuring Channels”:

37.2.1 CONDITION A.2 the lumping together of COMPLETION TIME(S) under A.2 is confusing as to which REQUIRED ACTION must be completed first.

37.2.2 The REQUIRED ACTION(S) A.1.1 and A.1.2 are, “Restore channel to operation OR ENSURE the reactor is SHUTDOWN.” The COMPLETION TIME is stated as Immediate for both REQUIRED ACTION(S). Please consider a sequence of events (e.g., either restore the channel to operation within an acceptable COMPLETION TIME, OR shutdown).

37.2.3 The COMPLETION TIME(S) for the REQUIRED ACTION(S) A.3.1 through A.3.3 are confusing in that no action is identified to take precedence over another, potentially leaving the operator to make their own assumptions as to the priority of events within one hour of any specified CONDITION. Also, please correct the spelling of "reactor bay."

37.2.4 CONDITION(S) A.4 through A.7 state a series of REQUIRED ACTION(S) that are not sequentially linked. Use of the same COMPLETION TIME for each action is contradictory.

37.2.5 The REQUIRED ACTION(S) A.4.3 and A.4.4 seem to contradict each other.

37.3 Proposed UT TRIGA TS 3.4 “Safety Channel and Control Rod Operability,” Specification B has no associated REQUIRED ACTION(S) or COMPLETION TIME(S).

37.4 Proposed UT TRIGA TS 3.5 “Gaseous Effluent Control,” logical “AND/OR” connectors are missing between REQUIRED ACTION(S) C.2.a-C.2.b and C.2.b-C.2.c. COMPLETION TIME(S) are all listed as IMMEDIATE which is contradictory. Please revise providing a clear sequence of the expected steps.

37.5 Proposed UT TRIGA TS 3.7 “Fuel Integrity,” the COMPLETION TIME listed for all REQUIRED ACTION(S) is IMMEDIATE. Please consider revising the REQUIRED ACTION(S) for Specification A and B to state, “Discharge fuel elements prior to reactor operation.”

37.6 Proposed UT TRIGA TS 3.8 “Reactor Pool Water”:

37.6.1 REQUIRED ACTION(S) A.1 through A.3 are in reverse order. The COMPLETION TIME(S) are all IMMEDIATE which is contradictory.

37.6.2 REQUIRED ACTION(S) B.1 and B.2 are in reverse order.

37.6.3 REQUIRED ACTION(S) C.1 and C.2 are in reverse order. The COMPLETION TIME(S) are all IMMEDIATE which is contradictory. Also, and the CONDITION seems to be improperly stated.

37.6.4 REQUIRED ACTION(S) D.2 and D.3 are in reverse order. The COMPLETION TIME(S) are all IMMEDIATE which is contradictory. A basis to support the established limits in Specification D is not provided. Such information should be discussed in the SAR and then utilized in the TS basis.

38. ANSI/ANS-15.1-2007 Section 4 “Surveillance requirements,” requests that the licensee provide a Surveillance Requirement (SR) for each LCO to demonstrate that minimum performance levels are ensured. Some deficiencies and differences are noted with the proposed UT TRIGA TS. Please confirm and revise accordingly, or explain why such changes are not necessary.

38.1 There are no SRs for the DAC or CSC that are listed as SCRAM channels in UT SAR Table 4.6.

38.2 There are no SRs for the reactor bay differential pressure for CONDITION A.3 in proposed UT TRIGA TS 3.3 “Measuring Channels.”

38.3 Proposed UT TRIGA TS 3.3 “Measuring Channels,” contains Surveillance Requirements for the Fuel Temperature Channel and the Upper Level Radiation Monitor but there are no associated LCO specifications.

38.4 There are no SRs for the Reactor Power Level scram, the Manual scram, or Fuel Temperature scram to support proposed UT TRIGA TS 3.4 “Safety Channel and Control Rod Operability.”

38.5 There are no SRs to support proposed UT TRIGA TS 3.7 “Fuel Integrity,” CONDITION C.

39. ANSI/ANS-15.1-2007 Section 5 “Design features,” requests that the licensee provide information necessary to prevent alterations to safety-related components that are not covered under other provisions of the TS. 10 CFR 50.36 describes design features as "features of the facility such as materials of construction and geometric arrangements." Some deficiencies and differences are noted with the proposed UT TRIGA TS. Please confirm and revise accordingly, or explain why such changes are not necessary.

39.1 Proposed UT TRIGA TS 5.1.3(1) allows fuel having a stoichiometry of 1.55 to 1.80 in hydrogen to be used in UT TRIGA. This is inconsistent with the range reported in GA Report E-117-833 which is the technical basis for NUREG-1282, the SER for TRIGA fuel.

39.2 The cited guidance recommends providing a description of: 1) core parameters; 2) conditions for operation of the reactor with damaged or leaking fuel elements; 3) parameters such as maximum core loading, thermal characteristics, physics parameters, etc; and 4) fuel burn-up limits. These design features are not stated in the proposed UT TRIGA TS.

39.3 Proposed UT TRIGA TS 5.2 “Reactor Fuel and Fueled Devises in Storage,” cites as a basis ANS Standard 15.1, Section 5.4. However, the cited text only states the requirement; it does not provide a basis for how UT is meeting the requirement. Please provide an appropriate basis.

39.4 Proposed UT TRIGA TS 5.4 incorporates considerations for experiments into the design features section. These considerations do not meet the regulations of the definition for design features from 10 CFR 50.36.

40. ANSI/ANS-15.1-2007 Section 6 “Administrative controls,” requests that the licensee provide TS that provide certain content. Some deficiencies and differences are noted with the proposed UT TRIGA TS. Please confirm and revise accordingly, or explain why such changes are not necessary.

40.1 ANSI/ANS-15.1-2007 Section 6.1 “Organization,” recommends organizational structures including levels and reporting authority. UT TRIGA TS 6.1.1 “Structure,” Figure 6.1, does not describe the organizational structure as described in ANSI/ANS-15.1-2007, Section 6.1 “Organization.”

40.2 ANSI/ANS-15.1-2007 Section 6.3 “Radiation safety,” recommends that a section be included that discusses the individual or group that shall be assigned responsibility for implementing the radiation protection program using the guidelines of “Radiation Protection at Research Reactor Facilities,” ANSI/ANS-15.11-1993 (R2004). This individual or group shall report to Level 1 or Level 2. The proposed UT TRIGA TS contains no such section.

40.3 Although the guidance of ANSI/ANS-15.1-2007 Section 6.1.3 “Staffing,” have been included in proposed UT TRIGA TS 6.1.3 “Staffing,” the following items are not consistent with the guidance:

- A designated senior reactor operator shall be readily available on call. “Readily Available on Call” means an individual who has been specifically designated and the designation known to the operator on duty, can be rapidly contacted by phone, by the operator on duty.
- A list of reactor facility personnel by name and telephone number shall be readily available in the control room for use by the operator. The list shall include (a) management personnel, (b) radiation safety personnel, (c) other operations personnel.
- Events requiring the presence at the facility of the senior reactor operator are (a) initial startup and approach to power, (b) all fuel or control-rod relocations within the reactor core region, (c) relocation of any experiment with reactivity

worth greater than one dollar; (d) recovery from unplanned or unscheduled shutdown or significant power reduction.

40.4 ANSI/ANS-15.1-2007 Section 6.1.4 “Selection and training of personnel,” recommends a section for ensuring that the selection and training of UT TRIGA staff is consistent with ANSI/ANS-15.4-1988. No such section is provided in the UT TRIGA TS.

40.5 ANSI/ANS-15.1-2007 Section 6.4 “Procedures,” recommends that procedures be written for surveillance checks, calibrations, and inspections required by the TS or those that may have an effect on reactor safety.

40.6 ANSI/ANS-15.1-2007 Section 6.7.2(1) “Special reports,” specifies facsimile or similar conveyance of the special report. Proposed UT TRIGA TS 6.8(c) specifies telegraph of similar conveyance.

40.7 ANSI/ANS-15.1-2007 Section 6.8 “Records,” provides recommendations for record retention. Section 6.8.2 recommends an administrative control that retraining and requalification records for operators be retained for at least one certification cycle (per 10 CFR 55.55(a) this period is 6 years) and be maintained at all times the individual is employed or until the certification is renewed. The proposed UT TRIGA TS 6.10 is not consistent with this guidance

ANNEX: SUPPLEMENT TO RAI-37

UT TRIGA TS 2.2 (LSSS)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Steady state power level exceeds 1100 kW (th)	A.1 Reduce power to less than 1100 kW (th) OR A.2. ENSURE REACTOR SHUTDOWN condition	A.1 IMMEDIATE A.2. IMMEDIATE

Illustration of how the LSSS can properly utilize action statements and completion times:

Eliminate definition of ENSURE.

Define IMMEDIATELY as: When "Immediately" is used as a Completion Time, The Required Action should be pursued without delay and in a controlled manner.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.1 Steady state power level exceeds 1100 kW	A.1.1 Reduce power to less than 1100 kW	xx minutes
A.2 REQUIRED ACTION and associated COMPLETION TIME of CONDITION A.1 not met.	A.2.1 Manually trip control rod breakers AND A.2.2 Establish REACTOR SHUTDOWN condition	IMMEDIATELY x hour

UT TRIGA TS 3.3 (MEASURING CHANNELS)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.4. Pool Area Radiation Monitor is not OPERATING	A.4.1 Restore MEASURING CHANNEL OR A.4.2 ENSURE reactor is shutdown OR A.4.3 ENSURE personnel are not on the upper level OR A.4.4 ENSURE personnel on upper level are using portable survey meters to monitor dose rates	A.4.1 IMMEDIATE A.4.2 IMMEDIATE A.4.3 IMMEDIATE A.4.4 IMMEDIATE

Illustration of how the TS can properly utilize action statements and completion times:

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.4.1 Pool Area Radiation Monitor is not OPERATING	A.4.1.1 Restore Pool Area Radiation Monitor to OPERATING	xx minutes
A.4.2 REQUIRED ACTION and associated COMPLETION TIME of CONDITION A.4.1 not met.	A.4.2.1 Ensure personnel are not on the upper level OR A.4.2.2 Ensure personnel on upper level are using portable survey meters to monitor dose rates	yy minutes zz minutes
A.4.3 REQUIRED ACTION and associated COMPLETION TIME of CONDITION A.4.2 not met.	A.4.3.1 Manually trip control rod breakers AND	IMMEDIATELY

	A.4.3.2 Establish REACTOR SHUTDOWN condition	x hour

Foreign Ownership, Control, or Domination

41. Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.33(d)(iii) requires each applicant to state whether it is owned, controlled, or dominated by an alien, a foreign corporation, or foreign government. UT SAR Section 15.1 states that UT is a State owned entity, and provides corroborating documentation in Appendix 15.1. However, the UT SAR does not provide a written statement whether UT is "owned, controlled, or dominated, by an alien, foreign corporation, or foreign government." Please provide a written statement that confirms or denies this status.

Financial Qualifications

42. Pursuant to 10 CFR 50.71(b):

> With respect to any production or utilization facility of a type described in § 50.21(b) or 50.22, or a testing facility, each licensee and each holder of a construction permit shall submit its annual financial report, including the certified financial statements, to the Commission. . .

UT SAR Section 15 provides information on financial qualifications pursuant to 10 CFR Section 50.33; however UT's latest annual financial statements were not included in the UT SAR. Please provide a copy of UT's latest annual financial statements.

43. Pursuant to 10 CFR 50.33(f)(2):

> [T]he applicant shall submit estimates for total annual operating costs for each of the first five years of operation of the facility. . .

UT SAR Section 15, Appendix 15.2 provides five-year operating costs from fiscal year (FY) 2012 through FY 2016. Assuming review of this application is completed on schedule, and a renewed license granted in FY 2013, please provide the estimated operating costs for each of the FYs 2013 through FY2017.

Decommissioning Cost Estimate

44. Pursuant to 10 CFR 50.75(d)(1):

> [e]ach non-power reactor applicant for or holder of an operating license for a production or utilization facility shall submit a decommissioning report as required by § 50.33(k) of this part.

Further, pursuant to 10 CFR 50.75(d)(2), the report must:

(i) Contain a cost estimate for decommissioning the facility;
(ii) Indicate which method or methods described in paragraph (e) of this section as acceptable to the NRC will be used to provide funds for decommissioning; and

(iii) Provide a description of the means of adjusting the cost estimate and associated funding level periodically over the life of the facility.

UT SAR Section 15, Appendix 15.4 updates the decommissioning cost estimate of the UT TRIGA to $888,609 in 2033, referencing NUREG/CR-1756 Addendum, "Technology, Safety and Costs of Decommissioning Reference Nuclear Research and Test Reactors." UT derived this original estimate by cost comparing the UT TRIGA reactor to the DORF (Diamond Ordnance Radiation Facility) reactor which possessed a comparatively smaller power limit (250 KW) and decommissioned over three decades ago in 1980. The February 21, 2012, supplement to the UT SAR provided further information on cost escalation factors, projections, calculations of the decommissioning cost estimate for UT TRIGA, and estimated a decommissioning cost of $2.71 million in 2033.

Please provide the following additional information:

44.1 A comparison of the UT TRIGA decommissioning cost estimate to more recently decommissioned research reactors of similar licensed power limit as the UT TRIGA.

44.2 A FY 2012 – FY 2013 decommissioning cost estimate for the UT TRIGA to meet the NRC's radiological release criteria for decommissioning the facility, which should also include a contingency factor of at least 25 percent. A contingency factor provides reasonable assurance for unforeseen circumstances that could increase decommissioning costs (see NUREG/CR-6477, NUREG/CR-1756, NUREG-1713).

44.3 Provide a calculation detailing how the rates in Table 15.3 "Escalation Costs," were derived.

44.4 Provide a calculation showing how the escalation factors in Table 15.4 "Calculation Summary," were derived.

Financial Assurance for Decommissioning

45. UT SAR Section 15, Appendix 15.3 gives a statement of intent (SOI) to provide financial assurance for decommissioning, as required by 10 CFR 50.75(e)(1)(iv). Where the applicant intends to use a SOI, the SOI must contain a cost estimate for decommissioning, and indicate that funds for decommissioning will be obtained when necessary. Further, the applicant must provide documentation verifying that the signator of the SOI is authorized to execute the SOI, which binds UT financially with respect to the eventual decommissioning of the UT TRIGA. As the UT SAR does not include all of the above information, please provide the following additional information:

45.1 An updated SOI containing the decommissioning cost estimate in 2013 dollars, and the name of the document(s) governing control of funds (refer to A.16.4 of

NUREG-1757, Vol. 3 "Consolidated NMSS Decommissioning Guidance," for the model of the Statement of Intent).

45.2 Written documentation verifying that the signator of the SOI, Kevin P. Hegarty, Vice President and Chief Financial Officer, is authorized to execute the SOI that binds UT financially. While the SOI states that as Chief Financial Officer for UT, Kevin Hegarty has the authority to sign the SOI, in the documentation submitted to the NRC, Rule 10501 Section 5, "Signature Authority," states only that:

> The Board of Regents delegates to the Chancellor or the president of an institution authority to execute and deliver on behalf of the Board contracts and agreements of any kind or nature, including without limitation licenses issued to the Board or an institution.