November 1, 2016

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 the renewal of Facility Operating License No. R-129, for the University of Texas at Austin, dated December 12, 2011, as most recently supplemented on July 15, 2015 (a redacted version of the application is available on the NRC's public Web site at www.nrc.gov under the Agencywide Documents Access and Management System Accession No. ML12156A097), as supplemented.

During our review of your application and supplements, questions have arisen for which additional information is needed. The enclosed request for additional information (RAI) identifies the additional information needed to continue our review. We request that you provide responses to the enclosed request for additional information within 30 days from the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.30(b), "Oath or affirmation," you must execute its response 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 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." Any information related to security should be submitted in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements." Following receipt of the additional information, we will continue our review of your renewal request.

If you have any questions regarding this review, please contact me at (301) 415-2856 or by electronic mail at Michael.Balazik@nrc.gov.

Sincerely,

/RA/

Michael F. Balazik, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-602
License No. R-129

Enclosure:
As stated

cc: See next page

cc:

Governor's Budget
and Policy Office
PO Box 12428
Austin, Texas 78711-2428

Bureau of Radiation Control
State of Texas
1100 West 49th Street
Austin, TX 78756

Dr. Gregory L. Fenves
The University of Texas at Austin
Office of the President
110 Inner Campus Drive, G3400
Austin, TX 78712-3400

Maurie McInnis
Executive Vice President and Provost
The University of Texas at Austin
1 University Station, G1000
Austin, TX 78712

Roger Mulder
Office of the Governor
P.O. Box 12428
Austin, TX 78711

P. Michael Whaley, Associate Director
Nuclear Engineering Teaching
Laboratory
The University of Texas at Austin
10100 Burnet Road, Building 159
Austin, TX 78758

Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

If you have any questions regarding this review, please contact me at (301) 415-2856 or by electronic mail at Michael.Balazik@nrc.gov.

Sincerely,

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ADAMS Accession No.: ML16285A350 *concurrence via e-mail NRR-106

OFFICE	NRR/DPR/PRLB	NRR/DPR/PRLB*	NRR/DPR/PRLB	NRR/DPR/PRLB
NAME	MBalazik	NParker (ELee for)	AAdams	MBalazik
DATE	10/19/16	10/17/16	10/20/16	11/01/16

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OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

REGARDING THE RENEWAL OF

THE UNIVERSITY OF TEXAS AT AUSTIN

TRIGA MARK II NUCLEAR RESEARCH 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, (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).

The NRC staff reviewed your request for additional information (RAI) responses, provided by letters dated September 17 (ADAMS Accession No. ML12307A071), and December 19, 2012 (ADAMS Accession No. ML13002A015), March 22 (ADAMS Accession No. ML13091A006), and August 21, 2013 (ADAMS Accession No. ML13246A014), July 15 (ADAMS Accession No. ML15211A638), August 26 (ADAMS Accession No. ML15251A234), October 23 (ADAMS Accession No. ML15313A027), and December 22, 2015 (ADAMS Accession No. ML16015A052), February 5 (ADAMS Accession No. ML16053A094), and May 2, 2016 (ADAMS Accession No. ML16132A239), which need additional information or clarification. For ease of tracking, RAI designation in the enclosure uses the same RAI designation as issued on June 25, 2012 (ADAMS Accession No. ML121500308). Additionally, RAI 46 and 47 are new information requests resulting from further review of your application for renewal.

The NRC staff's review used the guidance provided in NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content" and NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non Power Reactors: Standard Review Plan and Acceptance Criteria."

Enclosure

6.(R2) The guidance in NUREG-1537, Part 1, 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.

However, in your response dated September 17, 2012 (ADAMS Accession No. ML12307A071), you described your methodology but the response does not include supporting survey information that demonstrates that the radiation fields resulting from using those methods are acceptable.

Provide supporting radiation survey information that demonstrates the acceptability of your methodology for control of personnel exposure.

8.(R2) The guidance in NUREG-1537, Part 1, 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(R2) In your response dated July 15, 2015 (ADAMS Accession No. ML15211A638), the submission contains unexplained variations in fuel geometry values some of which do not agree with standard TRIGA accepted values.

Revise the neutronics analysis report and the associated models to use referenceable core element geometries.

11.(R2) The guidance in NUREG-1537, Part 1, Section 4.5.3, "Operating Limits," requests that the licensee define the operating limits for its facility. In your response dated July 15, 2015 (ADAMS Accession No. ML15211A638), the submission contains large deviations between calculated and measured reactivity values in Table 13, “Comparison of Reactivity Calculations to Surveillance Data,” that infers that the model supplying those results is not suitably predictive. In the February 5, 2016, response (ADAMS Accession No. ML16053A094) it appears that adjustments are being made to calculated values, but it is unclear what the arithmetic changes are and their basis. Recently, you have indicated that changes to your models are now providing improved results.

11.1(R2) Revise the neutronics analysis report and provide revised calculations of full power reactivity defects for power, xenon, and samarium.

11.2(R2) Revise the neutronics analysis report and provide a revised analysis demonstrating acceptable reactor shutdown and shutdown margin for both operational and LCCs.

11.3(R2) Revise the neutronics analysis report and provide a revised “transient analysis assuming that an instrumentation malfunction drives the most reactive control rod out in a continuous ramp mode,” (NUREG-1537, Part 1, Section 4.5.3) using a rate of withdrawal consistent with proposed UT TRIGA technical specifications (TS) values of the maximum control rod withdrawal speed, reactivity rate, and the control rod scram time including uncertainties.

11.4(R2) Revise the neutronics analysis report and provide revised technical parameters, “excess reactivity, control rod worth, temperature coefficients, [etc.]” (NUREG-1537, Part 1, Section 4.5.3) for the limiting and the current operational core.

11.5(R2) Identify the criteria that you are using to determine that your comparisons for excess reactivity, control rod worths, and or estimated critical positions are acceptable. Provide revised neutronics results that demonstrate that your model is suitably predictive. Any adjustments to code calculated values should have a clearly established basis and the changes made should be discernable to the NRC staff.

12.(R2) The UT Safety Analysis Report (SAR) Section 4.5.4, Subsection B, Figure 4.22, "Radial Variation of Power Within a TRIGA Fuel Rod," describes the power within a fuel element. The power distribution in Figure 4.22 continues to the center of the fuel element indicating that this curve is not applicable to stainless steel-clad fuel that has a zirconium rod in the center. However, in your response dated December 22, 2015 (ADAMS Accession No. ML16015A052), such information is not indicated.

Revise the neutronics analysis report and provide radial power distribution information for the fuel used in the UT core. In addition, provide a power distribution table for the LCC showing the total power in each fuel element. Provide a table showing the axial power distribution for the highest power fuel element in the LCC.

14.(R2) The guidance in NUREG-1537, Part 1, 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. In your response dated July 15, 2015 (ADAMS Accession No. ML15211A638), the submission contains large deviations between calculated and measured reactivity values that infers that the model supplying those results is not suitably predictive. Recently, you have indicated that changes to your models are now providing improved results.

14.1(R2) Revise the neutronics analysis report and provide a revised calculation of the fuel temperature coefficient.

14.2(R2) Revise the neutronics analysis report and provide calculations of the limiting fuel temperature for the LCC when pulsed to the maximum allowable reactivity.

15.(R2) The guidance in NUREG-1537, Part 1, Section 4.6, “Thermal-Hydraulic Design,” requests that the licensee provide information and analyses of thermal-hydraulic (T/H) conditions in its reactor demonstrating that sufficient heat removal capacity exists for steady-state or pulsing operation at the maximum licensed power level. However, in reviewing your response dated July 15, 2015 (ADAMS Accession No. ML15211A638), the submission utilizes neutronics results that are now being significantly revised.

15.1(R2) Revise the T/H report to utilize the revised neutronics analysis report information to describe the analytical methods used to determine the departure of nucleate boiling ratio, including the core inlet and exit conditions assumed and other assumptions and correlations employed. Ensure that revisions to geometric assumptions used in the neutronics analysis report are also used, as appropriate, in the T/H report. Ensure that all analysis assumptions are fully referenced. For any correlations or loss coefficients used, ensure that either they are based on previously approved methodologies and reports or that sufficient information is supplied to justify their use.

15.2(R2) The guidance in NUREG-1537, Part 1, Section 4.6, “Thermal-Hydraulic Design,” states 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 T/H 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.

Revise the T/H report to provide this information and provide a comprehensive description of the calculation 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 highest power fuel element in the LCC to safety limits, as stated in the TS.

19.(R2) The guidance in NUREG-1537, Part 1, 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. The UT SAR, Section 9.2.3, ”Operational analysis and safety function,” provides details on the operational analysis and safety function on the reactor bay heating, ventilation, and air conditioning system.

19.2(R2) In your response dated December 22, 2015 (ADAMS Accession No. ML16015A052), the stack diameter of 45.72 cm does not correspond to the cited area of 0.4012 m^2.

Provide resolution of the apparent discrepancy of the calculated and cited stack area.

20.(R2) The guidance in NUREG-1537, Part 1, 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(R2) During a site visit to the NETL, the NRC staff observed that fuel elements are stored in what appeared to be a non-standard rack for which no analysis was provided in the UT SAR. UT provided an analysis on March 22, 2013 (ML13091A006), that supports new fuel storage. In the RAI response, UT did not identify the storage location for irradiated fuel.

Identify any other locations covered by the license where fuel elements (new or irradiated) 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.

22.(R2) The guidance in NUREG-1537, Part 1, Section 11.1.1, "Radiation Sources," requests that the licensee include airborne dose information for characterization of Ar-41, 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. However, your response dated December 22, 2015 (ADAMS Accession No. ML16015A052), provides an attachment that calculates Ar-41 production and release to the reactor bay. There are apparent discrepancies in the calculations that may affect the results: (1) the dimensions in Figure 1, “Geometry of the Air Space above the Pool,” do not match the SAR discussions in Section 4.3, “Reactor Pool.” For example, pool construction consists of two half-cylinders with a radius of 6.5 ft. (1.981 m) separated by 6.5 ft. (1.981 m). However, Figure 1 shows a smaller cylinder radius and separation distance. This will lead to a lower calculated air volume above the pool; (2) the calculated air volume in Figure 1 cites a value of 3.28 m^3, but the volume used in Table 1, “Ar-41 Production Source Terms,” is 2.68 m^3; (3) the DAC value for the Ar-41 is $3x10^{-6}$µCi/ml (0.111Bq/ml). However, the analysis in Section 2.1, “Worker Doses,” uses a value of 0.0111 Bq/ml. This apparent discrepancy results in a lower stay time duration in Table 5, “Impact on Worker Doses, 1.1 MW Operation, HVAC Only.”

Provide the revised Ar-41 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 using assumptions, as well as the annual exposure for the maximally exposed member of the public consistent with your TS and Emergency Plan.

28.(R2) The guidance in NUREG-1537 Section 13.1.2, “Insertion of Excess Reactivity,” requests that the licensee provide an analysis of reactivity insertion events. However, in reviewing your response dated July 15, 2015 (ADAMS Accession No. ML15211A638), the submission utilizes neutronics results that are now being significantly revised.

Provide an analysis of excess reactivity insertion for the LCC using the revised neutronics models and information, as well as limiting conditions for the inlet temperature.

29.(R2) 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. The UT SAR Section 13.5, “Loss of Reactor Coolant Accident,” 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. However, in reviewing your response dated July 15, 2015 (ADAMS Accession No. ML15211A638), the submission utilizes neutronics results that are now being significantly revised.

Provide an analysis of this event for the LCC using the revised neutronics models and information.

30.(R2) The guidance in NUREG-1537, Part 1, Section 13.1.6, “Experiment Malfunction,” requests that the licensee provide analysis of an experiment malfunction event. However, in your response dated August 21, 2013 (ADAMS Accession No. ML13246A014), it is not clear at what locations the CAP 88 calculations are performed. Furthermore, CAP 88 is generally considered appropriate for normal operation (chronic) releases and not applicable to accident analysis. In Table 1, “Maximum Potential Dose Outside Reactor Bay from Fueled Experiments,” it is unclear how the maximum dose is calculated. It also appears that the iodine inventory decayed, but this is not clear in the RAI response. The reason for this interpretation is that the inhalation dose at a given location should be proportional to the quantity (curies) released multiplied by the dose conversion factor (Q*DCF). From the data in Table 1 of the response, the ratio of Sr-90/I-131 dose is 6.4, whereas the ratio of Q*DCF(Sr)/Q*DCF(I) is 3.961. This indicates that the I-131 curie release is less than the inventory of 932,000 µCi listed in Table 1.

Provide an analysis based on the accidental (i.e., short-term) release and demonstrate that the doses are less than the proposed limit in TS 5.4, demonstrate that the proposed TS limit is acceptable, or demonstrate that the doses are bounded by the MHA.

46. The guidance in NUREG-1537, Part 1, Section 11.1.4, “Radiation Monitoring and Surveying,” requests that the licensee identify the radiation monitoring equipment, its location, and function. The UT SAR, Section 11.1.4.2, “Radiation Monitoring Equipment,” lists only "Representative Radiation Detection Instrumentation."

Provide a list of all such equipment required for operation of UT TRIGA within the facility, specify where the equipment is located, describe any alarm functions, and for any such equipment that is applicable, cite the appropriate TS limiting condition for operation and surveillance requirements by number.

47. Section 3.3 of the UT Emergency Plan, “Protective Action Values” states: “… the Emergency Director with the concurrence of the Radiation Safety Officer may authorize exposure in excess of these values to facilitate rescue of personnel with injuries or take corrective actions to mitigate consequences of an emergency event. The whole body exposure limit for life-saving is 100 rem and 25 rem for corrective actions.”

Tables 2.2 in the U.S. Environmental Protection Agency (EPA) Protective Action Guide (PAG) Manual, dated 2013 and 1992 respectively, provide the following guidance for response worker exposure.

Table 2.2: EPA PAG Manual, 2013, Response Worker Guidelines

Guideline	Activity	Condition
5 rem (50 mSv)	All occupational exposures	All reasonably achievable actions have been taken to minimize dose.
10 rem (100 mSv)[a]	Protecting valuable property necessary for public welfare (e.g. a power plant)	Exceeding 5 rem (50mSv) unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.
25 rem (250 mSv)[b]	Lifesaving or protection of large populations.	Exceeding 5 rem (50mSv) unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.
[a] For potential doses >5 rem (50mSv), medical monitoring programs should be considered. [b] In the case of a very large incident, such as an improvised nuclear device, incident commanders may need to consider raising the property and lifesaving response worker guidelines to prevent further loss of life and massive spread of destruction.		

Table 2.2: EPA PAG Manual, 1992, Guidance on Dose Limits for Workers Performing Emergency Services

Dose limit [a] (rem)	Activity	Condition
5	All	
10	Protecting valuable property	Lower dose not practicable
25	Lifesaving or protection of large populations	Lower dose not practicable
>25	Lifesaving or protection of large populations	Only on a voluntary basis to persons fully aware of the risks involved (See tables 2-3 and 2-4)

[a] Sum of external effective dose equivalent and committed dose equivalent to non-pregnant adults from exposure and intake during an emergency situation. Workers performing services during emergencies should limit dose to the lens of the eye three times the listed value and doses to any other organ (including skin and body extremities) to ten times the listed value. These limits apply to all doses from an incident, except those received in unrestricted areas as members of the public during the intermediate phase of the incident (see chapters 3 and 4).

Revise the whole body exposure limit for life saving and corrective actions or justify the current exposure limits provided in the UT Emergency Plan.