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

August 6, 2019

Ms. Amber Johnson, Director
Nuclear Reactor and Radiation Facilities
University of Maryland
Department of Materials Science
and Engineering
4418 Stadium Drive
College Park, MD 20742-2115

SUBJECT: UNIVERSITY OF MARYLAND – REGULATORY AUDIT FOR LICENSE AMENDMENT REQUEST FOR THE USE OF 16 ADDITIONAL FUEL ELEMENTS IN THE MARYLAND UNIVERSITY TRAINING REACTOR (EPID NO. L-2018-LLA-0037)

Dear Ms. Johnson:

By letter dated January 29, 2018 (Agencywide Documents Access and Management System Accession No. ML18032A096), as supplemented by letters dated March 26, 2018 (ADAMS Accession No. ML18092A086), and June 6, 2019 (ADAMS Accession No. ML19165A021), the University of Maryland (UMD) submitted a request for an amendment to Renewed Facility Operating License No. R-70 for the Maryland University Training Reactor (MUTR). The requested amendment would authorize the use of 16 additional fuel elements in the reactor core.

The U.S. Nuclear Regulatory Commission (NRC) staff will conduct an onsite regulatory audit to review the UMD application beginning August 7, 2019, and continuing as necessary through September 2019. The intent of the audit is to gain understanding of your application and status of proposed changes to your facility, as applicable to the requested license amendment request (LAR) and your June 6, 2019 responses to our request for additional information. In addition, the regulatory audit will identify information that will be required to be docketed, support the basis of the licensing decision, and allow the NRC staff to more efficiently gain insights necessary to complete the review of the UMD LAR. The NRC staff has provided a copy of the audit plan as an enclosure to this letter.

At the completion of the regulatory audit, a regulatory audit summary will be prepared and provided to you. If necessary, you will have the opportunity to supplement the application to provide additional information or the option to withdraw the application.

We appreciate your support in providing space, the requested documentation and access to the necessary personnel and other materials that will assist in an efficiently conducted audit.

Should you have any questions on this matter, please contact me at 301-415-3398 or by e-mail at Cindy.Montgomery@nrc.gov.

Sincerely,

/RA/

Cindy K. Montgomery, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-166

License No. R-70

Enclosure:
As stated

cc: w/enclosure:

cc:

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Test, Research and Training
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SUBJECT: UNIVERSITY OF MARYLAND – REGULATORY AUDIT FOR LICENSE AMENDMENT REQUEST FOR THE USE OF 16 ADDITIONAL FUEL ELEMENTS IN THE MARYLAND UNIVERSITY TRAINING REACTOR (EPID NO. L-2018-LLA-0037)

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ADAMS Accession No.: ML19214A232; NRR-106

OFFICE	NRR/PRLB/PM*	NRR/PRLB/BC	NRR/PRLB/PM
NAME	CMontgomery	GCasto	CMontgomery
DATE	7/17/2019	7/31/2019	8/6/2019

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NUCLEAR REGULATORY COMMISSION
REGULATORY AUDIT PLAN FOR UNIVERSITY OF MARYLAND
LICENSE AMENDMENT REQUEST FOR THE USE OF 16 ADDITIONAL FUEL ELEMENTS IN THE MARYLAND UNIVERSITY TRAINING REACTOR
AUGUST 7, 2019, COLLEGE PARK, MD

Background

The U.S. Nuclear Regulatory Commission (NRC) staff is currently engaged in a review of the license amendment request for the use of 16 additional fuel elements in the Maryland University Training Reactor (MUTR), submitted by letters dated January 29, 2018 (Agencywide Documents Access and Management System Accession No. ML18032A096), as supplemented by letter dated March 26, 2018 (ADAMS Accession No. ML18092A086), and June 6, 2019 (ADAMS Accession No. ML19165A021). The requested amendment would authorize the use of 16 additional fuel elements in the reactor core. This regulatory audit is intended to assist NRC staff in confirming information submitted as part of the licensing amendment request.

Regulatory Audit Bases

The purpose of this audit is to determine if the use of the 16 additional fuel elements at MUTR meets the regulatory requirements and addresses applicable criteria in NUREG-1537. This audit will provide information necessary to complete the NRC staff's evaluation of the proposed use of 16 additional fuel elements in the reactor core. In addition, the regulatory audit will identify information that will be required to be docketed to support the basis of the licensing decision and will allow NRC staff to gain insights on the safety of the use of the 16 additional fuel elements.

To support this audit, the NRC audit team will visit MUTR in College Park, MD.

Regulatory Audit Scope

As part of the audit, the NRC staff will review non-docketed procedures and records related to the use of the 16 additional fuel elements, as well as interview key UMD personnel responsible for the safety of the reactor. The NRC staff will be evaluating whether the information provided in proposed amendment will support conclusions in the staff safety evaluation.

Information Necessary for the Regulatory Audit

UMD staff should be prepared to have the following documentation and information available:

- Oregon State University's Neutronics Report
- RAI Responses dated June 6, 2019
- Questions from staff review of June 6. 2019 responses (attached)

Team Assignments/Resource Estimates

The NRC staff performing this audit will be:

- Michael Balazik (Audit Leader)
- Greg Casto (Branch Chief)
- Cindy Montgomery (Project Manager)

Logistics

The audit will take place at MUTR on Wednesday, August 7, 2019.

Deliverables

At the completion of the regulatory audit:

- NRC staff will submit any additional requests for information necessary to complete the staff safety evaluation for the proposed LAR, within 30 days after the audit.
- NRC staff will prepare a regulatory audit summary, which will be issued within 90 days after the audit.

Audit Schedule

August 7, 2019

9:30 a.m.	Arrive at MUTR
9:30 a.m.	Entrance meeting, introductions, and license amendment status
10:00 a.m.	Begin Audit
12:00 p.m.	Break for Lunch
1:30 p.m.	Resume Audit
5:00 p.m.	End for the day

Additional audit activities will be planned in advance, as necessary to support the understanding of information necessary to complete the review of the LAR. It is expected that more interaction will be needed to identify information requests to support LAR review activities.

Audit Questions – See Following Pages

U.S. Nuclear Regulatory Commission Audit
University of Maryland - Core Configuration Change Amendment

Question 1 (from June 6, 2019 response to RAI 2)

Provide a thermal-hydraulic analysis for the proposed core configuration or explain why the thermal-hydraulic analysis for the current core configuration, as referenced in the LAR, bounds the proposed core configuration.

a) **University of Maryland (UMD) states in response to RAI 2 that the average power per element at full power will be reduced from 2.00 kW to 1.95 kW.**

   Explain the methodology used to calculate the average power per element.

b) **UMD performed the neutronics for the proposed core configuration at a power level of 250 kW. During the renewal, UMD performed the neutronics at 300 kW. Technical Specifications 3.2, Table 3.1 authorizes UMD to set the Reactor Power Level Scram to not to exceed 120% (300 kW).**

   Explain why the neutronics analysis for the proposed core does not bound the safety function setpoint of the Reactor Power Level Scram and is inconsistent with UMD's thermal hydraulic analysis performed during license renewal.

Question 2 (from June 6, 2019 response to RAI 4)

Table 3, "Rod worth measurements and calculations," of the LAR compares the current core configuration simulated and measured reactivity worths for the Regulating Rod, Shim 1, and Shim 2. The difference between the simulated and measured reactivity worths for Shim 1 and Shim 2 differ by $1.72 and $1.12, respectively.

Additional information is needed for the NRC staff to understand the differences between the simulated and measured reactivity worths for Shim 1 and Shim 2 and whether the model supplying those results is suitably predictive.

Provide an explanation of the substantial difference between the calculated and measure reactivity worths for Shim 1 and Shim 2.

a) **In response to RAI 4, UMD performed a different method for measuring rod worth and concluded that these measurements are consistent with the model.**

   Does UMD plan to continue using this rod worth measurement method for initial startup and during its required surveillance (Technical Specification 4.2.1).

   Provide a current graph of rod worth data up to 2019 (Figure 14 – Historic MUTR Control Rod Data).

Question 3 (from June 6, 2019 response to RAI 5)

The LAR proposes a limiting condition for operation (LCO) for excess reactivity of not greater than $3.50.

By letter dated December 18, 2006 (ADAMS Accession No. ML101480913), UMD provided information in response to a request for additional information (RAI) during license renewal review. In response to RAI 84, UMD provided information on ramp reactivity insertions caused by inadvertent rod withdrawal at both low and high-power conditions.

Additional information is needed for the NRC staff to understand if the information in the rod withdrawal analysis provided by letter December 18, 2006, is bounding given the proposed increase in the excess reactivity limit to $3.50 and that TS limitations give reasonable assurance that a rapid insertion of reactivity is not credible.

Provide a justification that the rod withdrawal analysis provided by the December 18, 2006, letter bounds the proposed excess reactivity LCO of $3.50. If not, provide a revised rod withdrawal analysis that considers an excess reactivity of $3.50.

a) **In response to RAI 5, UMD stated that the rod withdrawal analysis from December 2006 does not provide a bounding condition for the proposed excess reactivity LCO of $3.50 and credits the robust design of TRIGA fuel.**

   Does UMD have access to the rod withdrawal model that was performed in December 2006.

   Can UMD analyze the most limiting rod withdrawal scenario in the safety analysis report using $3.50 excess reactivity as an input.

Question 4 (from June 6, 2019 response to RAI 10)

LAR Table 3, “Rod worth measurements and calculations,” provides measured and simulated control rod reactivity worths for the current core configuration. Additionally, Table 3 provides simulated control rod reactivity worths for the proposed core configuration.

With the substantial differences between the simulated and measured control rod reactivity worths for the current core configuration, the NRC staff needs additional information to understand how the shutdown margin will always be maintained under actual conditions (i.e., measured) for the proposed core configuration. Because of this substantial control rod reactivity difference in the current core configuration, the UMD simulation of the proposed core configuration may not provide adequate predictions of control rod worths for determining that the shutdown margin will be maintained for the proposed core configuration.

Provide a shutdown margin analysis that includes relevant uncertainties, error limits, and worst-case conditions and takes into account the difference between the simulated and measured control rod worths for the current core configuration.

Provide an explanation of why the proposed core configuration simulation provides acceptable predictions of control rod worths for determining that the shutdown margin will be maintained for the proposed core configuration.

a) **In response to RAI 10, UMD stated that "adding fuel to the core will increase the control rod worth," However in evaluating information in Table 3, "Rod worth measurements and calculations," current calculated rod worth for every control rod did not increase. For Shim 1 and Shim 2, modeled reactivity rod worth decreased. Additionally, total rod worth decreased from $10.49 to $9.35. Explain the apparent discrepancy between UMD's response and the results of the control rod worth model.**

b) **Explain what control rod worth data UMD will use to calculate shutdown margin during initial startup of the proposed core.**

Question 5 (from June 6, 2019 response to RAI 11)

The LAR states the following:

*As an upward bound, a **$4.00** insertion of excess reactivity will be analyzed as the credible option for a prompt insertion of reactivity. This number is taken from technical specification 3.6.2, the total reactivity worth of an experiment.*

MUTR TS 3.6, "Limits on Experiments," Specification 2 states the following:

*The total absolute reactivity worth of EXPERIMENTS shall not exceed **$3.00,** including the potential reactivity which might result from experimental malfunction and EXPERIMENT flooding or voiding.*

Provide an explanation for the apparent discrepancy between the statements in the LAR above referring to a $4.00 insertion of excess reactivity and MUTR TS 3.6, Specification 2. In addition, for the proposed core configuration, provide the basis for selecting $4.00 of reactivity as a bounding analysis for a credible prompt insertion of reactivity, especially given that your proposed excess reactivity is $3.50.

a) **In UMD's renewal application, UMD analyzed a pulse of $3.70 (credible option) at 250 kW resulting in 988 degrees Celsius peak temperature. In UMD's license amendment request, UMD analyzed a $4.00 pulse at 220 kW resulting in a peak temperature of 538 degrees Celsius.**

   Explain why the $4.00 pulse results in a significantly lower peak temperature.

b) **In response to RAI 59 during renewal, UMD stated that recent MCNP calculations indicate that the most reactive fuel bundle is worth $5.70.**

   Does UMD estimate that central fuel bundle for the proposed core has an reactivity worth of $4.70.

Question 6 (from June 6, 2019 response to RAI 13)

The proposed TS 4.1, Specification 4, as written, is unclear on which and how many fuel bundles will be visually inspected annually. Additional information is needed for the NRC staff to understand if UMD intends to perform a visual inspection of at least 20 percent of the fuel bundles in the core on an annual frequency as referenced in NUREG-1537, Appendix 14.1, Section 4.1.6.

Provide an explanation if UMD can perform an adequate visual inspection of the remaining fuel bundles (i.e., other than fuel bundles in rows B and C) in the core. If so, state which fuel bundles can be adequately inspected.

Include additional information in TS 4.1, Specification 4, to explicitly state which and how many fuel bundles will be inspected on an annual frequency.

a) **Explain if UMD can perform a visual inspection of other fuel bundles in the core.**

b) **Explain and provide the procedure for fuel inspection.**

c) **Currently, UMD is inspecting 2 out of 24 fuel bundles (8.3% of the core) annually. UMD is proposing to add 4 fuel bundles to the core configuration. Provide the basis for only inspecting 2 out of 28 fuel bundles (proposed core) annually (7.1% of the core).**