March 23, 2016

Mr. Ralph Butler, Executive Director
University of Missouri-Columbia
Research Reactor Center
1513 Research Park Drive
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI AT COLUMBIA—CLARIFICATIONS NEEDED TO NUCLEAR REGULATORY COMMISSION STAFF REQUEST FOR ADDITIONAL INFORMATION REGARDING THE RENEWAL OF FACILITY OPERATING LICENSE NO. R-103 FOR THE UNIVERSITY OF MISSOURI AT COLUMBIA RESEARCH REACTOR (TAC NO. ME1580)

Dear Mr. Butler:

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for the renewal of Facility Operating License No. R-103, dated August 31, 2006 (redacted versions of the application and supplement are available on the NRC's public web site at www.nrc.gov under Agencywide Documents Access and Management System (ADAMS) Accession Nos.: ML062540114 - cover letter; ML092110573 - Safety Analysis Report (SAR), Chapters 1-9; ML092110597 - SAR, Chapters 10-18), for the University of Missouri at Columbia Research Reactor. The NRC staff reviewed your responses, by letter dated February 8, 2016 (ADAMS Accession No. ML16041A221), to our request for additional information (RAI), by letter dated April 17, 2015 (ADAMS Accession No. ML15098A648), and identified several RAI responses which needed additional information or clarification. These RAIs were discussed with your staff by a conference call conducted on March 15 and 17, 2016. Those RAI responses which need additional information or clarification are provided in the enclosure. We request that you provide responses within 14 days from the receipt 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 your 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 evaluation of your renewal request.

If you need additional time to complete this request, or have any questions regarding this review, please contact me at (301) 415-0893, or by electronic mail at Geoffrey.Wertz@nrc.gov.

Sincerely,

/RA by Alexander Adams for/

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

Docket No. 50-186

Enclosure:
As stated

cc: See next page

cc:

Les Foyto, Associate Director
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Homeland Security Coordinator
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Office of Administration
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Jefferson City, MO 65101

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

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ADAMS Accession No: ML16083A025 ***concurrence via email** **NRR-106**

OFFICE	DPR/PRLB/PM*	DPR/PRLB/LA*	DPR/PRLB/BC	DPR/PRLB/PM
NAME	GWertz	NParker	AAdams	GWertz (AAdams for)
DATE	3/23/16	3/23/16	3/23/16	3/23/16

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OFFICE OF NUCLEAR REACTOR REGULATION

CLARIFICATIONS NEEDED FOR THE

REQUEST FOR ADDITIONAL INFORMATION

FOR THE RENEWED LICENSE FOR

THE UNIVERSITY OF MISSOURI-COLUMBIA RESEARCH REACTOR

LICENSE NO. R-103; DOCKET NO. 50-186

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for the renewal of Facility Operating License No. R-103, dated August 31, 2006, as supplemented, for the University of Missouri at Columbia Research Reactor (MURR). The NRC staff reviewed your responses, by letter dated February 8, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A221), to our request for additional information (RAI), by letter dated April 17, 2015 (ADAMS Accession No. ML15098A648), and identified several RAI responses which needed additional information or clarification. These RAIs were discussed with your staff by a conference call conducted on March 15 and 17, 2016. We request that you provide responses within 14 days from the receipt of this letter. The RAI responses which need additional information or clarification are provided below.

Note: The numbering in the column labeled "RAI No." corresponds to the RAIs issued by NRC letter dated April 17, 2015. The brackets [page] at the end of each item indicate the page number on the RAI response provided by MURR letter dated February 8, 2016.

RAI No.	Information/Clarification Needed
3.c.	Provide control blade D total reactivity worth – measured and calculated in numerical form (not graphical) [page 9].
7.g.	• Explain origin of source term data provided in RAI response [page 19]. • Provide Attachment 4 in landscape mode to eliminate data wrapping around the next line, remove transport edits, and provide an explanation to translate calculated radioisotope inventories into the RAI response inventory. • Provide the equations (or spreadsheets) for calculations from Attachments 5 and 6.
7.g.iv	• Correct Kr-90 dose by eliminating the negative dose contribution from the curve fit [page 20]. • Review/correct the gamma source terms. • Correct reference to Attachment 7 (not Attachment 5 as indicated). • Provide an updated Attachment 7.
9.b.ii.	Explain the source term for the 30 minutes decay [page 38].

Enclosure

Fuel Failure During Reactor Operation Analysis [page 22]

- Explain the origin of core inventory of isotopes (which we now understand is not from Attachment 2) [page 24]
- The mass transport equation is not clear, bracketing appears inconsistent – provide step-by-step description of the transport process with supporting equations for clarity [page 26].
- Clarify how the current MURR TS 4.2.c containment building leakage rate is being used as the assumption for the leakage in the analysis [page 30].
- The analysis uses an iodine reduction factor of 75 percent. The NRC staff noted (from Attachment 13) that MURR previously used an iodine reduction factor of 50 percent in accordance with the guidance in Regulatory Guide 1.3 in support of MURR License Amendment No. 8. The NRC staff needs additional information to understand the technical basis for use of an iodine reduction factor of 75 percent in the current fuel failure analyses [page 31].
- The analysis indicates that there was no decay applied to the isotopes, but it appears that the decay of source isotopes was performed. Explain [page 32].
- Derived Air Concentration values for Kr-89, Kr-90, Xe-137, and Xe-139 were divided by 300. Title 10 of the *Code of Federal Regulations* Part 20, Appendix B, uses a factor of 219, which the NRC staff will also use. Consider revision using a factor of 219 [page 35].

Fuel Handling Accident Analysis [page 39]

- Origin of core inventory not clear (similar to comment on page 24 above) [page 40].
- The bracketing in several equations appears inconsistent (similar to comment on page 26 above, and again on page 47) [page 41].
- Units used are non-standard (micro-Curies per cubic foot versus micro-Curies per cubic milliliter, similar comment on pages 47 and 48). Verify units [page 41].
- The value of 229,801 cubic feet was used versus the Technical Specification value of 225,000 cubic feet (similar comment on pages 47 and 63). Explain [page 41].

Fueled Experiment Failure [page 56]

- Several equations do not appear to have been bracketed correctly. Explain.
- Units used are non-standard (micro-Curies per cubic foot versus micro-Curies per cubic milliliter, similar comment on pages 47 and 48). Verify.