August 11, 2016

Dr. Jeffrey A. Geuther, Manager
Kansas State University
Kansas State University Nuclear Reactor Facility
112 Ward Hall
Manhattan, KS 66506-5204

SUBJECT: KANSAS STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST FOR FACILITY OPERATING LICENSE NO. R-88, FOR THE KANSAS STATE UNIVERSITY NUCLEAR REACTOR

Dear Dr. Geuther:

The U.S. Nuclear Regulatory Commission (NRC) staff is continuing its review of your application for a license amendment, by letter dated April 9, 2012 (Agencywide Documents Access and Management System (ADAMS), Accession No. ML12109A063) to Facility Operating License No. R-88 for the Kansas State University (KSU) Research Reactor, for the use of up to four fuel elements of 12.5 percent uranium by weight in certain locations of the core of the KSU TRIGA Mark-II nuclear reactor facility.

By letter dated April 28, 2014 (ADAMS Accession No. ML16200A317), you responded to our request for additional information (RAI). During our review of your response, additional questions have arisen for which we require additional information and clarification. Please provide responses to the enclosed RAI within 45 days from the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 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 amendment request.

If you have any questions about this review or if you need additional time to respond to this request, please contact me at 301-415-3965 or via electronic mail at Spyros.Traiforos@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-188
License No. R-88

Enclosure:
As stated

cc: See next page

Docket No. 50-188

Kansas State University

cc:

Office of the Governor
State of Kansas
Suite 2415
300 SW 10th Avenue
Topeka, KS 66612-1590

Thomas A. Conley, RRPJ, CHP
Section Chief Radiation and Asbestos Control
KS Dept of Health & Environment
1000 SW Jackson, Suite 330
Topeka, KS 66612-1365

Mayor of Manhattan
P.O. Box 748
Manhattan, KS 66502

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

If you have any questions about this review or if you need additional time to respond to this request, please contact me at 301-415-3965 or via electronic mail at Spyros.Traiforos@nrc.gov.

Sincerely,

/RA/

Spyros A. Traiforos, Project Manager
Research and Test Reactors Licensing Branch
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Office of Nuclear Reactor Regulation

Docket No. 50-188
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Enclosure:
As stated

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ADAMS Accession No.: ML16189A194 NRR-088

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DATE	07/20/2016	07/20/2016	08/11/2016	08/11/2016

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING LICENSE AMENDMENT REQUEST FOR

KANSAS STATE UNIVERSITY NUCLEAR REACTOR FACILITY

LICENSE NO. R-88; DOCKET NO. 50-188

The U.S. Nuclear Regulatory Commission (NRC) staff is continuing its review of your license amendment request (LAR), submitted by letter dated April 9, 2012, (Agencywide Documents Access and Management System (ADAMS), Accession No. ML12109A063), to Facility Operating License No. R-88 for the Kansas State University (KSU) Research Reactor, for the use of up to four fuel elements of 12.5 percent uranium by weight in certain locations of the core of the KSU TRIGA Mark-II nuclear reactor facility.

This request for additional information (RAI) is based on our review of the above LAR, the safety analysis report (SAR) dated December 12, 2004 (ADAMS Accession No. ML052580517), and your responses of April 28, 2014 (ADAMS Accession No. ML16200A317), to the NRC RAIs dated March 19, 2014 (ADAMS Accession No. ML14065A539).

The regulatory basis for LAR resides in Title 10 of the *Code of Federal Regulation* (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," and states "Whenever a holder of a license, including a construction permit and operating license under this part, and an early site permit, combined license, and manufacturing license under part 52 of this chapter, desires to amend the license or permit, application for an amendment must be filed with the Commission, as specified in §§ 50.4 or 52.3 of this chapter, as applicable, fully describing the changes desired, and following as far as applicable, the form prescribed for original applications." The reference to the "Original applications," as used in the requirements presented in 10 CFR 50.90 refer to the operating license and construction permit applications. The regulations in 10 CFR 50.34, "Contents of applications; technical information," provides operating license requirements in 10 CFR 50.34(b), "Final safety analysis report," and construction permit requirements in 10 CFR 50.34(a), "Preliminary safety analysis report." To the extent that this information is also required by the KSU Reactor Technical Specification, 10 CFR 50.36, "Technical specification," provides those requirements.

NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria," provides guidance concerning the type and level of detail of the information that is required to support the NRC staff review of your LAR. The information requested is needed by the NRC staff to independently verify that the acceptance criteria discussed in Section 4.6 of NUREG-1537, Part 2, are met by the applicant.

1. SAR Section 4.2.5, "Core Support Structures," states "The bottom grid plate, which supports the weight of the fuel elements, has holes for receiving the lower end fixtures. Space is provided for the passage of cooling water around the sides of the bottom grid plate and through 36 experiment penetrations. The 1.5-in. (3.8 cm) diameter holes in

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the upper grid plate serve to space the fuel elements and to allow withdrawal of the elements from the core. Triangular-shaped spacers on the upper end fixtures allow the cooling water to pass through the upper grid plate when the fuel elements are in position. The reflector assembly supports both grid plates."

Provide the drawings of the core support and other structures. Also provide documentation describing the flow path geometry around the side of the bottom grid plate.

2. The loss coefficient for the core exit is calculated on page 4-26 of the SAR to be 0.171. It is described as a contraction loss. The actual flow will undergo a contraction followed by an expansion when flowing through the grid plate. Provide the basis for the formula used to calculate the core exit loss coefficient.

3. Coolant flow rate and temperature rise for natural convection cooling are tabulated in Table 4.11. Are the hydraulic diameter and flow area values used in the calculation, core average values or hot channel values?

4. According to SAR, Section 4.6, the calculation for core flow rate vs. power uses a core inlet temperature of 27 degrees Celsius and uses an equation that is applicable only to single phase flow. Are the pool temperature limits designed to ensure that single phase flow exists across the core?

5. SAR Section 4.6, states that the entrance of coolant into the core is from the side, above the lower grid plate (see Section 4.2.5), and the entrance pressure loss would be expected to be negligible. There is no basis for this statement. Provide the basis.

RAI Nos. 6 through 11, refer to the base, unperturbed Monte Carlo N-Particle (MCNP) code input (at 8 weight percent) that was supplied with your RAI response dated April 28, 2014 (ADAMS Accession No. ML16200A317).

6. The NRC staff wants to reconcile the fuel pin cylindrical radii given in surfaces 200 through 202 with what they were able to calculate from the SAR and some of the cited references that describe Mark III fuel. The NRC staff arrived at the following values for pin radii: middle zirconium rod (0.3175 centimeters (cm)); fuel-moderator material (1.8161 cm); gap (1.8415 cm); and clad (1.8669 cm). Supply the basis for the dimensions given in Surfaces 200 through 202.

7. For the surfaces that define the fuel elements (surfaces 1201 through 1630), the respective fuel element radii are all defined as 1.8985 cm, but NRC staff were expecting this value to be consistent with that defined for the universal fuel element radius in surface 202. Give the basis for this number.

8. For the thickness of the aluminum casing surrounding the graphite reflector, NRC staff found different values in the MCNP code input, depending upon what side of the graphite reflector was being considered. State what the value of the thickness should be.

9. There are three fuel elements in the B Ring of the core that are instrumented for temperature. In RAI No. 2, of the KSU RAI response (ADAMS Accession No. ML16200A317), KSU gives the results of a heat balance to infer the steady state operating temperatures of each ring in the core. Has the facility recorded any steady state temperatures from these elements to confirm the calculations and heat balance methodology? Have power readings ever been recorded during pulsing operation? If so, please describe the results of any applicable confirmatory measurements.

10. In RAI No. 1 of the KSU RAI response, KSU gives a methodology for determining the change in Uranium-235 mass with burnup (initial fuel composition minus the burnup per element). Provide the composition of the maximum burnup element that is calculated through this methodology.

11. For Cell 176, the stainless steel shell of the source is defined as 0.394473 grams per/cubic centimeter (g/cc). This is almost an order of magnitude less than the source density given in the Stainless Steel material card (m9, 7.9 g/cc). Has this cell been volume homogenized?

12. This RAI is generated from your current TS 3.4, “Safety Channel and Control Rod Operability,” and it is beyond what is addressed in your LAR. 10 CFR 50.36(c)(2)(ii), requires a technical specification limiting condition for operation of a nuclear reactor must be established for a structure, system, or component (for example, control rods) that meet specific criteria. Specifically, 10 CFR 50.36(c)(2)(ii), Criterion 3 states “A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.” In addition, American National Standard Institute/ American Nuclear Society-15.1-2007, “The Development of Technical Specifications for Research Reactors,” Section 2.2, “Limiting safety systems settings,” states that limiting safety systems settings shall be established. The guidance in NUREG-1537, Part 1, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,” Chapter 14, “Technical Specifications,” Appendix 14.1, “Format and Content of Technical Specifications for Non-Power Reactors,” Subsection 3.2, item (1), “Operable Control Rods,” asks the number and type of operable control and safety rods be specified. However, under the current TS 3.4 there are no technical details specified regarding the operability and numbers of your reactor control rods. Provide a specific proposal to the current TS 3.4 that would demonstrate, as a limiting condition, control rods in reactor core provide a success path for the safe operation of your reactor.