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Washington, DC 20555-0001

DATE: 10 March 2011

SUBJECT: Response to February 24, 2011 Letter: KANSAS STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION REGARDING THE REQUEST FOR POSSESSION LIMIT INCREASE FOR THE KANSAS STATE UNIVERSITY TRIGA MK-II NUCLEAR REACTOR FACILITY (TAC NO. ME4730).

Dear Mr. Wertz:

A possession limit increase request was submitted for the Kansas State University TRIGA reactor facility. The request was for a limit increase of 200 g ^{235}U, from 4.200 kg to 4.400 kg, to be used in connection with the operation of the reactor. This increase would allow the facility to receive six new fuel elements from CERCA.

On February 24, 2011, the NRC responded with a Request for Additional Information (RAI) regarding the possession limit increase. As a consequence of the RAI, the Facility has determined that a minor change to the Physical Security Plan must be processed prior to the receipt of the new fuel. This change has been determined not to constitute a decrease in effectiveness, and will be discussed in a separate submittal.

The response to the RAI is enclosed. If you have any further questions, please do not hesitate to contact me at 785 532 6657.

I verify under penalty of perjury that the foregoing is true and correct.

Executed on 10 March 2011,

Jeffrey A. Geuther

Docket No. 50-188

Enclosure: Response to RAI

cc: Geoffrey Wertz, Project Manager

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NRR

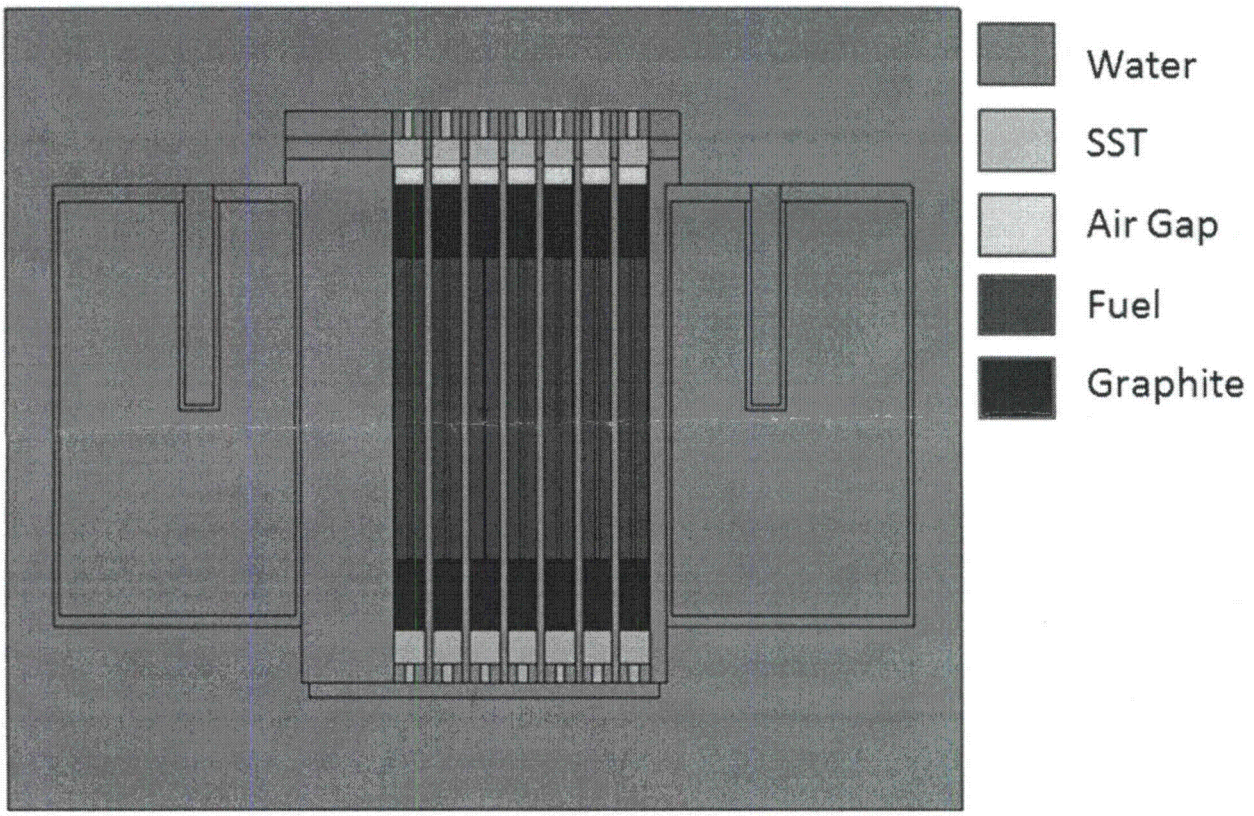

FIGURE 2 - SIDE VIEW OF MCNP MODEL, COLOR-CODED BY MATERIAL.

3. *Title 10 of the Code of Federal Regulations (10 CFR) Section 50.54 (q) requires research reactor licensees to develop and implement an Emergency Plan; 10 CFR 73 requires research reactor licensees to develop and implement a Security Plan; and 10 CFR 20 requires research reactor licensees to develop and implement a Radiation Protection Program. Please indicate if any changes to the Emergency or Security Plans, or Radiation Protection Program are necessary as a result of this license amendment request.*

The Radiation Protection Plan and Emergency Plan have been reviewed and will not need to be revised in order to accept the new fuel.

The Physical Security Plan requires a minor change related to the license amendment request. It has been determined that the change does not constitute a decrease in effectiveness. The change will be executed prior to the receipt of the new fuel, and does not require prior NRC approval. Documentation of the change and a copy of the revised Physical Security Plan will be sent as a separate Submittal under the provisions of 10CFR-2.390.

4. *Regulation 10 CFR 50.36 requires research reactor licensees to develop technical specifications. Please indicate whether any changes to the KSU technical specifications are necessary as a result of this license amendment request.*

The Technical Specifications limit fuel to 9.0% loading if it is to be in the reactor core (TS 5.1.3.1). However, the loading of fuel in storage is not limited, and the only restrictions on un-irradiated fuel are that the k-effective in storage cannot exceed 0.8 and that the elements must be stored in a safe, stable geometry (TS 5.2.3). Both of these requirements are satisfied by

storing the fuel in the in-core racks, and therefore the Technical Specifications need not be revised until approval is sought to load the fuel in the core.

5. *NUREG-1537, Part 1, Section 13, "Accident Analysis," provides detailed guidance for research reactors to evaluate accident scenarios relevant to their specific facility in their safety analysis report (SAR). Please describe if any changes to the accident scenarios, as currently described in the KSU SAR, result from this license amendment request.*

The accident scenarios in the KSU Reactor SAR are not affected by the in-pool storage of 12%-loaded new fuel elements, and need not be revised.

The questions listed in the Request for Additional Information are listed below, along with the corresponding Facility response.

1. *NUREG 1537, Part 1, Section 11.1.1 provides guidance for demonstrating that sources of radiation are monitored and controlled. Please indicate if the fuel is unirradiated.*

The fuel to be received at the facility is fresh fuel, and has never been irradiated.

2. *NUREG 1537, Part 1, Chapter 9.2, "Handling and Storage of Reactor Fuel," provides guidance to demonstrate that subcriticality is ensured. Your November 1, 2010 letter indicated that the new fuel would be stored in sets of two racks, with the fuel in two rows of six (6) fuel elements, but at different axial elevations to reduce neutron coupling. However, the KSU SAR, Section 9.2, Fuel Handling and Storage of Reactor Fuel Rev. 5/08, indicates that the fuel racks allow only for single row spacing up to six elements. Please clarify the storage orientation of the fuel storage racks and if a change to SAR is needed.*

Chapter 10.2 of the SAR describes the fuel storage geometry as single rows of six elements per row, whereas the license amendment request referred to axially-offset double rows of elements. The fuel racks consist of either single rows of (up to) six elements, or two rows in the same polar location, but separated by 29" of vertical distance. Since the fueled region of TRIGA elements is 15" in length, the fueled region of two elements will be separated by at least 14" of distance if the elements are in the double racks. This separation distance is many mean free paths for a thermal neutron in water, and sufficiently decouples the two rows that they are effectively two single rows. Therefore, the SAR description is accurate. However, the Facility also believes that the SAR description of the racks as single rows was confusing, and a clarification to the geometry of the racks in SAR 10.2 will be pursued.

In the MCNP model used in the Facility's criticality safety analysis of 12%-loaded fuel stored in the in-pool fuel racks, the racks were modeled as seven elements long, with no vertical separation between the two rows. The model was a modification of an existing model of the reactor, so the graphite reflector was in the model geometry. The removal of the graphite reflector lowers k-effective to 0.66627 +/- 0.00022, which is lower by a large margin than the limit of 0.8 given in the Technical Specifications, section 5.2. With this modification, the fuel elements are modeled in a large pool of water, which is conservative compared to the actual storage geometry, in which concrete occupies approximately half the solid angle about the fuel element storage racks. The fuel rack metal was not included in the model. The location of fourteen fresh 12%-loaded fuel elements in one set of two racks is extremely conservative. If the fresh fuel was mixed with irradiated elements, or fresh elements with lower loading, the k-effective would decrease due to a decrease in the ^{235}U content (and therefore the reactivity) of the irradiated or lower-loaded elements relative to the fresh 12% elements.

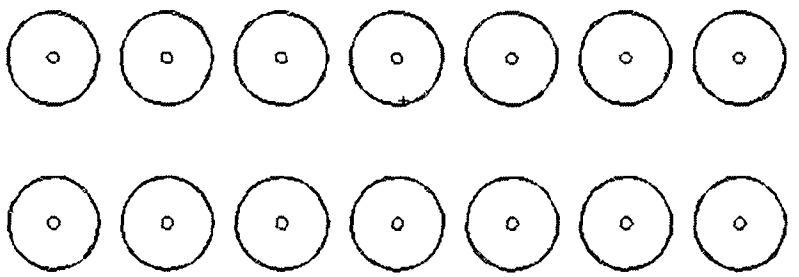

FIGURE 1 - TOP-DOWN VIEW OF FUEL ELEMENT ARRAY IN MCNP MODEL