OREGON STATE UNIVERSITY

Reply to Request for Additional Information (Redacted Version)

Docket No. 50-243
License No. R-106

February 11, 2008

Original document contained Safeguards Information and is withheld from the public

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February 11, 2008

Mr. Alexander Adams
U. S. Nuclear Regulatory Commission
Research and Test Reactors Branch A
Office of Nuclear Reactor Regulation
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Reference: Oregon State University TRIGA Reactor (OSTR)
Docket No. 50-243, License No. R-106
Request for Additional Information (RAI) Regarding Amendment Request for Increase in Possession Limits for Reactor Conversion, Oregon State University TRIGA Reactor (TAC NO. MD7360) dated January 11, 2008

Subject: Oregon State University Response to RAI Regarding Amendment Request for Increase in Possession Limits for Reactor Conversion, Oregon State University TRIGA Reactor dated January 11, 2008

Mr. Adams:

In a letter dated January 11, 2008, the U.S. Nuclear Regulatory Commission (NRC) requested that Oregon State University (OSU) provide additional information in regards to the OSU amendment request for an increase in the possession limit in support of the reactor conversion. Answers to the RAI can be found in the attached enclosure. When this letter is attached with the enclosure, please withhold this letter from public disclosure per 10 CFR 2.390.

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

Executed on: 2/11/08.

Sincerely,

Steve Reese
Director

Enclosure

cc: Document Control, NRC (w/o Enclosure)
Craig Bassett, NRC
John Cassady, OSU (w/o Enclosure)
Rich Holdren, OSU (w/o Enclosure)
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[redacted]

Oregon State University

Responses to RAI Letter of January 11, 2008

REQUEST FOR ADDITIONAL INFORMATION OREGON STATE UNIVERSITY TRIGA REACTOR DOCKET NO. 50-243

The purpose of the following question is to determine possession limits under 10 CFR Part 70.

1. **For your proposed first stage license condition 2.b(5), your application states that you will receive, possess, but not use the new low-enriched uranium (LEU) fuel. However, your proposed license condition does not contain the constraint "but not use." Please clarify. Your proposed license condition also contains wording "and to possess, but not separate, such special nuclear material as may be produced by the operation of the facility." Please explain how this wording is related to the possession of the new LEU fuel until the conversion order is issued? If this is a proposed general improvement to your license conditions, please submit it as part of your license renewal application.**

   To address these concerns, we propose the following language for section 2.b(5), for the "first stage":

   > Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," to receive and possess but not use up to 16.30 kilograms of contained uranium-235 at enrichment less than 20 percent in the form of non-power reactor fuel in connection with operation of the reactor.

2. **Section 9, Auxiliary Systems. The end of this section states as fuel is received at the OSTR facility it will be stored in a physically secure location. Is this the location discussed in Section 9, or is there another storage location that will be employed? If there is another storage location, please discuss criticality of fuel stored in this location.**

   Note: [redacted] The LEU storage container was modeled as an infinite two-dimensional array. [redacted] The HEU storage rack was modeled as a 10X20 finite square pitch array.

   The LEU storage facility is not discussed in detail in the conversion SAR, as submitted. [redacted]

[redacted]

MCNP5 analysis has been performed on the storage facility. The LEU storage facility was modeled as an infinite two-dimensional square array of fuel elements with concrete below the storage container and air above the storage container. Fuel spacing and orientation is maintained by two aluminum support plates, one six inches above the bottom of the fuel elements and the other eight inches below the top of the fuel elements. The fuel storage lattice has a pitch of 10.0 cm.

If the storage container is assumed to contain fuel surrounded by air, the calculated value of k_∞ is 0.66814 +/- 0.00034. If the storage container is assumed to contain fuel surrounded by water, the calculated value of k_∞ is 0.64591 +/- 0.00033. The fact that k_∞ with water is less than k_∞ with air is due to the use of an infinite array. A lower k_∞ results since water is a better absorber than air and the importance of moderation and scattering is greatly reduced in an infinite lattice. In each case, the actual value of the multiplication factor will be less than the calculated value of k_∞. Since k_∞ is well below the OSTR proposed criticality limit of 0.9, the planned storage rack is adequate for storage of new LEU 30/20 fuel.

3. **Section 9, Auxiliary Systems. Why is K-eff with equal mixtures of fuel higher than it is with either high-enriched uranium or LEU fuel alone?**

The calculations were performed for a finite, 10X20 square pitch array of 200 FLIP fuel elements, 200 LEU 30/20 fuel elements and a mixture of 100 FLIP and 100 LEU 30/20 fuel elements. The k_{eff} value for the mixture should have been between the k_{eff} values for the pure FLIP and pure LEU 30/20 cases. The calculated k_{eff} value for the mixture was greater than both pure cases due to the fact that incorrect number densities for LEU 30/20 fuel were utilized in the pure LEU model and in the mixed model.

We have verified that correct HEU and LEU number densities were used in the extensive core calculations performed in section 4 of this conversion SAR. The storage array calculations were performed independently, approximately six months after the section 4 calculations were completed. No other MCNP calculations were performed in support of the conversion SAR.

The storage rack calculations have been repeated with correct number densities and with radial (3 rings) and axial (5 segments) zoning for the HEU MOL elements. Number densities for representative fuel elements from each ring (A through F) were obtained from the HEU MOL core. Results are tabulated below. Note that the multiplication factor for the mixed rack containing 100 F1 elements from the HEU MOL core and 100 LEU 30/20 elements lies between those of the LEU and HEU F1 cases.

Rack Contents	k_{eff}
200 new LEU 30/20 FE's	0.61238 +/- 0.00070
200 B1 FE's (HEU MOL core)	0.52929 +/- 0.00064
200 C1 FE's (HEU MOL core)	0.53118 +/- 0.00064
200 D1 FE's (HEU MOL core)	0.53488 +/- 0.00066
200 E1 FE's (HEU MOL core)	0.54580 +/- 0.00067
200 F1 FE's (HEU MOL core)	0.54783 +/- 0.00065
100 LEU 30/20 + 100 FLIP F1 FE's (HEU MOL)	0.57719 +/- 0.00069

For completeness, the LEU analysis and the most reactive HEU analysis (200 F1 FE's from the HEU MOL core) were re-performed with the Bulk Shield Tank water replaced with air. Although the storage array is highly over-moderated, replacing water with air reduced the multiplication factor in each case. Regardless, the k_{eff} is well below the OSTR proposed criticality limit of 0.9 in all cases.

4. **Why does OSU need possession of the LEU fuel prior to issuance of the conversion order?**

The new LEU 30/20 TRIGA fuel will be shipped to the Oregon State TRIGA Reactor in TN-BGC1 shipping containers. Relicensing of the TN-BGC1 containers has taken longer than anticipated. However, an extension was granted which allows shipments in the cask only up to June 30, 2008. This deadline necessitates that the new fuel elements be transported to the OSTR well in advance of the scheduled reactor conversion date. It is understood that the preferred path would be for the NRC to issue one order encompassing the reactor conversion and the necessary possession increase, but this is precluded by the timing of shipment and conversion activities. Therefore, Oregon State University is asking for a separate order to specifically authorize the increase in the possession limit.