

June 21, 2007

EA-07-160

Mr. Jere H. Jenkins
Director of Radiation Laboratories
Purdue University
School of Nuclear Engineering
Nuclear Engineering Building
400 Central Drive
West Lafayette, IN 47907-2017

SUBJECT: ISSUANCE OF ORDER MODIFYING LICENSE NO. R-87 TO AMEND
POSSESSION LIMIT FOR URANIUM-235 ASSOCIATED WITH CONVERSION
FROM HIGH-TO LOW-ENRICHED URANIUM (AMENDMENT NO. 11) -
PURDUE UNIVERSITY RESEARCH REACTOR (TAC NO. MD5643)

Dear Mr. Jenkins:

The U.S. Nuclear Regulatory Commission (NRC) is issuing the enclosed Order, as Amendment No. 11 to Facility Operating License No. R-87, allowing possession of low enriched uranium (LEU) in the form of reactor fuel to prepare for the conversion of the Purdue University Research Reactor from high-enriched uranium (HEU) fuel to LEU fuel in accordance with Section 50.64 of Title 10 of the *Code of Federal Regulations*. This Order is being issued in response to your letter dated May 25, 2007. The NRC staff also referred to your application for conversion dated August 13, 2006, as supplemented on May 3, 2007, during its review. The Order adds License Condition 2.B.(4) to allow receipt and possession, but not use in the reactor, of the LEU fuel that will be needed for conversion. The Order will become effective 20 days after the date of its publication in the *Federal Register*, provided there are no requests for a hearing.

Sincerely,

/RA by MMendonca for/

Alexander Adams, Jr., Senior Project Manager
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-182

Enclosures: 1. Order
2. Safety Evaluation
cc w/encl: See next page

cc:

Mayor
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609 W. Navajo
West Lafayette, IN 47906

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

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 Director of Radiation Laboratories
 Purdue University
 School of Nuclear Engineering
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DATE	06/07/07	06/08/07	06/14/07	/ /07	/ /07
OFFICE	PRTA/BC	DPR/D	ADRA	NRR/D	DPR/PM
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)	
)	
PURDUE UNIVERSITY)	Docket No. 50-182
)	EA-07-160
(Purdue University Research Reactor))	

ORDER MODIFYING FACILITY OPERATING LICENSE NO. R-87

I.

Purdue University (the licensee) is the holder of Facility Operating License No. R-87 (the license) issued on August 16, 1962, by the U.S. Atomic Energy Commission, and subsequently renewed on August 8, 1988, by the U.S. Nuclear Regulatory Commission (the NRC or the Commission). The license authorizes operation of the Purdue University Research Reactor (the facility) at a power level up to 1 kilowatt thermal. The facility is a research reactor located on the campus of the Purdue University, in the city of West Lafayette, Tippecanoe County, Indiana. The mailing address is Radiation Laboratories, Purdue University, Nuclear Engineering Building, 400 Central Drive, West Lafayette, IN 47907-2017.

II.

Title 10 of the Code of Federal Regulations (10 CFR) Section 50.64, limits the use of high-enriched uranium (HEU) fuel in domestic non-power reactors (research and test reactors) (see 51 FR 6514). The regulation, which became effective on March 27, 1986, requires that if Federal Government funding for conversion-related costs is available, each licensee of a non-power reactor authorized to use HEU fuel shall replace it with low-enriched uranium (LEU) fuel acceptable to the Commission unless the Commission has determined that the reactor has a unique purpose. The Commission's stated purpose for these requirements was to reduce, to the maximum

extent possible, the use of HEU fuel in order to reduce the risk of theft and diversion of HEU fuel used in non-power reactors.

Paragraphs 50.64(b)(2)(i) and (ii) require that a licensee of a non-power reactor (1) not acquire more HEU fuel if LEU fuel that is acceptable to the Commission for that reactor is available when the licensee proposes to acquire HEU fuel and (2) replace all HEU fuel in its possession with available LEU fuel acceptable to the Commission for that reactor in accordance with a schedule determined pursuant to 10 CFR 50.64(c)(2).

Paragraph 50.64(c)(2)(i) requires, among other things, that each licensee of a non-power reactor authorized to possess and to use HEU fuel develop and submit to the Director of the Office of Nuclear Reactor Regulation (Director) by March 27, 1987, and at 12-month intervals thereafter, a written proposal for meeting the requirements of the rule. The licensee shall include in its proposal a certification that Federal Government funding for conversion is available through the U.S. Department of Energy or other appropriate Federal agency and a schedule for conversion, based upon availability of replacement fuel acceptable to the Commission for that reactor and upon consideration of other factors such as the availability of shipping casks, implementation of arrangements for available financial support, and reactor usage.

Paragraph 50.64(c)(2)(iii) requires the licensee to include in the proposal, to the extent required to effect conversion, all necessary changes to the license, to the facility, and to licensee procedures. This paragraph also requires the licensee to submit supporting safety analyses in time to meet the conversion schedule.

Paragraph 50.64(c)(2)(iii) also requires the Director to review the licensee proposal, to confirm the status of Federal Government funding, and to determine a final schedule, if the licensee has submitted a schedule for conversion.

Section 50.64(c)(3) requires the Director to review the supporting safety analyses and to issue an appropriate enforcement order directing both the conversion and, to the extent consistent with protection of public health and safety, any necessary changes to the license, the facility, and licensee procedures. In the Federal Register notice of the final rule (51 FR 6514), the Commission explained that in most, if not all, cases, the enforcement order would be an order to modify the license under 10 CFR 2.204 (now 10 CFR 2.202).

Section 2.309 states the requirements for a person whose interest may be affected by any proceeding to initiate a hearing or to participate as a party.

III.

On August 13, 2006, as supplemented on May 3, 2007, the licensee submitted its conversion proposal. The NRC staff is in the process of reviewing the conversion proposal. On May 25, 2007, the licensee submitted an additional letter as part of its conversion proposal, which indicated that early approval to changes to the uranium-235 possession limit in its license were needed to support the proposed schedule for conversion to LEU fuel. The receipt and possession, but not use in the reactor, of the LEU fuel are required by the licensee at this time to assemble the fuel elements in order to meet the proposed timely conversion. The LEU fuel contains the uranium-235 isotope at an enrichment of less than 20 percent. The NRC staff reviewed the licensee's proposal and the requirements of 10 CFR 50.64, and has determined that the public health and safety and common defense and security require the licensee to receive and possess the LEU fuel prior to the conversion. This is necessary so the LEU fuel elements may be prepared to convert the reactor from HEU fuel in accordance with the schedules planned by the Department of Energy to support U.S. non-proliferation policies and the licensee to support its academic mission.

IV.

Accordingly, pursuant to Sections 51, 53, 57, 101, 104, 161b, 161i, and 161o of the Atomic Energy Act of 1954, as amended, and to Commission regulations in 10 CFR 2.202 and 10 CFR 50.64, IT IS HEREBY ORDERED THAT:

Facility Operating License No. R-87 is modified by adding the following license condition:

2.B.(4) Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," to receive and possess, but not use in the reactor, in addition to the amount specified under License Condition 2.B.(2), up to 4.0 kilograms of contained uranium-235 in the form of reactor fuel, at enrichments less than 20 percent.

This Order will be effective 20 days after the date of publication of this Order in the *Federal Register*.

V.

Pursuant to the Atomic Energy Act of 1954, as amended, any person adversely affected by this Order may submit an answer to this Order, and may request a hearing on this Order, within 20 days of the date of this Order. Any answer or request for a hearing shall set forth the matters of fact and law on which the person adversely affected, relies and the reasons why the Order should not have been issued. Any answer or request for a hearing shall be filed (1) by first class mail addressed to the Office of the Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, Attention: Rulemaking and Adjudications Staff; or (2) by courier, express mail, and expedited delivery services to the Office of the Secretary, Sixteenth Floor, One White Flint North, 11555 Rockville Pike, Rockville, Maryland, 20852, Attention: Rulemaking and Adjudications Staff. Because of possible delays in delivery of mail to the United States Government Offices, it is requested that answers and/or requests for hearing be transmitted to the Secretary of the Commission either by e-mail addressed to the Office of the

Secretary, U.S. Nuclear Regulatory Commission, HEARINGDOCKET@NRC.GOV; or by facsimile transmission addressed to the Office of the Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C., Attention: Rulemakings and Adjudications Staff at 301-415-1101 (the verification number is 301-415-1966). Copies of the request for hearing must also be sent to the Director, Office of Nuclear Reactor Regulation and to the Assistant General Counsel for Materials Litigation and Enforcement, Office of the General Counsel, with both copies addressed to the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, and the NRC requests that a copy also be transmitted either by facsimile transmission to 301-415-3725 or by e-mail to OGCMailCenter@nrc.gov.

If a person requests a hearing, he or she shall set forth in the request for a hearing with particularity the manner in which his or her interest is adversely affected by this Order and shall address the criteria set forth in 10 CFR 2.309.

If a hearing is requested by a person whose interest is adversely affected, the Commission shall issue an Order designating the time and place of any hearing. If a hearing is held, the issue to be considered at such hearing shall be whether this Order should be sustained.

In accordance with 10 CFR 51.10(d) this Order is not subject to Section 102(2) of the National Environmental Policy Act, as amended. The NRC staff notes, however, that with respect to environmental impacts associated with the changes imposed by this Order as described in the safety evaluation, the changes would, if imposed by other than an Order, meet the definition of a categorical exclusion in accordance with 10 CFR 51.22(c)(9). Thus, pursuant to either 10 CFR 51.10(d) or 51.22(c)(9), no environmental assessment nor environmental impact statement is required.

For further information see the letter from the licensee dated May 25, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML071500054), the

application for conversion and safety analysis report (ADAMS Accession No. ML062400495 and ML070920272), the NRC staff's request for additional information (ADAMS Accession No. ML070680273), the licensee's reply (ADAMS Accession No. ML071410299) and the cover letter to the licensee and the staff's safety evaluation dated June 21, 2007 (ADAMS Accession No. ML071550409), available for public inspection at the Commission's Public Document Room (PDR), located at One White Flint North, Public File Area O1 F21, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible electronically from the ADAMS Public Electronic Reading Room on the Internet at the NRC Web site, <http://www.nrc.gov/reading-rm/adams.html>. Persons who do not have access to ADAMS or who have problems in accessing the documents in ADAMS should contact the NRC PDR reference staff by telephone at 1-800-397-4209 or 301-415-4737 or by e-mail to pdr@nrc.gov.

Dated this 21st day of June 2007

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

James T. Wiggins, Acting Director
Office of Nuclear Reactor Regulation

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING ORDER ON

POSSESSION LIMIT CHANGES TO ALLOW CONVERSION

FROM HIGH-ENRICHED TO LOW-ENRICHED URANIUM FUEL

FACILITY OPERATING LICENSE NO. R-87

PURDUE UNIVERSITY RESEARCH REACTOR

PURDUE UNIVERSITY

DOCKET NO. 50-182

1.0 INTRODUCTION

By letter dated May 25, 2007, Purdue University (the licensee or Purdue) indicated that a change to the Purdue University Research Reactor uranium-235 possession limit was needed to allow for the timely conversion from the use of high-enriched uranium (HEU) fuel to low-enriched uranium (LEU) fuel in accordance with Section 50.64 of Title 10 of the *Code of Federal Regulations* (10 CFR). This regulation was promulgated to reduce the risk of theft and diversion of HEU fuel used in non-power reactors (research and test reactors). The U.S. Nuclear Regulatory Commission (NRC) staff has determined, as discussed below, that the addition of License Condition 2.B. (4) to allow receipt and possession, but not use in the reactor, of up to an additional 4.0 kgs of contained uranium-235 in the form of reactor fuel at enrichments less than 20 percent (LEU fuel) is acceptable.

2.0 BACKGROUND

On August 13, 2006, as supplemented on May 3, 2007, the licensee submitted their application for conversion of the Purdue University Research Reactor from the use of HEU fuel to LEU fuel. The NRC staff is currently reviewing the application. However, the licensee has identified the need to possess the LEU fuel sooner than the current NRC schedule for completion of the review of the application for conversion.

The license currently includes a possession limit of special nuclear material to allow for operation of the facility to conduct licensed research reactor activities. In its letter of May 25, 2007, the licensee indicated that an increase to the possession limit for special nuclear material is required to allow for the timely conversion to LEU fuel. The licensee indicated that it is working with the U.S. Department of Energy (DOE), DOE contractors, and the NRC to convert the Purdue University Research Reactor from HEU fuel to LEU fuel in support of the Global Threat Reduction Initiative. The licensee's letter stated that in order to minimize shut down time

of the facility, allow for a timely restart, and perform required tasks for conversion in a timely fashion, a period will exist in which the Purdue University Research Reactor will need to possess a quantity of U-235 in excess of the current licensed maximum. As additional evidence, the licensee provided a DOE letter dated February 15, 2007. In that letter, DOE indicated that fresh fuel plates and fuel containers will likely be fabricated at separate locations and delivered to Purdue for assembly into fuel elements to replace the fuel currently in the reactor. After this letter was written by DOE, the licensee confirmed that separate fabrication of fuel components was the option chosen by DOE. Further, DOE expected that this logistical issue will require an increase in the special nuclear material possession limit to accommodate the fuel inventory at the facility during the conversion process. This possession limit order is needed in advance of the conversion order.

3.0 EVALUATION

The licensee has not requested any changes to the Technical Specifications (TSs) nor security plan. Thus, the additional material will be received and possessed under the current terms of the reactor license. The NRC staff reviewed the license, TSs, and security plan requirements for the facility and finds that the possession of the additional LEU fuel will not require additional safety or security controls or conditions beyond those already in place. The NRC staff also finds that this increase in the fuel possession limit is within the normal possession limits for research reactors.

The increased possession limit allows receipt and possession of the LEU fuel. It does not allow use of the LEU fuel in the reactor. This change does not authorize conversion of the reactor to LEU fuel. Conversion of the reactor to allow the use of LEU fuel is currently undergoing a separate evaluation by the NRC staff. Therefore, the radioactive fission product inventory will not be increased by the increased fuel possession limit and the routine effluent or potential accident release levels will not increase beyond those already analyzed and accepted under the current license and TSs.

DOE is providing the LEU fuel to Purdue. DOE has made a decision to have the fuel plates and the fuel boxes that hold the plates fabricated by different contractors. The components will be shipped to Purdue for final assembly. Purdue will place the fuel plates in a new dry storage facility. After assembly, the LEU fuel elements will be placed in the dry storage racks. The licensee also has fuel storage racks in the reactor pool.

In accordance with the existing TS 5.3.1, all reactor fuel assemblies shall be stored in a geometric array where the multiplication factor, K-eff, is less than 0.8 for all conditions of moderation and reflection. The licensee provided information on the storage of the LEU fuel in the fuel storage racks. For the new dry fuel storage racks, the licensee's analysis shows that the TS limit is satisfied with a considerable margin for both the normally dry condition (K-eff of 0.015) and although the licensee did not identify a scenario, under the assumption that the storage rack is flooded with water (K-eff of 0.26).

The licensee also performed a calculation of the multiplication factor assuming the LEU fuel is stored in the reactor pool storage racks. The analysis shows that the TS limit is satisfied with a very large margin (K-eff of 0.33). The reactor pool storage racks incorporate BORAL, a neutron absorbing material that reduces the multiplication factor. The licensee performed a calculation assuming the BORAL is removed and the rack contains 18 fuel elements all of which contained the maximum number of plates (14). This was done as a bounding analysis because the

BORAL is integral to the construction of the racks and cannot be easily removed. The K-eff of this limiting case was 0.77, within the TS limit. The in-pool calculation assumes the geometry of an isolated storage rack. Based upon the dimensions of the pool layout provided in Figure 4-1 of the Safety Analysis Report for conversion, it can be seen that the storage racks are far enough from the core for this assumption to be justified.

The method used by the licensee for the analysis is the Monte Carlo code MCNP. This is a state-of-the-art code frequently used for this type of analysis. We have reviewed the licensee's use of the code for all other aspects of their conversion analysis and found that they were knowledgeable in the application of the code. Hence, we have a high level of confidence in their results.

In response to a request for additional information from the NRC staff on the application for conversion, the licensee stated that procedures for assembly of the fuel elements will be written and certified by the Facility Director, the Reactor Supervisor and the safeguards and oversight committee (Committee on Reactor Operations) for the reactor. All fuel handling will be done under the supervision of licensed Senior Reactor Operators. Only one bundle (about four fuel elements) of fuel plates will be moved at a time. Therefore, the staff concludes that the licensee will have approved procedures and appropriate staff for receipt and possession of the LEU fuel. Therefore, the staff concludes that the potential for accidental criticality during fuel movement and storage is not increased with the increased fuel possession limit.

The increase in the special nuclear material possession limit does not impact the security requirements for the facility. In accordance with 10 CFR 73.2, the increased possession would be consistent with special nuclear material of moderate strategic significance (Category II). The licensee's current security plan meets the requirements for this level of material under 10 CFR 73.67(d).

The inspection program has found that the licensee has routinely used such material safely and securely.

The licensee submitted a proposed change to License Condition 2.B.(2) in its May 25, 2007, letter to increase the possession limit from three to seven kilograms. As proposed, the licensee's changes did not differentiate between HEU and LEU fuel. To clarify possession of the HEU and LEU fuel, no changes are to be made to License Condition 2.B.(2) which allows for possession of the current HEU core. Rather, License Condition 2.B.(4) is added to the license to allow for the receipt and possession, but not use, of the LEU fuel. License Condition 2.B.(4) reads as follows:

- 2.B.(4) Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," to receive and possess, but not use in the reactor, in addition to the amount specified under License Condition 2.B.(2), up to 4.0 kilograms of contained uranium-235 in the form of reactor fuel, at enrichments less than 20 percent.

A telephone conversation between the project manager and the Director of Radiation Laboratories on May 30, 2007, confirmed that these differences were understood and could be implemented in a manner consistent with the protection of public health and safety.

Because the requested increased possession limit may be possessed safely and securely under the terms of the existing TSs and security plan, the increase in the special nuclear material possession limit as specified above is acceptable to the NRC staff. Further, the NRC staff has determined that the public health and safety and the common defense and security require the licensee to receive and possess the LEU fuel so that the LEU fuel may be configured into fuel elements to convert from HEU fuel in accordance with a schedule that allows the University to meet its educational mission while meeting the schedule planned by the DOE to support U.S. non-proliferation policies.

3.0 ENVIRONMENTAL CONSIDERATION

In accordance with 10 CFR 51.10(d), an Order is not subject to Section 102 of the National Environmental Policy Act. The NRC staff notes, however, that even if these changes were not being imposed by an Order, the changes would not require an environmental impact statement or environmental assessment. The license changes involve use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes in inspection and surveillance requirements. The NRC staff has determined that the changes involve no significant increase in the amounts or types of any effluents that may be released off site and no significant increase in individual or cumulative occupational radiation exposure. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.10(d) or 51.22(b), no environmental impact statement or environmental assessment is required.

4.0 CONCLUSION

The NRC staff has concluded, on the basis of the considerations discussed above, that (1) the proposal by the licensee for possession of LEU fuel is consistent with and in furtherance of the requirements of 10 CFR 50.64, (2) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities; and (3) such activities will be conducted in compliance with the Commission's regulations and will not be inimical to the common defense and security or the health and safety of the public. Accordingly, it is concluded that an enforcement order should be issued pursuant to 10 CFR 50.64(c)(3) to increase the license possession limit to allow the possession of LEU fuel.

Principal Contributors: A. Adams Jr., NRC
D. Diamond, Brookhaven National Laboratory

Date: June 21, 2007