October 14, 2004

Dr. Eva J. Pell
Vice President for Research
and Dean of the Graduate School
Pennsylvania State University
304 Old Main
University Park, PA 16802-1504

SUBJECT: ISSUANCE OF AMENDMENT NO. 37 TO FACILITY OPERATING LICENSE NO. R-2 — PENNSYLVANIA STATE UNIVERSITY (PENN STATE) BREAZEALE REACTOR (TAC NO. MC4553)

Dear Dr. Pell:

The Commission has issued the enclosed Amendment No. 37 to Facility Operating License No. R-2 for the Penn State Breazeale Reactor. The amendment consists of a change to the surveillance requirement for the linear power level monitoring channel. A copy of the related safety evaluation supporting Amendment No. 37 is also included.

If you have any questions regarding this amendment, please contact Kevin Witt at (301) 415-4075, or by Internet e-mail at kmw@nrc.gov.

Sincerely,

/RA/

Marvin M. Mendonca, Senior Project Manager
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-5

Enclosures: 1. Amendment No. 37
2. Safety Evaluation

cc w/enclosures: Please see next page

cc:

Mr. Eric J. Boeldt, Manager of
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Dr. C. Frederick Sears, Director
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Mr. William P. Dornsife, Director
Bureau of Radiation Protection
Department of Environmental Protection
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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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PENNSYLVANIA STATE UNIVERSITY

DOCKET NO. 50-5

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 37
Licensee No. R-2

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that

   A. The application filed by the Pennsylvania State University (the licensee), dated October 1, 2004, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the regulations of the Commission as stated in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance that (i) the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) such activities will be conducted in compliance with the regulations of the Commission;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;

   E. This amendment is issued in accordance with the regulations of the Commission as stated in 10 CFR Part 51, and all applicable requirements have been satisfied; and

   F. Prior notice of this amendment was not required by 10 CFR 2.105 and publication of a notice for this amendment is not required by 10 CFR 2.106.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the enclosure to this license amendment, and paragraph 2.C(2) of License No. R-2 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 37, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA by Marvin Mendonca for/

Patrick M. Madden, Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Enclosure: Appendix A, Technical
Specifications Changes

Date of Issuance: October 14, 2004

ENCLOSURE TO LICENSE AMENDMENT NO. 37

FACILITY OPERATING LICENSE NO. R-2

DOCKET NO. 50-5

Replace the following page of the Appendix A Technical Specifications with the enclosed page. The revised page is identified by amendment number and contains a vertical line indicating the area of change.

Remove	Insert
27	27

c. Since the initial core is subcritical, adding and then inadvertently removing all negative reactivity experiments leaves the core in its initial subcritical condition.

d. The design basis accident is the MHA (See Safety Analysis Report, Section IX). A chemical explosion (such as detonated TNT) or a mechanical explosion (such as a steam explosion or a high pressure gas container explosion) may release enough energy to cause release of fission products or loss of reactor shutdown capability. A projectile with a large amount of kinetic energy could cause release of fission products or loss of reactor shutdown capability. Accelerated corrosion of the fuel cladding due to material released by a failed experiment could also lead to release of fission products.

   If an experiment failure occurs a special investigation is required to ensure that all effects from the failure are known before operation proceeds.

e. This specification is intended to reduce the likelihood that airborne activities in excess of the limits of Appendix B Table 2 of 10 CFR Part 20 will be released to the atmosphere outside the facility boundary.

f. The 5 mCi limitation on I-131 through I-135 ensures that in the event of failure of a fueled experiment, the exposure dose at the exclusion area boundary will be less than that postulated for the MHA (See Safety Analysis Report, Section IX) even if the iodine is released in the air.

4.0 SURVEILLANCE REQUIREMENTS

4.1 Reactor Parameters

4.1.1 Reactor Power Calibration

Applicability

This specification applies to the surveillance of the reactor power calibration.

Objective

The objective is to verify the performance and operability of the power measuring channel.

Specification

A thermal power channel calibration shall be made on the linear power level monitoring channel biennially, not to exceed 30 months.

Basis

The thermal power level channel calibration will ensure that the reactor is operated at the authorized power levels.

4.1.2 Reactor Excess Reactivity

Applicability

This specification applies to surveillance of core excess reactivity.

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 37 TO FACILITY OPERATING LICENSE NO. R-2

PENNSYLVANIA STATE UNIVERSITY

DOCKET NO. 50-5

1.0 INTRODUCTION

By letter dated October 1, 2004, the Pennsylvania State University (PSU) (the licensee) requested changes to the Technical Specifications (TSs) for the Pennsylvania State Breazeale Reactor.

The proposed changes would revise the surveillance requirement for reactor power calibration in the TSs. Specifically, the proposed changes would revise TS 4.1.1 by replacing the word "annually" with "biennially" and changing the words "15 months" to "30 months", such that it will read as follows:

> "*A thermal power channel calibration shall be made on the linear power level monitoring channel biennially, not to exceed 30 months.*"

2.0 REGULATORY EVALUATION

The proposed change would require the linear power level monitoring channel to be calibrated by a thermal power equilibrium every two years instead of every year as is practiced currently. The linear power level monitoring channel is one of the indicators of the reactor state and is used during all modes of operation except for pulse mode. The linear power level monitoring channel signal is obtained from the wide range monitor, which consists of a fission chamber.

The wide range monitor is a component of the reactor safety system (RSS). The RSS provides all of the scram and operational interlock functions required by the TSs. In order to comply with TS 3.1.1.b, the normal high power scrams level for the reactor is set at 1.1 MW. This scram level was chosen since operation at that power is within the bounds established by the safety analysis report (SAR) for steady state operations.

NUREG-1537, [Ref. 2], gives guidance on the conduct of licensing actions reviews to NRC staff who review research reactor licensing applications. Chapter 7 lays out the acceptance criteria for the reactor control system, which is applicable for this proposed change since the linear power level monitoring channel is an essential component of the reactor control system.

The acceptance criteria for technical specifications are laid out in ANSI/ANS 15.1 [Ref. 3]. ANSI/ANS 15.1 provides the parameters and operating characteristics of a research reactor that should be included in the technical specifications. Because of the wide diversity of research reactor designs and operating characteristics, some items may not be applicable to all facilities. Specifically, ANSI/ANS 15.1 recommends a thermal power verification for reactors with a maximum power level of 2 MW or less shall be completed annually.

10 CFR 50.36(b) requires that "[e]ach license authorizing operation of a production or utilization facility of a type described in §50.21 or §50.22 will include technical specifications. The technical specifications will be derived from the analyses and evaluation included in the Safety Analysis Report (SAR), and amendments thereto, submitted pursuant to §50.34. The Commission may include such additional technical specifications as the Commission finds appropriate." "Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility" as specified in 10 CFR 50.36(c)(2).

As specified in 10 CFR 50.36(c)(2)(ii) "A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the following criteria: (A) Criterion 1. Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary. (B) Criterion 2. A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. (C) Criterion 3. 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. (D) Criterion 4. A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

"Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met," as specified in 10 CFR 50.36(c)(3). Per 10 CFR 50.36(c)(3), the surveillance requirement to calibrate the linear power level monitoring channel is necessary to assure the limiting conditions for operation (TS 3.1.1.a, 3.1.1.b and 3.1.4.b) will be met.

As discussed below in the technical evaluation, the proposed change provides assurance that the linear power level monitoring channel will maintain its function and therefore, is acceptable.

3.0 TECHNICAL EVALUATION

The staff has reviewed the licensees regulatory and technical analyses in support of its proposed license amendment which is described in the licensee's submittal.

3.1 TS 4.1.1

The proposed change refers to the surveillance period for the linear power level monitoring channel. The current surveillance period of one year was set to ensure that the reactor will not operate in excess of the authorized power levels in the TSs. TS 3.1.1.a specifies that the reactor may be operated at steady state power levels of 1 MW (thermal) or less and TS 3.1.1.b specifies that the maximum power level shall be no greater than 1.1 MW. For pulse mode operation, TS 3.1.4.b specifies that pulses shall not be initiated from power levels above 1 kW.

Guidance from ANSI/ANS 15.1 recommends a surveillance period of one year for a thermal power verification, although the basis for setting this period is not specified in the standard. A surveillance period should be set such that there is reasonable assurance that the instrument can be relied upon to provide consistent and accurate readings. The licensee has shown that the linear power level monitoring channel can maintain an acceptable level of stability over the proposed two year time frame. According to the license amendment request letter sent by the

licensee, "[r]eview of our records show that the last time we needed to adjust indicated power to the thermal power measurements was 1998."

In addition to showing that the power channel provides consistent and accurate readings, there are other factors that should be considered as well. The power level channel is not the only indication of reactor state. Reactor power limitations are included in the limiting conditions for operation, which are the lowest functional capability or performance level required for safe operation of the facility. Reactor fuel temperature is heavily relied upon to ensure that the operation is as anticipated. Fuel temperature is the facility safety limit, which is necessary to reasonably protect the integrity of the principal physical barriers that guard against the uncontrolled release of radioactivity. Comparatively, the fuel temperature is a much more important variable that needs to be monitored to ensure the safe operation of the facility. So long as the fuel temperature is maintained within the applicable limitations in the TSs, the health and safety of the general public is acceptably ensured.

Chapter 9 of the SAR shows that if the reactor were operating at 1.15 MW (50 kW higher than the required scram level) steady state, the highest measured fuel temperature would be 650^{o}C. The required scram level in the TSs is 650^{o}C. At this power level, the temperature scram would ensure that the reactor would be shut down before the power level increases significantly beyond that point. If there were to be a sudden reactivity insertion of approximately $1 with the power at 1.15 MW, a maximum fuel temperature of 843^{o}C would be obtained resulting in a reactor scram. This maximum temperature is still significantly less than the safety limit of 1150^{o}C established in the TSs.

Since the facility is a research reactor, experimental determinations of the core properties are important for routine operations. In addition to making direct readings of fuel temperature and reactor power during operations, other methods can be used to determine reactor power. Irradiation experiments can determine the power level by measuring the number of reactions in the material. Even though this is a secondary method of measuring reactor power and can have uncertainties associated with it, the experimental value obtained can be loosely compared to the value that is indicated on the power channels in the control room. The licensee indicated that such experiments show that reactor power has been acceptable.

In summary, the licensee's request to change the TS surveillance requirement for the linear power level monitoring channel does not affect the safe operations of the facility. The licensee has shown that the channel's readings meet applicable acceptance criteria over a two-year period and beyond that time frame. In addition, power indication is not quite as important as temperature indication since fuel temperature is the safety limit, which protects the integrity of the fuel cladding. Fuel temperature is monitored and as long as the temperature can be shown to stay within the applicable limitations, the fuel temperature will ensure the integrity of the fuel cladding. Furthermore, experimental values of power are constantly measured due to the nature of the operations of the facility, and if any deviations are noticed, subsequent investigations will be initiated. Based on these facts, the NRC finds that the proposed change to the surveillance requirement in TS 4.1.1 is acceptable.

4.0 ENVIRONMENTAL CONSIDERATION

This amendment involves changes in the installation or 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 this amendment involves no significant increase in the amounts, and no significant change in the 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). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSION

The staff has concluded, on the basis of the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously evaluated, or create the possibility of a new or different kind of accident from any accident previously evaluated, and does not involve a significant reduction in a margin of safety, the amendment does not involve a significant hazards consideration; (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 the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

6.0 REFERENCES

1. Amendment Request from Licensee, October 1, 2004. (ML042750380)
2. NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," February 1996.
3. ANSI/ANS 15.1, "The Development of Technical Specifications for Research Reactors," December, 1990.
4. Safety Analysis Report for the Penn State Breazeale Nuclear Reactor

Principal Contributor: Kevin M. Witt, NRR

Date: October 14, 2004