September 5, 2008

Dr. Kenan Unlu, Director
Radiation Science and Engineering Center (RSEC)
Breazeale Nuclear Reactor
University Park, PA 16802-2301

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING THE PENNSYLVANIA STATE UNIVERSITY PENN STATE BREAZEALE REACTOR APPLICATION FOR LICENSE RENEWAL (TAC NO. MC9534)

Dear Dr. Unlu:

We are continuing our review of your application for renewal of Facility Operating License No. R-2 for the Pennsylvania State University Penn State Breazeale Reactor dated December 6, 2005. During our review, questions have arisen for which we require additional information and clarification. Please provide responses to the enclosed requests for additional information no later than October 31, 2008. Please note that if your response contains any sensitive information, it must be properly labeled and clearly indicated in the cover letter. In accordance with 10 CFR 50.30(b), your response must be executed in a signed original under oath or affirmation. Following receipt of your response, we will continue our review of your application.

If you have any questions regarding this review, please contact me at 301-415-2784.

Sincerely,

/RA/

William B. Kennedy, Project Engineer
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-5

Enclosure: As stated
cc w/enclosure: See next page

cc:

Mr. Eric J. Boeldt, Manager of
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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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REQUEST FOR ADDITIONAL INFORMATION

PENNSYLVANIA STATE UNIVERSITY

PENN STATE BREAZEALE REACTOR

DOCKET NO. 50-5

Questions Related to the Safety Analysis Report

CHAPTER 2

2.1 General meteorological information for the site, other than extremes, is not included in the description of site characteristics. Provide site information on temperature ranges, humidity, and average wind speed, or justify its exclusion.

CHAPTER 4

4.1 Section 4.2.2, Control Rods, Page IV-12. Describe how the transient rod responds to a scram signal and loss of site power.

4.2 Section 4.3, Reactor Pool, Page IV-18.

a. Describe the operating restrictions and controls regarding the location of the reactor during operation. Address the effects of radiation damage to the concrete pool walls and epoxy liner for the extended 20-year operational life.

b. Provide an evaluation of the age-related degradation of the concrete and reinforcing steel and the ability of the pool to maintain structural integrity in the event of design basis seismic activity for the extended 20-year operational life. This evaluation should include a discussion of the potential damage and leakage rate from design basis seismic activity.

4.3 Section 4.5.1, Normal Operating Conditions, Page IV-20. Provide an analysis to show worst-case reactivity effects of improperly locating the core in the pool, i.e., potential interaction between fuel storage and reactor core, or describe the controls (procedural requirements, interlocks, physical barriers, etc.) that prevent interaction between the core and any fuel in storage.

4.4 Section 4.5.1, Normal Operating Conditions, Page IV-20. What prevents movement of fuel elements during operation?

4.5 Section 4.5.1, Normal Operating Conditions, Page IV-22, Figure 4-12. What is in position E-6 in Core Loading #52? What are the configuration restrictions regarding what may be loaded into core grid positions, i.e., must all fuel positions be filled with fuel, or can positions be vacant or filled with other reflectors or experiments? How is Technical Specification (TS) 5.2 interpreted regarding any restrictions?

4.6 Section 4.5.3, Operating Limits, Page IV-25. Describe any burnup limits on the fuel and how it is determined when to retire fuel from use in the core.

4.7 Section 4.5.3, Operating Limits, Page IV-25. Provide an evaluation of the applicability of the General Atomics pulsing temperature limit of 830°C to the Penn State Breazeale Reactor (PSBR), and if applicable, describe the impact on the technical specifications and safety analyses. (Reference: "Pulsing Temperature Limit for TRIGA LEU Fuel," TRD 070.01006.05, Rev. A.)

4.8 Section 4.6, Thermal-Hydraulic Design, Page IV-25. Provide a thermal-hydraulic analysis of the PSBR to demonstrate that natural convection provides adequate cooling to maintain clad temperatures below 500 °C, as stated in the basis for the fuel temperature safety limit of 1150 °C. Include a discussion of the analysis methods and correlations used to determine the minimum Critical Heat Flux Ratio (CHFR) for steady-state and transient operation (including the reactivity insertion accident). (Reference: "TRIGA Reactor Thermal-Hydraulic Study," TRD 070.01006.04, Rev. A.)

4.9 Core Configuration Control. Discuss any restrictions regarding reactor condition for fuel movement and explain the purpose of TS 3.2.5.

CHAPTER 5

5.1 Section 5.2, Primary Coolant System, Page V-1. In the first paragraph, which system is responsible for the 40 gpm recirculation of the pool water? At the bottom of page V-3, the last paragraph mentions a primary side flow rate of 400 gpm.

5.2 Section 5.5, Primary Coolant Makeup Water System, Page V-7. What is the power source mentioned for the secondary heat exchanger pump that is independent of site electricity? No secondary pump is listed in Table 8-2 for equipment powered by the diesel generator.

CHAPTER 11

11.1 The discussion in Chapter 11 of radiation sources of concern focuses almost entirely upon argon-41, to the exclusion of other radionuclides. However, no mention is made of periodic confirmatory measurements of effluent to verify that argon-41 is the only radionuclide being released. Provide a description of any confirmatory measurements regarding other radionuclides or justify why it is not needed.

11.2 Section 11.1.4 states the survey equipment that is available and Section 11.1.6 mentions that unannounced radiation and contamination surveys are conducted, but neither section mentions the minimum frequency of such surveys (i.e., quarterly, annually). Specify the minimum survey frequency for the controlled areas of the PSBR along with the basis for the minimum survey frequency.

11.3 Tritium is an activation product that is generated in the D_2O Thermal Column and is monitored periodically. Section 11.4 does not mention survey or monitoring methodology or frequency for tritium. Describe the tritium monitoring methodology and frequency or justify why it is not needed.

11.4 No mention is made of the frequency or criteria for radiation surveys for posting in beam areas. Describe the minimum frequency or criteria for radiation surveys in these areas.

11.5 The Controlled Area and Restricted Area as defined in 10 CFR 20.1003 are not defined in the SAR. Describe the boundaries of the Controlled and Restricted Areas at the PSBR.

11.6 Chapter 11 does not discuss radiological access control to the building. Describe how access control for radiological areas of the building is accomplished.

11.7 Chapter 11.5 mentions the use of personal dosimetry for those individuals required to be monitored. However, no mention is made if the dosimetry is National Voluntary Laboratory Accreditation Program (NVLAP) certified as required by 10 CFR 20.1501(c). Confirm that personal dosimetry used at the PSBR is NVLAP certified appropriate for the radiation encountered at PSBR.

11.8 The annual doses on the area dosimeters are lower than natural background rates, implying that a correction for natural background is being made. Describe this correction and how was it determined.

11.9 Chapter 11 does not mention supplemental dosimetry for multi-badging use such as ring badges. Describe if supplemental badges are available for use.

11.10 Section 11.1.5 indicates that personal dosimeters are mounted in select locations within the facility to monitor those areas. Describe the provisions made in the processing routines for these “non-personal” dosimeters that take into account their use in this manner or justify why such provisions are not needed.

11.11 Chapter 11 does not mention the use of “engineering controls” or minimization efforts for control of contamination. Describe how these factors are incorporated in the PSBR radiation protection program.

11.12 Chapter 11 indicates that all persons using radioactive material or persons who are monitored receive appropriate Radiation Protection Office (RPO) training. The discussion does not mention the period of time before refresher radiological training is required. Describe the period of time that RPO training is valid before retraining is required.

CHAPTER 13

13.1 Section 13.1.A. TRIGA Fuel Temperature Analysis of the PSBR. Given all of the assumptions and uncertainties in deriving Equation (35), i.e., maximum clad temperature of 140±10°C, axial peaking factor, A_o & B_o factors, Δ_{tg}, experimental measurements, measured-to-peak factor of 1.6, temperature coefficient, initial pool temperature, correlation uncertainty, etc. What is the overall uncertainty in the maximum fuel temperature estimates provided by Equation 35 (or similar equations for other instrumented fuel elements)? Discuss the uncertainties in individual parameters used in deriving Equation (35) as necessary to establish the overall uncertainty and the corresponding safety margin.

13.2 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR. Explain how the measured-to-peak fuel temperature factor of 1.6 for pulses is derived from the profile described by Equation 4 and the parameters in Table 13-1.

13.3 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR. How is the temperature performance for new fuel batches determined? Does each new batch contain one or more instrumented fuel elements that undergo a calibration scheme? Is a most limiting instrumented fuel element selected from those available?

13.4 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR, Page XIII-17. How does the data in lines 9 & 10 of Table 13-2 demonstrate the increase in Δ_{tg} diminishes to zero?

13.5 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR, Page XIII-17. The equation at the bottom of page XIII-17 uses a t_{tc} of 445 °C for element I-14 loaded in core position G-8. Table 13-2 lists a t_{tc} of 455 °C for element I-14 loaded in core position G-8. Clarify which is the correct temperature.

13.6 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR, Page XIII-22. The maximum fuel temperature of 1095°C in the first paragraph is calculated from Equation (35) using a T_o = 21°C. Describe any restrictions on the initial pool temperature during pulse mode operation to ensure the calculated 1095°C is a conservative maximum?

13.7 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR, Page XIII-22. Is Equation (28) referred to in the 2nd paragraph the correct reference or should it be Equation (35)?

13.8 Section 13.1.A, TRIGA Fuel Temperature Analysis of the PSBR, Page XIII-24. Should the second line in Table 13-6 be position G-10?

13.9 Section 13.1.B, Evaluation of the LSSS, Page XIII-25. In the last paragraph, the maximum fuel temperature for a $3.50 pulse is evaluated as 1095°C using Equation (34) for element I-14 and a NP of 2.2. Provide a similar calculation for element I-15 showing the corresponding equation and values for element I-15.

13.10 Section 13.1.2, Insertion of Excess Reactivity, Page XIII-33. Provide a more detailed explanation of how the data for the maximum measured $2.25 pulse temperature for element I-15 and Core Loading 47 was used to calculate the maximum fuel temperature for the reactivity insertion accident at an initial power of 1.15 MW. What is the NP for the location of element I-15 in Core Loading 47? Is the reactivity insertion accident based on the TS NP limit of 2.2 and maximum elemental power density of 24.7 kW?

13.11 Section 13.1.3, Loss of Coolant, Page XIII-34. Provide an estimate of the radiation doses outside the Controlled Area from a loss-of-coolant accident.

13.12 Section 13.1.7, Loss of Normal Electric Power, Page XIII-44. Assuming the reactor is operating, describe if and how the reactor would shutdown on loss of on-site electrical power with the diesel generator functioning, and without the diesel generator functioning. How does loss of power to the facility exhaust system, emergency exhaust system, or the continuous air monitors cause a shutdown?

Questions Related to Financial Qualifications and Decommissioning

Pursuant to 10 CFR 50.33(f)(2), “applicants to renew or extend the term of an operating license for a nonpower reactor shall include the financial information that is required for an initial license.” To comply with this requirement, please provide the following updated and supplemental information to the 2005 Pennsylvania State University (the University) application for a renewed license for the PSBR.

1. Under 10 CFR 50.33(d), certain information is required by an applicant, the University, as applicable. The application states that the University is a non-profit university, organized under the laws of the Commonwealth of Pennsylvania. To comply with 10 CFR 50.33(d), please state the organizational form of the University (e.g., corporation) and, if a corporation, provide the information required under 10 CFR 50.33(d)(3). If none of the provisions of 10 CFR 50.33(d) are applicable, please so state.

2. As required by 10 CFR 50.33(f)(2), "the applicant shall submit estimates for total annual operating costs for each of the first five years of operations of the facility." Since the information provided in the University's 2005 submittal for a renewed license is now out of date, provide the estimated operating costs for each of the years 2009 to 2013 (the first full five-year period after the projected date of license renewal) as well as the University's sources of funding to cover the operating costs for the PSBR for the above five years.

3. The application indicates that the cost for decommissioning the reactor was $10,540,718 in 2006 dollars. To comply with 10 CFR 50.75(d), please update the application to 2008 to include: (1) a current (2008) cost estimate for decommissioning the facility showing costs of labor, waste disposal, other items (such as energy, equipment, and supplies), a contingency factor (normally 25%), and total decommissioning costs in 2008 dollars to meet the NRC's radiological release criteria; (2) a statement of the decommissioning method to be used (e.g., DECON); and (3) a full identification of the specific means of adjusting the cost estimate (e.g., consumer price index, waste burial cost data from NUREG-1307, or labor price index) periodically over the life of the facility and a numerical example updating the 2008 cost estimate.

4. The application states that the University is using a self-guarantee to fund and carry out its decommissioning activities. The NRC staff recognizes that the University is using the self-guarantee for the PSBR and five other NRC-licensed facilities. For renewal of the PSBR license, please provide the following:

a. An updated self-guarantee, including the current (2008) decommissioning cost estimate for the PSBR and the most recent decommissioning cost estimates for the other NRC-licensed facilities covered by the self-guarantee. The updated submittal must include all the documentation listed in Section A.14.3 of NUREG-1757, Vol. 3, "Consolidated NMSS Decommissioning Guidance."

b. Documentation that the signator of the self-guarantee, if not the Chief Executive Officer or Chief Financial Officer (e.g., corporate controller), has the authority to bind the University in the self-guarantee.

c. If the updated self-guarantee agreement will be in the same format used in the applicant's July 12, 2007 self-guarantee agreement, consider the following and make any appropriate revisions to the 2007 format:

    (1) Recital 8 of the Pennsylvania State University Self-Guarantee Agreement states that "The guarantor agrees to submit audited financial statements and financial test data annually within 180 days of the close of its fiscal year." NUREG-1757 specifies a submittal period of within 90 days of the close of the guarantor's fiscal year. Provide justification for the University's proposal to use the 180-day period, or change the submittal period to within 90 days of the close of the guarantor's fiscal year as specified in NUREG-1757.