February 26, 2009

Robert J. Agasie, Director
Nuclear Reactor Laboratory
University of Wisconsin - Madison
1513 University Avenue, Room 1215 ME
Madison, WI 53706-1687

SUBJECT: UNIVERSITY OF WISCONSIN – REQUEST FOR ADDITIONAL INFORMATION RE: AMENDMENT REQUEST FOR REACTOR CONVERSION (TAC NO. MD9592)

Dear Mr. Agasie:

By letter dated August 25, 2008 to the U.S. Nuclear Regulatory Commission (NRC) (Agencywide Documents Access and Management System Accession No. ML082470092) the University of Wisconsin-Madison requested an amendment to the University of Wisconsin Nuclear Reactor (UWNR) Facility Operating License No. R-74, and Technical Specifications (TS). The Amendment is to facilitate the conversion of the reactor from high enriched uranium (HEU) to low enriched uranium (LEU).

The NRC staff has reviewed your submittal and determined that additional information is needed to complete the review. Please provide responses to the enclosed request for additional information within 45 days of the date of this letter. In accordance with Title 10 of the *Code of Federal Regulations* Section 50.30(b), your response must be executed in a signed original under oath or affirmation. Following receipt of the additional information, the NRC staff will continue the review of your amendment request.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for NRC staff review and contribute toward NRC's goal of efficient and effective use of staff resources. If you have any questions, please contact me at (301) 415-3934 or by electronic mail at William.Schuster@nrc.gov.

Sincerely,

/RA AAdams for/

William C. Schuster IV, Project Manager
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-156

Enclosure:
As stated

cc w/encl: See next page

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William C. Schuster IV, Project Manager
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Docket No.: 50-156
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As stated
cc w/encl: See next page
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cc:

Mayor of Madison
City Hall
210 Martin Luther King, Jr. Boulevard, Room 403
Madison, Wisconsin 53703

Chairman, Public Service
Commission of Wisconsin
610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854

Manager
Radiation Protection Section
Division of Public Health
Dept of Health and Family Services
P.O. Box 2659
Madison, WI 53701-2659

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

Victor Goretsky
Assistant Director & Radiation Safety Officer
Department Environmental Health & Safety
530 Environmental Protection And Safety Bldg
30 N Murray St
Madison, WI 53715

REQUEST FOR ADDITIONAL INFORMATION

UNIVERSITY OF WISCONSIN-MADISION

UNIVERSITY OF WISCONSIN NUCLEAR REACTOR

DOCKET NO. 50-156

TAC NO MD9592

By letter dated August 25, 2008 to the U.S. Nuclear Regulatory Commission (NRC) (Agencywide Documents Access and Management System Accession No. ML082470092) the University of Wisconsin-Madison requested an amendment to the University of Wisconsin Nuclear Reactor (UWNR) Facility Operating License No. R-74, and Technical Specifications (TS). The Amendment is to facilitate the conversion of the reactor from high enriched uranium (HEU) to low enriched uranium (LEU).

The purpose of the following questions is to determine compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.64.

1. Sections 1.1, 1.3, 4.2.2, and 4.2.3. In Section 1.1 and 1.3, your application states that only the fuel and new fuel storage will be changed as part of the conversion, however in Section 4.2.2 you state that the transient rod guide tube will be replaced. Is the transient road guide tube being replaced as a part of the conversion? If so, please provide justification.

2. Sections 1.1, 1.3, 4.2.2, and 4.2.3. In Section 1.1 and 1.3, your application states that only the fuel and new fuel storage will be changed as part of the conversion, however in Section 4.2.3 you state four additional reflectors will be installed.

    a. Are additional reflectors being added as part of the conversion? If so, please provide justification.

    b. Is the design of new graphite reflectors consistent with the design of the current reflectors? If not, please provide details.

3. Section 1.3. Are any other core components being added or changed as part of conversion? If so, please provide justification.

4. Section 4.2.1, Table 4.2.2. In Section 1.1 and 1.3, the units for uranium enrichment appears as percent U-235, however in Table 4.2.2 units of enrichment appear as atomic percent. Should enrichment be stated in units of weight percent?

5. Section 4.2.3 and 4.2.5. In Section 4.2.5, your application states that no changes will be required to in-core experimental facilities however in Section 4.2.3 it states that graphite

reflectors will be placed in positions D3 and D7 in lieu of currently installed irradiation baskets. Please clarify.

6. Section 4.5.1. In Table 4.5.3, your application states the calculated integral worth of the transient rod is 1.467 %Δk/k, however on page 27 you state the value is 1.334 %Δk/k (BOL, HEU). Please discuss the difference between these two values.

7. Section 4.5.1. Are there any other measurements that have been performed on the reactor which could be used to help benchmark the MCNP model with the present HEU fuel?

8. Section 4.5.1. In Tables 4.5.4, 4.5.5, 4.5.6, 4.5.7, and 4.5.8, the units for differential worth curve are given as [%Δk/k in]. Should the units be [%Δk/k / in]?

9. Section 4.5.1/4.5.2. In Tables 4.5.6 and 4.5.13, the units for the void coefficients are given as [Δk/k / %void]. Is that correct or should the units be [%Δk/k / %void]?

10. Section 4.5.1/4.5.2. In Tables 4.5.6 and 4.5.13, the void coefficient are stated as negative values, however the coolant temperature coefficient are stated as positive values. Should the coolant temperature coefficient be stated as negative or positive values?

11. Section 4.5.1/4.5.2. In Tables 4.5.6 and 4.5.13, the coolant temperature coefficients are stated in units of [Δk/k / K]. Is that correct or should the units be [%Δk/k / K]?

12. Section 4.5.1/4.5.2. In Tables 4.5.7 and 4.5.14, the units for the prompt temperature coefficients are given as [%Δk/k K]. Should the units be [%Δk/k / K]?

13. Section 4.5.2. Please provide more specific information on the calculation of the shutdown margin for the LEU fuel. Demonstrate how the calculation satisfies the Technical Specification 3.1 requirement for shutdown margin of 0.2 %Δk/k?

14. Section 4.7.1. RELAP5/MOD3.3 had a fundamental error in the point kinetics model that has recently been fixed. Does the version of the code used in the conversion analysis have the fixes implemented? If not, confirm that the UWNR analysis model is giving results consistent with the transient, e.g. by checking results as a function of time step or with another stand-alone point kinetics model.

15. Section 4.7.1. Is there a TS or administrative control on the maximum allowable bulk coolant temperature? If not, please discuss why a limit on bulk coolant temperature is not needed.

16. Section 4.7.2. In Table 4.7.1. What is the sensitivity of the steady-state results, such as flow rate and critical heat flux, associated with the uncertainty in the derived inlet and outlet pressure loss coefficients?

17. Section 4.7.4. In Figure 4.2.1, the location of one instrumented fuel element is shown as E3 NE. The title of Figure 4.7.10 indicates that the instrumented fuel element may have moved from E3 NE to E4 SE for these temperature measurements. Please explain.

18. Section 4.7.4. Are there comparisons of measured versus calculated instrumented fuel element temperatures at D4 SW?

19. Section 4.7.4. What is the axial location of the radial temperature results shown in Figure 4.7.11?

20. Sections 4.7.7 and 4.7.8. Please explain why the maximum fuel temperature for the LEU core is the highest at MOL and yet the hot rod power at MOL is lower than that at BOL. Also, please discuss the opposite trends in the MDNBRs, shown in Tables 4.7.13 (LEU-BOL) and 4.7.16 (LEU-MOL), as calculated by the Groneveld 2006 and the Bernath correlation.

21. Figures 4.7.16 (p. 84), 4.7.45 (p. 115), 4.7.51 (p. 122), and 4.7.57 (p. 128). These graphs depict hot rod power to reach CHF as a function of flow rate at HEU-BOL, LEU-BOL, LEU-MOL, and LEU-EOL. Please provide the numerical values of the critical rod power as determined by the Groneveld 2006 and the Bernath correlation for core powers of 1 MW, 1.3 MW and 1.5 MW at HEU-BOL, LEU-BOL, LEU-MOL, and LEU-EOL.

22. Section 4.7.4, 4.7.7, 4.7.8, and 4.7.9. When you calculated coolant flow rate versus hot rod power for various core configurations, RELAP5 calculated flow oscillations at some power. Above this hot rod power, you provide graphs showing projections of coolant flow rate. Is the extrapolation of flow calculated by RELAP5 above the last predicted stable flow realistic? Please discuss.

23. Section 4.7.4, 4.7.7, 4.7.8, and 4.7.9. RELAP5 calculated flow oscillations at a power of around 28 kW/rod. Demonstrate that DNB is a more conservative criterion than flow instability in determining the thermal limit of the UWNR.

24. Section 4.7.5 and 4.7.10. Was a weighted or averaged fuel temperature used in the calculation of the reactivity feedback?

25. Section 4.7.5 and 4.7.10. Was the effect of direct gamma heating of the coolant incorporated in the RELAP5 model?

26. Section 4.7.5 and 4.7.10. Was the power distribution in the core maintained constant during the pulse and was the assumption conservative?

27. Figures 4.7.22, 4.7.59, 4.7.66, 4.7.73. These figures show power at about 10 MW at 0.25 second following pulse initiation. What is the power profile until the reactor scrams?

28. Section 4.7.6. In Figure 4.7.34, does the axial power distribution reflect the movement of the control blades out of the core as a function of burnup?

29. Section 4.7.6. Are there core locations other than D5 SW that will have pin power peaking factors greater than 1.61 if a fresh LEU fuel pin is inserted in those locations at MOL or EOL?

30. Section 4.7.6. Your application states that if the hot rod at core location D5 SW needed to be replaced that the CHF limit would not be exceeded. What acceptance criteria is used following replacement of the fuel? Would a 10 CFR 50.59 review be performed as part of the fuel rod replacement?

31. Section 4.7.7 (p. 110). At what coolant temperatures and pool levels are the LEU core calculations performed? If temperatures and levels used are not licensed limits, please explain.

32. Table 4.7.12 (p. 111), 4.7.15 (p. 119), and 4.7.17 (p. 124). Why is the maximum fuel temperature at LEU-EOL lower than that at LEU-MOL?

33. Tables 4.7.12 (p. 111) and 4.7.15 (p. 119). The hot rod power shown at LEU-MOL is lower than that at LEU-BOL, however the maximum fuel temperature is higher at LEU-MOL. Please discuss.

34. Please refer to questions 56 and 58 when responding to the following question:

    Table 4.7.14. The calculated thermocouple temperatures at 1 MW for location D4 SW appear to be above the LSSS limit of 400°C. Please explain. What are the thermocouple temperatures at 1.3 MW and 1.5 MW?

35. Section 10.2. How much cadmium was assumed in the calculation for Table 10.2.1?

36. Section 12.6. Are there any quality assurance tests that University of Wisconsin will apply upon receipt of the fuel? If yes, please briefly describe.

37. Section 12.7. At what stage of the startup will the graphite reflectors be inserted?

38. Section 12.7. Your application states that "IFE [instrumented fuel element] bundles will be loaded and the IFE then installed before updating the 1/M plot for that bundle." Will the IFE be tested and calibrated? If so, when?

39. Section 12.7. Your application states you will determine shutdown margin using the rod drop method. Will you determine excess reactivity? If so, please discuss?

40. Section 12.7. How many power increment steps will be utilized and how large are the increments?

41. Section 12.7. Will the power and fuel temperature coefficient of reactivity calculations be based on measured data or based on computer models?

42. Section 13. From a review of your accident analyses, it appears that some of the scenarios (e.g. maximum hypothetical accident (MHA), loss-of-coolant accident (LOCA), etc.) may have a potential radiological impact outside the reactor facility. From a review of your emergency plan, dated 5/14/04, it is not clear how response is handled in any potentially impacted areas outside the operations boundary in the engineering building. Please discuss.

43. Section 13.1. It is stated that certain isotopes (e.g., I-130m, I-136, Kr-89, Xe-137) were not included in the estimates for whole-body and thyroid dose because of their “short half-lives (less than 10 minutes).” Given the short exposure time of five minutes, these isotopes will make a contribution to the doses. Please justify their exclusion, or submit revised doses.

44. Section 13.1.2. In equation 13.1.1, the exponent is given as $\exp(-1.34x10^{-4}/T)$. Should the exponent be $\exp(-1.34x10^{4}/T)$?

45. Section 13.1.5.1. Why was the fifth floor of the Mechanical Engineering Building specifically excluded from the dose calculation? Are individuals on the fifth floor evacuated? If not, what would their non-occupational dose be?

46. Section 13.1.7.1. During winter months, you mention the buoyancy rise of the stack exhaust would be significant. What is the buoyancy and momentum rise during the winter and summer months, respectively? What assumption is most conservative?

47. Section 13.1.7, 13.1.8 and 13.1.9. For those scenarios where the ventilation system is in operation, what is the dose to persons in the Mechanical Engineering Building from shine from the volumetric source term in the confinement building until it is ventilated to the environment?

48. Section 13.1.7. Can a person in the unrestricted environment receive a dose from shine from the plume passing overhead greater than the immersion dose when the plume reaches the ground?

49. Section 13.2. In the Rapid Insertion of Reactivity Accident, it appears the total scrammable worth of the blades, 8.86 %Δk/k, was instantaneously inserted into the core 2 seconds after the transient. If the reactor was operating at 1.3 MW at BOL, is 8.86 %Δk/k blade worth available to scram the reactor? What is the calculated position of the blade at BOL?

50. Section 13.2. The total scrammable blade worth used in the analysis of the rapid addition of reactivity accident included the worth of the transient rod. However, the Technical Specifications (TS 3.3.3 Table 1) require that in the pulse mode a transient rod scram occurs 15 seconds or less after the pulse. Is the 2-second scram delay assumption (including the transient rod) conservative?

51. Section 13.3.2. In referece to Table 13.3.1, what are the estimated doses to the staff and people in the Mechanical Engineering Building from direct radiation following a LOCA?

52. Section 13.3.3. The estimated time required to drain the pool was calculated using Equation 13.3.1. Does the calculated drain time of 836 sec. represent the time to lower the pool water level to the top of the core or to the core mid-plane where the beam port is located?

53. Section 13.3.3. Do the calculations of the dose rates shown in Table 13.3.1 assume the fuel is completely uncovered or half-covered with water?

54. Table 13.3.3. According to Table 13.3.3, the starting temperatures for the LEU-BOL and LEU-MOL cores are the same. Please discuss.

55. Section 13.3.3. Your application states analysis has been performed that demonstrates a complete LOCA is more limiting than a partial LOCA. Please discuss or provide references 33 and 34.

56. Section 14. Please provide replacement TS pages with the proposed changes to the TS.

57. Section 14. For each proposed change to the TS, provide a justification.

58. Please refer to questions 30 and 58 when responding to the following question:

    Section 14.2.2. What are the predicted temperatures of the IFE in their existing core positions when the limiting safety system setting (LSSS) for power is reached?

59. Section 14.2.2. The discussion of the basis for the LSSS for the fuel temperature refers to a 25°C margin to the fuel temperature safety limit. Provide the analysis for the development of this margin to the safety limit.

60. Please refer to questions 30 and 56 when responding to the following question:

    Section 14.2.2. The basis for the TS discusses a relationship between power peaking of 1.16 and a LSSS of 500°C. However, this is not discussed in section 4.7.6 of the SAR. Please address.

61. Section 14.3.2 (p. 236). Is a separate Technical Specification needed for a limit to prevent exceeding 830°C? Does the 1.4 %Δk/k reactivity insertion limit (TS 3.2) prevent reaching 830°C for all conditions of operation and all times in core life? Please discuss.

62. Section 14.3.3.4 (p. 236). This proposed technical specification appears to be identical to the LSSS. Please explain why it is needed.

63. UWNR TS 3.3.3, “Reactor Safety System.” In Table 1, it appears the function for the Fuel Element Temperature may be inconsistent with the proposed LSSS of 500°C as measured in an instrumented fuel element with a pin power peaking factor of at least 1.61. Please discuss.

64. UNWR TS 5.6, “Reactor Building.” Please verify that the bases for the current TS are consistent with the conversion safety analysis report.

65. Section 15.2. The NRC supports restating license conditions to make the conditions clearer to understand. Also, the exempt status table in the license condition is not needed with the conversion to LEU. The requirements of 10 CFR 73.6 applies to your special nuclear material the table not withstanding. An example of a restated license condition based on your proposed possession limits is as follows:

    2.B.(2) Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material,"

    a. to receive, possess and use, in connection with operation of the facility, up to 15.0 kilograms of contained uranium-235 enriched to less than 20 percent in the form of TRIGA reactor fuel;

    b. to receive, possess and use, in connection with operation of the facility, up to 150 grams of contained uranium-235 of any enrichment in the form of neutron detectors;

    c. to receive, possess and use, in connection with operation of the facility, up to 16 grams of contained plutonium in the form of plutonium-beryllium neutron source;

    d. to receive, possess, use, but not separate, in connection with operation of the facility, such special nuclear material as may be produced by operation of the facility; and

    e. to possess, but not use, up to 18.0 kilograms of contained uranium-235 at equal to or greater than 20 percent enrichment in the form of TRIGA fuel until the existing inventory of this fuel is removed from the facility.

    Please provide a bases for your proposed LEU possess limit of 15 kilograms of contained uranium-235.