OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

TEXAS A&M UNIVERSITY TEXAS ENGINEERING EXPERIMENT STATION

NUCLEAR SCIENCE CENTER REACTOR

LICENSE NO. R-83

DOCKET NO. 50-128

The U. S. Nuclear Regulatory Commission (NRC) staff is continuing the review of your application for renewal of Facility Operating License No. R-83, dated February 27 2003, as supplemented by letter dated March 30, 2005, and July 22, 2009. During our review, questions have arisen for which we require additional information and clarification. Our review conformed to the Guidelines for Preparing and Reviewing Applications for the Licensing of Non-power Reactors, NUREG 1537, Part 1 and the Interim Staff Guidance on the Streamlined Review Process for Research Reactors. Please address and provide the requested information to the following:

1. According to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.36(c)(1)(i)(A), safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against uncontrolled release of radioactivity. NUREG 1537, Part 2, Section 4.2.1 states that maintaining fuel integrity should be the most important design objective.

   In Section 4.6.1 of the Texas A&M 2009 Safety Analysis Report (SAR) the steady-state T-H analysis of the reactor core assumes that the reactor is operating at 1.0 MW with the coolant inlet temperature at 30 degrees Celsius. There is no high temperature limit in the Technical Specifications (TS) or alarm signal available to the operator indicating that the coolant temperature is beyond the temperature assumed in the T-H analysis.

   Please discuss any potential effect on fuel temperature and Critical Heat Flux assuming that the water temperature is above the 30 degrees Celsius and why there is no temperature alarm required including a TS item describing a potential limiting condition regarding high water temperature.

2. NUREG 1537, Part 2, Chapter 13 states that credible accidents should be categorized and the most limiting accident in each group should be analyzed in detail including the potential consequences of the various accident scenarios, among them loss of coolant accident (LOCA) events.

   The Loss of Coolant analysis in Chapter 13, Section 13.5.2 of the 2009 SAR shows that even in the unlikely scenario of instantaneous loss of all coolant flow the fuel can be safely cooled by air at the peak fuel rod power densities. It is also shown in 2009 SAR Section 13.5.2 Table 13-3 that the reactor pool may **[**
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   ]. Please discuss a partial LOCA scenario and indicate whether the fuel temperature in a partially uncovered core is still bounded by the 2009 SAR LOCA analysis.

3. The requirements of 10 CFR Sections 20.1201(a)(1) and 20.1301(a)(1) include limiting the total effective dose equivalent to facility staff and individual members of the public from the licensed operations. Compliance to 10 CFR Section 20.1301 is described in 10 CFR Section 20.1302.

   The LOCA events analyzed in 2009 SAR Chapter 13 Section 13.5.2 assumes that the reactor core becomes uncovered with the potential increase in dose rates to the staff and members of the public due to unshielded gamma-rays.

   Please indicate the potential accumulated dose to the facility staff members considering the facility evacuation plan and whether is in agreement with 10 CFR Section 20.1201 requirements. In addition, please discuss the maximum accumulated dose to a member of the public due to unshielded gamma-rays and sky-shine, and whether it satisfies 10 CFR Section 20.1301 requirements.

4. NUREG 1537, Part 1, Section 4.3, Reactor Tank or Pool states that the applicant should present all information about the pool necessary to ensure its integrity, should assess the possibility of uncontrolled leakage of contaminated primary coolant, and should discuss preventive and protective features.

   Section 4.3 Chapter 4 of the 2009 SAR provides limited information in this area:

   a. Please discuss the reactor pool water level monitoring system, alarm levels and required responses from the facility operators and/or university personnel, if a remote alarm signal is present.

   b. Please discuss the basis for not requiring a TS for a pool level alarm.

c. Please discuss potential draining pathways of reactor pool water leakage, facility operator responses to a water leakage, radioactivity monitoring as a result of the leakage, and the normal radioactive material content of the pool before release.

d. Please explain the significance of the **[ ],** including assumptions and boundary conditions, **[ ]**

e. Please discuss the scenario when there is an excessive leakage in the heat exchanger piping, how this type of leakage would be identified (low level alarm, temperature alarm, etc.), and how the Nuclear Science Center would respond should the facility be unoccupied.

5. NUREG-1537 states that the format and content of the TS follow that of American National Standards Institute (ANSI), American Nuclear Society (ANS) 15.1. ANSI/ANS 15.1-2007, Section 1.3, Definitions, describes the definitions for uniform interpretation of terms and phrases used for research and test reactors. Texas A&M University (TAMU) TS 14.1 does not define the following terms: core configuration, excess reactivity, license, licensee, protective action, reactor operator, and senior reactor operator. Please define these terms or provide a basis for not including these definitions.

6. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS 15.1-2007, Section 1.3, Definitions, describes the definitions for uniform interpretation of terms and phrases used for research and test reactors. The 2009 SAR TSs use the following terms that are not defined: protective devices and operator. Please define these terms or use terms that have been defined in TS 14.1; or provide a basis for not including these definitions.

7. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 1.3 provides a definition of “Reference Core Condition.” TAMU uses the term “Cold Critical” in TS 14.3.1.5 and 14.3.6.1; however the term is not defined. Please evaluate the term “Cold Critical” against the ANSI/ANS-15.1 standard definition for “Reference Core Condition” and consider developing a definition that can be included in TAMU TS 14.1 and used in the Limiting Condition for Operations (LCO) for Excess Reactivity and Shutdown Margin in TS 14.3.1.3 and TS 14.3.1.5 respectively.

8. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4 provides allowable surveillance intervals for varying time periods and specifically states that “weekly” shall be an “interval not to exceed 10 days.” TAMU TS 14.4 does not define allowable surveillance intervals, however defines these time periods in Section 14.1. TAMU TS 14.1.46 defines “Weekly” as “should be performed at least once every calendar week.” Please include a 10 day limit within the definition of “weekly” or provide a basis for maintaining the current definition.

9. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 6.7.2 discusses special reporting requirements for operational occurrences. TAMU TS 14.1.31(3) lists a reportable occurrence as "A reactor safety system component malfunction that renders or could render the reactor safety system incapable of performing its intended safety function unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdowns." ANSI/ANS-15.1, Section 6.7.2 does not include the stipulation for conditions discovered during maintenance. Please consider removing the stipulation or provide a basis for including this stipulation.

10. TAMU TS 14.3.1.1 establishes that, for the purposes of testing and calibration, the reactor may be operated at power levels greater than the licensed power level. Specifically, operation is authorized up to 1.3 MW, while licensed power level is 1.0 MW. Please develop a method for meeting testing/calibration requirements without exceeding the licensed power level and eliminate this exemption from the licensed power level in TS 14.3.1.1 or provide a basis for maintaining the TS in its current state.

11. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.2(1) includes guidance on establishing LCOs for minimum number of operable control rods (defined in terms of scram time). Please discuss whether TAMU TS 14.3.2 is consistent with the standard guidance.

12. TAMU TS 14.3.2, Table 14-2, establishes the function for the Fuel Element Temperature and High Power Level safety channels as "Scram at LSSS" and "Scram at 125%" respectively. Please consider changing to statements where the safety channels are required to scram "prior to exceeding" rather than "at" the designated limit.

13. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.2(8) includes guidance on establishing permitted bypassing of channels for the purposes of calibrations and maintenance. Please discuss whether TAMU TS 14.3.2 should include acceptable conditions for bypassing channels for this purpose.

14. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.3 provides guidance for establishing LCOs on coolant systems to include coolant level limits, leak or loss of coolant detection and fission product activity detection. Please discuss whether TAMU TS 14.3 is consistent with the standard guidance.

15. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Sections 3.4.1 and 3.4.2 define operations that require confinement and equipment needed to achieve confinement. TAMU TSs 14.3.3.1 and 14.3.3.2 include notes that establish exceptions for the operability of the central exhaust fan. If the intent of these notes is for confinement to be maintained as operable while

the main exhaust fan is taken out of service, please provide a basis for the exception and a limit on the period of time that the fan can remain inoperable.

16. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.5 provides guidance to ensure the minimum number of ventilation fans for normal operation is defined. Please provide an evaluation of TAMU TS 3.5 in relation to this standard to include an explanation of the basis for the exemption allowing reactor operation with the ventilation system inoperable for maintenance. Further, please consider establishing a statement that includes a limit for the period of time that the ventilation system can remain inoperable or provide a basis for the current format.

17. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.7.1 provides a time limit for alternate methods of radiation monitoring with a channel out of service. Please review the notes associated with TS 14.3.5.1 and 14.3.5.3, and consider adding time limits consistent with the standard guidance or provide a basis for not including time limits.

18. NUREG 1537, Part 1, Section 10.1 Experimental Facilities and Utilization, states that the applicant should provide sufficient information to demonstrate that no proposed operations involving experimental irradiations or beam utilization will expose reactor operations personnel, experimenters, or the general public to unacceptable radiological consequences. Regulatory Guide 2.2, Section C.1.c.(3) states that the "materials of construction and fabrication and assembly techniques should be so specified and used that assurance is provided that no stress failure can occur at stresses twice those anticipated in the manipulation and conduct of the experiment or twice those which could occur as a result of unintended but credible changes of, or within, the experiment."

    TAMU SAR Chapter 14, Technical Specifications, Section 3.6.2(1a) Material Limitations, allows that explosive materials in quantities less than 25 mg may be irradiated in the reactor in a container "provided that the pressure produced upon detonation of the explosive has been calculated and/or experimentally demonstrated to be less than the design pressure of the container." Please discuss how TAMU will ensure a safety factor of two in TAMU TS 14.3.6.2.

19. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.8.2 provides guidance for double encapsulation of experiments involving corrosive materials. Please discuss whether TAMU TS 14.3.6.2 is consistent with the standard guidance.

20. The requirements of 10 CFR Section 50.36(c)2(ii)B, Criterion 2 state that written technical specification limiting condition of operation must be established for process variable 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. ANSI/ANS 15.1-2007, Section 3.8.1(2) requires establishing a limiting condition of operation for the sum of the absolute values of the reactivity worths of all experiments.

TAMU SAR Chapter 14, Technical Specifications, Section 3.6.1 Reactivity Limits establishes a limit for secured and non-secured single experiments. There is no reactivity limit specification for the sum of the absolute value of all experiments in the reactor as required by 10 CFR Section 50.36(c)2(ii)B with guidance from ANSI/ANS 15.1.3.8.1(2).

Please discuss the basis whether there is a need for a Limiting Condition for Operation (LCO) regarding the sum of absolute value of all experiments in the reactor ensuring that the total maximum reactivity worth limit is not exceeded.

21. TAMU TS Section 14.3.6.4, Xenon Irradiation for Iodine Production, limits the total facility Xenon-125 of all experiments to 3500 curies (Ci). The corresponding bases state that the production of Xenon-125 in excess of this limit is not necessary. Please discuss the basis and methodology for this limit.

22. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 3.3 provides guidance for establishing LCOs on coolant systems to include water chemistry requirements. TAMU TS 14.3.8 establishes pH limits for bulk pool water with a two week exception for deviations. Please provide the basis for two weeks exception for primary coolant chemistry.

    Additionally, while TAMU TS 14.3.8 establishes an operating limit on the conductivity and pH of the primary coolant, there is no corresponding surveillance in TAMU TS 14.4. The pH and radioactivity level of the reactor pool water should be monitored on a periodic basis. TAMU TS 14.3.8 implicitly requires testing not less than two weeks. If this is considered a surveillance program, please discuss why a specific TS item in TAMU TS 14.4 is not required.

23. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4 provides guidance for identifying which surveillances can be deferred during shutdown and which must be performed prior to reactor operations. Please discuss whether TAMU TS 14.4 is consistent with the standard guidance.

24. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.1(1) provides guidance for surveillance requirements on Excess Reactivity. Please discuss whether TAMU TS 14.4.2 is consistent with the standard guidance.

25. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.1(2) provides guidance for surveillance requirements on Shutdown Margin and includes the stipulation “and following significant core configuration and/or control rod changes.” Please discuss whether TAMU TS 14.4.2.3 is consistent with the standard guidance.

26. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.2(1) provides guidance for surveillance requirements on reactivity worth of control rods and includes the stipulation "and following significant core configuration and/or control rod changes." Please discuss whether TAMU TS 14.4.3.1 is consistent with the standard guidance.

27. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.2(9) provides guidance for surveillance requirements on reactor control interlocks. Please discuss whether TAMU TS 14.4.3 is consistent with the standard guidance.

28. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.3 provides guidance for surveillance requirements on reactor coolant systems. Please discuss whether TAMU TS 14.4.3 is consistent with the standard guidance.

29. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.5 provides guidance for surveillances on ventilation system filter efficiency measurements and an operability check of any emergency exhaust systems. Please discuss whether the TAMU TS 14.4.4 is consistent with the standard guidance.

30. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 5.1 provides guidance for including a "description of the site and of the facility including location and exclusion or restricted areas." Please discuss whether TAMU TS 14.5 is consistent with the standard guidance.

31. TAMU TS 14.6.1.3(1) includes a note establishing conditions for when a reactor operator or trainee can be replaced by maintenance personnel if there is a Senior Reactor Operator present. The note references TAMU TS 14.1.29(b). Please clarify what conditions are being exempted in the note associated with this TS.

32. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 6.1.4 references ANSI/ANS-15.4-1988 (R1999), "Selection and Training of Personnel for Research Reactors" as the standard for selection and training of personnel at research reactors. Please discuss whether TAMU TS 14.6.1.4 is consistent with the standard guidance.

33. NUREG-1537, Chapter 12.1 Conduct of Operations, Organizations states that the organization shall meet the non-power reactor standard ANSI/ANS 15.1-2007. ANSI/ANS 15.1.6.2.2, Review and Audit Groups, Quorums states not less than one-half of the membership where operating staff does not constitute a majority is considered as quorums. TAMU TS 14.6.2.2 does not specify the composition of the Safety Review Committee (SRC), just the number of members. Please discuss the composition of the SRC and the number of members from operating staff.

34. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 6.4 includes guidance for procedures that shall be prepared and approved to cover a list of specific activities. One of the activities is maintaining exposures and releases as low as reasonably achievable (ALARA). Please discuss whether TAMU TS 14.6.3 is consistent with the standard guidance.

35. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 6.4 includes guidance for procedures that shall be prepared and approved to cover a list of specific activities. TAMU TS 14.6.3(5) does not include all TS surveillance procedures. For example: testing of the ventilation system is not included (refer to TAMU TS 14.4.4). Please discuss the basis for not including a requirement for these surveillance procedures to be designated by TAMU TS 14.6.3 as procedures requiring Reactor Safety Board and NSC Director approval.

36. NUREG-1537 states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 6.6.1 discusses the actions to be taken in case of a safety limit violation and specifically mentions that a report shall be prepared that includes a discussion of the effect of the violation upon the health and safety of the public. Please discuss whether TAMU TS 14.6.3 is consistent with the standard guidance.

37. The requirements of 10 CFR Section 50.36 specifically identify the following three conditions as requiring record retention until the Commission terminates the license of the reactor:

    a. Exceeding a safety limit.
    b. Failure of an automatic safety function to function as required.
    c. Failure to meet a Limiting Condition for Operation.

    Please discuss whether TAMU TS 14.6.7 is consistent with the regulation.