

October 28, 2015

Mr. Ralph Butler, Executive Director
University of Missouri-Columbia
Research Reactor Center
1513 Research Park Drive
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI AT COLUMBIA - REQUEST FOR ADDITIONAL INFORMATION REGARDING THE PROPOSED TECHNICAL SPECIFICATIONS FOR THE RENEWAL OF FACILITY OPERATING LICENSE NO. R-103 FOR THE UNIVERSITY OF MISSOURI AT COLUMBIA RESEARCH REACTOR (TAC NO. ME1580)

Dear Mr. Butler:

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for the renewal of Facility Operating License No. R-103, dated August 31, 2006 (redacted versions of the application and supplement are available on the NRC's public web site at www.nrc.gov under Agencywide Documents Access and Management System Accession Nos.: ML062540114 - cover letter; ML092110573 - Safety Analysis Report (SAR), Chapters 1-9; ML092110597 - SAR, Chapters 10-18), for the University of Missouri - Columbia Research Reactor. During the NRC staff review, as well as from our site visit conducted May 12 and 13, 2015, questions have arisen for which additional information is needed. The enclosed request for additional information (RAI) identifies the additional information needed to complete our review. We request that you provide responses to the enclosed RAI within 45 days from the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.30(b), "Oath or affirmation," you must execute your response in a signed original document under oath or affirmation. Your response must be submitted in accordance with 10 CFR 50.4, "Written communications." Information included in your response that is considered sensitive or proprietary, that you seek to have withheld from the public, must be marked in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Any information related to security should be submitted in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements." Following receipt of the additional information, we will continue our evaluation of your renewal request.

R. Butler

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If you need additional time to complete this request, or have any questions regarding this review, please contact me at (301) 415-0893, or by electronic mail at Geoffrey.Wertz@nrc.gov.

Sincerely,

/RA/

Geoffrey A. Wertz, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186

Enclosure:
Request for Additional Information

cc: See next page

University of Missouri-Columbia

Docket No. 50-186

cc:

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Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

R. Butler

- 2 -

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ADAMS Accession No: ML15280A314

***concurrence via email**

NRR-088

OFFICE	DPR/PRLB/PM*	DPR/PRLB/LA	DPR/PRLB/BC	DPR/PRLB/PM
NAME	GWertz	NParker	AAdams	GWertz
DATE	10/7/15	10/8/15	10/ 28 /15	10/ 28 /15

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OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

FOR THE RENEWED LICENSE FOR

THE UNIVERSITY OF MISSOURI-COLUMBIA RESEARCH REACTOR

LICENSE NO. R-103; DOCKET NO. 50-186

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for the renewal of Facility Operating License No. R-103, dated August 31, 2006 (redacted versions of the application and supplement are available on the NRC's public web site at www.nrc.gov under Agencywide Documents Access and Management System (ADAMS) Accession Nos.: ML062540114 - cover letter; ML092110573 - Safety Analysis Report (SAR), Chapters 1-9; ML092110597 - SAR, Chapters 10-18), for the University of Missouri - Columbia Research Reactor (MURR). During the NRC staff review, as well as from our site visit conducted May 12 and 13, 2015, questions have arisen associated with the proposed technical specifications (TSs) provided by letter dated January 27, 2014 (ADAMS Accession No. ML14030A132). The enclosed request for additional information (RAI) identifies the additional information needed to complete our review. We request that you provide responses to the enclosed RAI within 45 days from the date of this letter.

The NRC staff review of the proposed MURR TSs was based on the requirements in Title 10 *Code of Federal Regulations* (10 CFR) 50.36, "Technical specifications," and the guidance provided in NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," Chapter 14, Appendix 14.1, "Format and Content of Technical Specifications for Non-Power Reactors," and American National Standards Institute/American Nuclear Society (ANSI/ANS) 15.1-2007, "The Development of Technical Specifications for Research Reactors."

The RAIs are listed below in the order of the sections of the proposed MURR TSs (Definitions, Safety Limits (SLs) and Limiting Safety System Settings, Limiting Conditions of Operation (LCOs), Surveillance Requirements (SRs), Design Features, and Administrative Controls). NRC staff RAIs are also provided for several of the proposed TS Bases. For each RAI below, unless otherwise indicated, provide: 1) a response; 2) a revised TS consistent with the referenced guidance, or; 3) a justification explaining why no change to the proposed TS is needed.

Enclosure

1. TS 1.0 Definitions:
 - a. The proposed MURR TS definition for "Abnormal Occurrences" provides criteria that may not be consistent with the guidance provided ANSI/ANS-15.1-2007, Section 6.7.2, as described below:
 - i. Specification c, which states, in part, "unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdowns," is not consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.7.2, item (1)(c)(iii), states, in part, "If the malfunction or condition is caused by maintenance, then no report is required."
 - ii. Specification e, which states, in part, "which could result in exceeding prescribed radiation exposure limits of personnel or environment or both;" is an exception not found in the guidance in ANSI/ANS-15.1-2007, Section 6.7.2, item (1)(c)(v).
 - b. The proposed MURR TS does not include a definition for "Containment," as provided in the guidance in ANSI/ANS-15.1-2007.
 - c. The proposed MURR TS does not include a definition for "Core Configuration," as provided in the guidance in ANSI/ANS-15.1-2007.
 - d. The proposed MURR TS definition of "Excess Reactivity" does not contain the provision, as provided in the guidance in ANSI/ANS-15.1-2007, that the evaluation is performed at "reference core conditions."
 - e. The proposed MURR TS definition for "Operational Modes" states that the reactor can be "operated safely." The term "operated safely" is not defined in the TSs and could be subject to interpretation.
 - f. The proposed MURR TS definition for "Reactor Operator" and "Senior Reactor Operator" states "certified." ANSI/ANS-15.1-2007 provides guidance that operators are "licensed."
 - g. The proposed MURR TS definition for "Reactor Safety System" does not include one of the criteria provided in the guidance in ANSI/ANS-15.1-2007, which states, in part, "or to provide information for initiation of manual protective action."
 - h. The proposed MURR TS definition for "Reactor Shutdown" does not appear to be consistent with the guidance provided in NUREG-1537, which includes criteria for: 1) the shutdown reactivity ($\$1.00$); 2) the reference core condition; and, 3) the reactivity worth of any installed experiments.
 - i. The proposed MURR TS definitions for "Shim Blade (Rod)" and "Regulating Blade (Rod)" do not indicate any safety function, e.g., whether the blades are scrammable.
 - j. The proposed MURR TS does not appear to include a definition for "Scram Time" as provided in the guidance in ANSI/ANS-15.1-2007.

- k. The proposed MURR TS definition for “Unscheduled Shutdown” states, in part, “that occurs after all “Blade Full-In Lights” have cleared.” The term “Blade Full-in Lights” does not appear to be clearly defined in the TSs.
2. TS 2.0 Safety Limits and Limiting Safety System Settings:
 - a. The proposed MURR TS 2.1, Specifications a, b, and c, and accompanying TS Figures 2.0, 2.1 and 2.2, provide SLs that appear to represent the normal operating conditions associated with Core Power, Core Flow, Reactor Water Inlet Temperature, and Pressurizer Level, and thus appear to be LCOs. The guidance in NUREG-1537 appears to provide a SL of 530 degrees Celsius (°C) as an acceptable limit for the MURR fuel type. Explain the SL curves.
 - b. The proposed MURR TS 2.1, Specifications a, b, and c, differs from the current TS 2.1, Specifications a, b, and c, issued in License Amendment No. 36, by letter dated July 8, 2013 (ADAMS Accession No. ML13133A349). Provide a justification for the revised wording.
 - c. The proposed MURR TS 2.2, Limiting Safety System Setting (LSSS) provides the reactor power limit in units of percent of licensed power (e.g., 125% of full power). NRC staff is not clear if the measuring channel used in the control room display displays the same units (percent reactor power), and if the measuring channel is calibrated to percent reactor power.
 - d. The proposed MURR TS 2.2, LSSS states that a coolant flow rate of 1,625 gallons per minute (gpm) is required from "either" loop for operation in Mode I. SAR Section 4.6.4.1, indicates that the minimum flow is 1,625 gpm, whereas, your response to RAI A.20, by letter dated July 16, 2010 (ADAMS Accession No. ML12354A237), states that 1,600 gpm is required for Mode II operation. Explain the difference.
 3. TS 3.0 Limiting Conditions for Operation:
 - a. The proposed MURR TS 3.1, Specification c, Exception, states, in part, “the reactor may be operated with less than eight fuel assemblies.” The NRC staff is not clear how operation in this mode is consistent with the definitions of the TS Operating Modes (Modes I, II, or III) as provided in the proposed MURR TS 2.2.
 - b. The proposed MURR TS 3.1, Specification d, provides a fuel burnup limit. NUREG-1537, Appendix 14.1, Section 4.1, item (6), provides guidance for surveillance requirements for burnup limits. There does not appear to be a corresponding SR in the proposed MURR TSs. Propose a SR, or, if a SR is not practical, propose moving the specification for fuel burnup to TS Section 5, Design Features.

- c. The proposed MURR TS 3.1, Specification e, provides the LCO for inoperable (damaged) fuel that includes “anomalies” and a coolant channel dimensional check. NUREG-1537, Appendix 14.1, Section 3.1, item (6) (a), provides guidance that damaged fuel should have limits on growth, bowing, or bending, and detectable fission products. It also includes the guidance that the specification should reference the fuel manufacturer’s guidance or recommendations for detecting deterioration. Explain the proposed LCO definition of fuel “anomalies,” and if the additional criteria as provided by the guidance in NUREG-1537 (fuel manufacturer) should also be included in the proposed MURR TS 3.1, Specification e, to establish fuel operability.
- d. The proposed MURR TS 3.2, Specification c, states, in part, “The shim blades shall be capable of insertion to 20% withdrawn position.” The NRC staff reviewed the information provided in the associated TS Basis, which described the reactivity insertion at the 20% withdrawn position (91%), and could not find a supporting analysis in the referenced SAR Section 13.2.2. Therefore, the basis for the 20% withdrawn position is not clear.
- e. The proposed MURR TS 3.2, Specifications d and e, provide a reactivity insertion rate limit for the regulating blade and shim blades ($\Delta k/k/sec$).
 - i. The basis for the limit for the regulating blade is not provided or referenced. Indicate if a supporting analysis is available.
 - ii. The associated SR requirements, TS 4.2, Specifications d and e, provide limits based on blade speed. The correlation between blade speed (TS 4.2) and the associated reactivity insertion rate (TS 3.2) is not clear.
- f. The proposed MURR TS 3.2, Specification f, provides a requirement for operability of the rod run-in function and provides a table of logic requirements.
 - i. Item 1: The trip set point is indicated as “115% of full power (Max).” Confirm that the channel for the setpoint is calibrated in percent reactor power.
 - ii. Item 8: The trip setpoint is indicated as “<10% withdrawn and bottomed.” NRC staff is not clear as to how to interpret this set point.
- g. The proposed MURR TS 3.2, Specification g, provides a table for the required number of operable reactor safety system instrument channels.
 - i. Item 1: The trip set point is indicated as “125% of full power (Max).” Confirm that the channel setpoint is calibrated in percent reactor power.
 - ii. Items 3, 4, 5, and 9 provide trip set points based on flow rates in gpm. However, the associated TS footnotes (2), (3), and (4) suggest a delta-pressure (delta-P) based on a flow value in a table.
 - (1) Provide a reference for the flow value table.
 - (2) Explain if the setpoint is based on flow or delta-P.

- (3) Indicate if the control room indications are provided in units of flow or delta-P.
- h. The proposed MURR TS 3.3, provides requirements for reactor coolant systems.
- i. Specification d, references 10 CFR Part 20, Appendix B, Table 3. For releases to the public, the NRC staff is questioning if the TS should refer to the effluent concentrations in 10 CFR Part 20, Appendix B, and Table 2?
 - ii. Specifications f and h, provide limits associated with the reactor coolant system pH ranges. For your consideration, the NRC staff has evaluated the use of a conductivity limit to control the pH and provided guidance by letter dated May 11, 2015 (ADAMS Accession No. ML15114A433).
 - iii. Specification I, provides an anti-siphon pressure specification. It also appears to provide additional requirements and operator actions that could be considered TS action statements, LCOs and SRs, in the case of a low-pressure alarm or low water level condition. Determine if the requirements for a low-pressure alarm or low water level condition constitute additional LCO or SRs.
- i. The guidance in NUREG-1537 and ANSI/ANS-15.1-2007, Section 3.3, "Coolant Systems," states, in part, "minimum operating equipment, or operating limits, or both, shall be specified for shutdown cooling or pump requirements." An LCO for shutdown cooling system minimum requirements does not appear to be included in the proposed MURR TS.
- j. The proposed MURR TS 3.4, provides requirements associated with the reactor containment building.
- i. The proposed MURR TS 3.4, uses the term "containment integrity" and "personnel airlock," whereas SAR, Section 6.2, "Containment System" appears to use the terms "integrity" and "pedestrian entry." Explain the difference in these terms.
 - ii. The proposed MURR TS 3.4, requires operation of the exhaust system as a necessary component of "containment integrity." However, from information gained during the NRC staff site visit, it appears that operation of the exhaust system is also required to support the use of non-reactor facilities located in adjoining buildings, such as hot cells. Discuss the need to establish TS LCOs on the operation of the exhaust system, or on the operation of the non-reactor facilities, to provide ventilation of these non-reactor systems.

- iii. The MURR SAR, Section 6.2.6, describes two modes of operation of the containment system: 1) normal operation; and, 2) isolation upon activation of a high radiation signal at the reactor pool bridge or exhaust plenum.
 - (1) It is not clear if either mode is described in TS 3.4.
 - (2) It is not clear which equipment is necessary to ensure operability of each mode.
- iv. Specification a, Item (2), indicates the utility seal trench is filled to a required depth of 4.25 feet (51 inches). SAR Section 6.2.6, indicates a required depth of 65 inches. Explain the difference.
- v. Specification a, Item (3), states, in part, "all of the reactor containment building ventilation system's automatically-closing doors and automatically-closing valves are operable or placed in the closed position." The NRC staff is not clear regarding this TS requirement. A review of the associated TS basis or SAR Section 6.2, did not provide an explanation of the operability of the doors and valves. Explain the required operability of the doors and valves.
- vi. Specification a, Item (6), refers to the MURR facility annual integrated leak rate test and as such is not a condition of equipment required to achieve containment integrity. It appears to be a surveillance requirement and not an LCO. Explain why this item should not be moved to the SRs.
- vii. Specification b, is not clear to the NRC staff. It appears to contain an applicability statement, and not an LCO. Based on the guidance in NUREG-1537 and ANSI/ANS-15.1-2007, the LCO should be based on the operability of equipment necessary to ensure the operability of the reactor building containment integrity.
- viii. Specification c, is not clear to the NRC staff. It appears to contain an applicability statement, an LCO, a setpoint, a SR, a TS exception, as well as some procedure guidance for the operators to manually actuate containment isolation. The guidance in NUREG-1537 and ANSI/ANS-15.1-2007, discusses the operability of equipment to ensure containment. Revise Specification (c) to state the LCO requirements and ensure that the associated SRs are properly stated in the appropriate section of the TSs.
- k. The proposed MURR TS 3.5, Specification c, provides for overlap of adjacent ranges of nuclear instrument channels, but is not clear to the NRC staff as to which channels are affected, what the allowable ranges are, and whether these ranges are affected by the operational Mode.
- l. The proposed MURR TS 3.7, Specification a, provides requirements for radiation monitoring channels.
 - i. Setpoints and functions of the radiation monitors do not appear to be in the

proposed MURR TS 3.7. The guidance in Table 14.1 in NUREG-1537, Appendix 14.1, provides information on the setpoints and functions of the radiation monitors.

- ii. Environmental monitors do not appear to be included in the proposed MURR TS. The guidance in NUREG-1537, Appendix 14.1, Section 3.7.1, item (4), "Environmental Monitors," provides that environmental monitors should be specified in the proposed MURR TS.

m. The proposed MURR TS 3.8, provides controls on experiments:

- i. The specifications in proposed TS 3.8, do not appear to follow the format provided in the guidance in NUREG-1537 and ANSI/ANS-15.1-2007 which provides subsections for: "Reactivity Limits," "Materials," and "Failure and Malfunctions." Consider organizing the specifications to follow the guidance provided above.
- ii. Specification c, does not appear to be supported by an analysis in the MURR SAR.
 - (1) Provide an analysis which explains the dose from the release being averaged over a year and not treated as an instantaneous release.
 - (2) The exception provided to "Fueled Experiments (see Specification 3.8.a)" is not explained in the Basis or described in the SAR. Provide an analysis or explanation for the exception.
- iii. Specification d, states "explosive materials shall not be irradiated," but then adds information relative to limiting an experiment to 25 milligrams of TNT-equivalent explosives. This specification is not clear to the NRC staff.
- iv. Specification e, states "other experiments," without providing a definition or explanation.
- v. Specifications f, g, and l, do not appear to be LCOs consistent with the guidance in NUREG-1537, but rather appear to be procedural controls.
- vi. Specification n, uses the description "first-of-a-kind" which does not appear to be described in the TS, or have an associated TS definition.
- vii. Specification o, requires both HEPA and charcoal filters as well as continuous monitoring for increases in radioactive material accumulation. However, there is no LCO to control the presence of these filters nor is there an identification of the monitoring system needed to support their use.
- viii. Specification p, uses the term "secured removable experiment" which does not appear to be described or have an associated TS definition.

4. TS 4.0 Surveillance Requirements:

- a. Proposed MURR TS LCOs: 3.1.a, 3.1.c, 3.1.d, 3.1.e, 3.2.a, 3.5.c, 3.3.b, 3.3.e, 3.3.h, 3.3.i, 3.4.a, 3.4.b, and 3.5.c, do not appear to have corresponding SRs.
- b. The proposed MURR TS 4.1, provides SRs for reactor core parameters:
 - i. Specification a, does not define the criteria for determining when “significant core configuration and/or control blade change,” exists.
 - ii. Specification c, does not indicate the criteria for acceptable results of the fuel inspections.
- c. The proposed MURR TS 4.2, provides SRs for reactor control and reactor safety systems:
 - i. Specification a, states “drop time,” which does not appear to correspond to any of the LCOs listed in TS 3.2.
 - ii. The proposed MURR TS 4.2, Specifications b and j, do not appear to have any corresponding LCOs.
 - iii. Specifications d and e, appear to require a limit based on withdraw and insertion speed; whereas, the proposed MURR TS 3.2, Specifications d and e, provide limits based on reactivity rate.
 - iv. Specification g, states, in part, “that the reactor safety system shall be channel tested.” The NRC staff is not clear if this SR refers to all specifications (a. through h.) of proposed MURR TS 3.2.
- d. The proposed MURR TS 4.3, Specifications d and g, do not appear to have corresponding LCOs and associated limits.
- e. The proposed MURR TS 4.4, Specification a, states, in part, “No special maintenance shall be performed just prior to the test.” The NRC staff is unclear as the basis for this statement in the SR.
- f. The proposed MURR TS 4.5, Specification c, provides an exception to performing the surveillance that is not clearly described, and the basis for the exception is not provided.
- g. The proposed MURR TS 4.6, provides SRs for the emergency electrical power system:
 - i. Specification a, states, in part, “The operability of the emergency power generator.” However, the NRC staff is not clear as to the criteria for operability of the emergency power generator.
 - ii. TS LCO 3.6, Specification a, refers to the emergency electrical power system. Neither Specification a or b, include the emergency electrical power system. Explain the emergency electrical power system, LCO 3.6, Specification a, surveillance test.

- h. The proposed MURR TS 4.7, provides SRs for the radiation monitoring systems and airborne effluents.
 - i. Specification a, states, in part, “radiation monitors shall be verified operable by monthly radiation source checks or channel tests.” The NRC staff is not clear if radiation source checks and channel tests represent equivalent surveillance tests.
 - ii. TS LCO 3.7, Specification b, does not appear to have a corresponding SR within TS 4.7.
 - i. The proposed MURR TS 4.8, Specification a, states, in part, “the criteria of Specification 3.8, shall be evaluated.” However, the criteria for the acceptability of the evaluation are not provided.
5. TS 5.0 Design Features:
- a. The proposed MURR TS 5.1, Specification a, contains a footnote, which seems redundant to information in the Basis, or referenced in the SAR.
 - b. The proposed MURR TS 5.2, Exception a, is not clear, and it appears to be redundant TS 2.1, Specification a for Mode II operation.
 - c. The proposed MURR TS 5.2, Exception b, exempts certain components from Specification 5.2.e. However, the response to RAI A.49, by letter dated October 29, 2010 (ADAMS Accession No. ML12355A023), stated that the size of components of concern did not present a hazard to the PCS. As such, the NRC staff is not clear if these components are considered major components as defined by TS 5.2, Specification e, and if so, then it appears that the TS 5.2, Exception b, is not necessary.
6. TS 6.0 Administrative Controls:
- a. The proposed MURR TS 6.1.3, does not appear to include the guidance in ANSI/ANS-15.1-2007, Section 6.1.3, that a designated senior reactor operator shall be available in an “on call” status.
 - b. The NRC staff are unable to find any requirements in the proposed MURR TSs, Section 6, which are consistent with the guidance provided in ANSI/ANS-15.1-2007, Section 6.1.4, and the ANSI/ANS-15.4-1998, regarding the selection and training of personnel.
 - c. The proposed MURR TS 6.2, Specification a. (1), does not appear to be consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.2.3, that the review should include all changes to the facility.
 - d. The proposed MURR TS 6.2.2, does not appear to be consistent with the guidance of ANSI/ANS-15.1-2007, Section 6.2.2, states, in part, “that operating staff may not constitute a majority of the Reactor Advisory Committee.”

- e. The NRC staff are unable to find any requirements in the proposed MURR TSs, Section 6, which are consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.8.2, regarding records to be retained for at least one operator certification cycle.
7. TS Bases:
- a. The NRC staff review of the proposed MURR TS Bases identified the following:
 - i. The proposed MURR TS Bases, listed below appear to need a description or to provide a SAR reference to the referenced TS:
 - (1) TS 3.1, Specifications a and b;
 - (2) TS 3.2, Specifications a and d;
 - (3) TS 3.5, Specifications a, c and d;
 - (4) TS 3.7, Specification b; and
 - (5) TS 3.8, Specifications a, b, c, f, g, h, and i.
 - ii. The proposed MURR TS 2.2.a Basis, does not appear to reference the analysis submitted in License Amendment 36.
 - iii. The proposed MURR TS 3.1, Specification c Basis, does not appear to provide a reference for a supporting analysis for the Exception provided for operation with less than eight fuel assemblies. Provide a reference to an analysis supporting operation with less than eight fuel assemblies.
 - iv. The proposed MURR TS 3.2.h Basis, does not appear to provide any information relative for the interlocks cited in the table of interlocks.
 - v. The proposed MURR TS 5.2.e Basis, does not appear to incorporate the material introduced by the response to RAI A.49, by letter dated October 29, 2010 (ADAMS Accession No. ML12355A023), concerning hazards to the reactor coolant system.
 - vi. The proposed MURR TS 3.8.a Basis, references SAR Section 13.2.6. However, the SAR only compares the iodine and strontium isotope limits to the Maximum Hypothetical Accident analysis, which assumes that the failure occurs in the coolant system with no dose consequence. The NRC staff questions whether the TS Basis should reference a safety analysis that considers failures of fueled experiments that could occur in other locations of the facility.