June 16, 2016

Colonel L. Andrew Huff, Director
Armed Forces Radiobiology Research Institute
8901 Wisconsin Avenue
Bethesda, MD 20889-5603

SUBJECT: ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE - REQUEST FOR ADDITIONAL INFORMATION REGARDING THE RENEWAL OF FACILITY OPERATING LICENSE NO. R-84 FOR THE ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE TRIGA REACTOR FACILITY (TAC NO. ME1587)

Dear Colonel Huff:

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of the Armed Forces Radiobiology Research Institute (AFRRI) application dated June 24, 2004 (a redacted version of the safety analysis report is available on the NRC's public Web site at www.nrc.gov under Agencywide Documents Access and Management System Accession No. ML101650415), as supplemented, for the renewal of Facility Operating License No. R-84 for the AFRRI TRIGA reactor facility.

During our review, questions have arisen for which additional information and clarification is needed. The enclosed request for additional information (RAI) identifies the additional information needed to continue our review. We request that you provide responses to the enclosed RAI within 30 days from the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 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.

If you have any questions regarding this review, please contact me at 301-415-3398 or by electronic mail at Cindy.Montgomery@nrc.gov.

Sincerely,

***/RA/***

Cindy K. Montgomery, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-170
License No. R-84

Enclosure:
Request for Additional Information

cc: See next page

If you have any questions regarding this review, please contact me at 301-415-3398 or by electronic mail at Cindy.Montgomery@nrc.gov.

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**ADAMS Accession No.: ML16159A291** *concurrence via e-mail NRR-106

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OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

REGARDING THE RENEWAL OF

THE ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE

TRIGA REACTOR FACILITY

LICENSE NO. R-84; DOCKET NO. 50-170

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of the Armed Forces Radiobiology Research Institute (AFRRI) license renewal application dated June 24, 2004 (a redacted version of the safety analysis report (SAR) is available on the NRC's public Web site at www.nrc.gov under Agencywide Documents Access and Management System (ADAMS) Accession No. ML041800067), as supplemented. The NRC staff's review used the guidance in NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," and supporting information from the American National Standards Institute/American Nuclear Society (ANSI/ANS)-15.1-2007, "The Development of Technical Specifications for Research Reactors." During our review, questions have arisen, for which additional information and clarification is needed. This request for additional information (RAI) identifies the additional information needed to continue our review. Many of these RAIs below will refer to the Technical Specifications (TSs) provided by the AFRRI letter dated February 26, 2016 (a redacted version can be found in ADAMS Accession No. ML16060A210). We request that you provide responses to this RAI within 30 days from the date of the cover letter.

1. For the purpose of re-issuing the AFRRI license, provide the total number of grams of uranium-235 and plutonium needed for special nuclear material, of any enrichment, in the form of detectors, fission plates, foils, and solutions.

2. Section 302(b)(1)(B) of the Nuclear Waste Policy Act of 1982 states that the NRC requires current confirmatory documentation, as a precondition to issuing or renewing an operating license for a research or test reactor, that the licensee has entered into an agreement with the Department of Energy (DOE) for the disposal of high-level radioactive wastes and spent nuclear fuel.

   In the renewal application, AFRRI has not provided evidence of compliance with Section 302(b)(1)(B) of the Nuclear Waste Policy Act of 1982.

   Provide a copy of the current valid DOE fuel contract suitable for the NRC staff to use to verify that DOE continues to retain title of the AFRRI fuel and is obligated to take AFRRI's spent fuel and/or high-level wastes. Include the terms and effective dates of the agreement.

3. Proposed TS 5.1, “Site and Facility Description,” does not include a description of the licensed area including the location of the exclusion or restricted areas.

   ANSI/ANS 15.1-2007, Section 5.1, “Site and Facility Description,” guidance states, in part, that “A general description of the site and of the facility including location and exclusion or restricted areas shall be present.”

   Provide a description of the licensed area including the location of the exclusion or restricted areas and refer only to publicly available documents (e.g., not the physical security plan), or provide an explanation of why it is not necessary. In addition, provide a description of the operations boundary.

4. The compound adjective “long term” is not defined in proposed TS 4.6, “Reactor Fuel Elements,” Specification a., which states:

   > Fuel elements shall be inspected visually for damage or deterioration and measured for length and bend in accordance with the following:
   >
   > a. Before being placed in the core for the first time or following long term storage;

   Quantify the compound adjective “long term” in proposed TS 4.6, Specification a.

5. The inability to remove a TRIGA fuel element from the core is an abnormal condition that warrants further evaluation. The criteria for dispositioning fuel that cannot be normally removed through the upper grid plate is not addressed in proposed TS 3.7, “Fuel Parameters,” Specification d., as this TS does not explicitly pertain to fuel that cannot be removed through the top of the grid plate.

   Modify proposed TS 3.7 to include fuel that cannot be removed through the top of the grid plate.

6. Proposed TS 3.2.1, “Reactor Control System,” Specification b., states, “The reactor shall not be operated unless the four control rod drives specified in Section 5.2.2.b. are operable or fully inserted.”

   A. Clarify the conditions under which the reactor can be operated and the meaning of the term “fully inserted.”

   B. Clarify whether you meant that “[the associated control rod is] fully inserted,” or that the control *drives must be* operable or *fully inserted*.

   C. Since this specification allows operation with fully inserted control rods, provide an analysis demonstrating that acceptable thermal hydraulic conditions are maintained when operating in a condition with control rods fully inserted.

7. Proposed TS 4.2.1, “Reactor Control Systems,” Specification c., states:

> On each day that pulse mode operation of the reactor is planned, a functional performance check of the transient rod system shall be performed. Semiannually, not to exceed 7.5 months, the transient rod drive cylinder and the associated air supply system shall be inspected, cleaned, and lubricated as necessary.

A. Define the phrase “functional performance check” and include the minimum performance criteria that is required to demonstrate proper operation of the transient rod, as well as the means for evaluating acceptable performance.

B. Indicate whether functional means a channel check or channel test. If it does not mean either of these, then define functional.

C. Modify proposed TS 4.2.1 to include these clarifications, or justify why the changes are unnecessary.

8. The following questions pertain to the limiting condition for operation, proposed TS 3.3, “Coolant Systems,” and the corresponding surveillance requirement, proposed TS 4.3.

Proposed TS 3.3, “Coolant Systems,” states, in part, the following:

Specifications

a. The reactor shall not be operated above a thermal power of 5 kW when the core outlet temperature exceeds 60°C;
b. The reactor shall not be operated if the conductivity of the bulk water is greater than 5 micromhos/cm; and
c. Both audible and visual alarms shall be provided to alert the AFRRI security guards and other personnel to any drop in reactor pool water level greater than 6 inches.

Proposed TS 4.3, “Coolant Systems,” states, in part, the following:

Specifications

a. The pool water temperature, as measured near the input to the water purification system, shall be measured daily, whenever operations are planned.
b. The conductivity of the bulk water shall be measured monthly, not to exceed 6 weeks.
c. The reactor coolant shall be measured for radioactivity at least quarterly, not to exceed 4 months.
d. The audible and visual reactor pool level alarms shall be tested quarterly, not to exceed 4 months.

A. The guidance in ANSI/ANS 15.1-2007, Section 3.3, "Coolant Systems," states, "Minimum operating equipment, or operating limits, or both, shall be specified for the following: . . . (5) fission product activity detection; . . ."

However, no TS operating limit has been proposed on coolant radioactivity. Additionally, proposed TS 4.3, Specification c., is a surveillance for radioactivity detection, but no actions are specified to be taken if radioactivity is found to be above the operational limit.

Describe how abnormal coolant radioactivity (indicative of abnormal fission product activity) would be detected by the operator. Provide a TS limit on fission product activity that provides a maximum upper limit of acceptable activity. This TS should correspond with surveillance TS 4.3, Specification c. Specify the corresponding actions to be taken if the limit is reached. Alternatively, justify why it is not necessary.

B. The basis for the proposed TS 3.3 pool temperature limit discusses the protection of the water purification resins. Given that the thermal hydraulic analysis was based on the assumption of a maximum pool temperature of 60 degrees C, and given that reactor operation at temperatures greater than 60 degrees C would be unanalyzed, provide a revision to proposed TS 3.3 that specifies 60 degrees C as the maximum temperature permitted. Provide an appropriate basis for TS 3.3 that considers the results of the thermal hydraulic analysis. (See also RAI 31.D.)

C. The current TS 4.3, Specification b., states that conductivity shall be measured weekly. In your February 9, 2016, RAI responses (ADAMS Accession No. ML16040A310), you provided a justification for monthly measurement of conductivity, which stated:

> The stability of conductivity within the AFRRI TRIGA pool water system has been proven by more than 5 decades of operations. Furthermore, experience demonstrates that the conductivity of the pool water not vary with reactor usage. Additionally, corrosion is an extremely slow process, making daily/weekly measurements unnecessary. NUREG-1537, Part 1, Appendix 14.1, Section 4.3, "Coolant Systems," Item (6) "Conductivity and pH," provides guidance that the conductivity and pH should be measured weekly. Monthly measurements are permitted if the reactor is shutdown for long periods of time and/or if justification is provided in the SAR. Since conductivity is not a function of usage, and NUREG-1537 permits monthly measurements, then it should be acceptable to make measurements on a monthly basis, whether or not operations are planned.

The regulations in 10 CFR 50.36 cover the protection of fuel cladding. Describe alternate indications available to operators for early detection of ion exchange failure or other inadvertent contamination in the pool water, given a monthly surveillance requirement.

9. There are inconsistencies between the specifications included in proposed TS 3.2, "Reactor Control and Safety Systems," and the corresponding surveillance requirements in proposed TS 4.2, "Reactor Control and Safety Systems." As stated in ANSI/ANS 15.1-2007, Section 4, "a specific system from a Section 3 specification will establish the minimum performance level, and a companion Section 4 surveillance requirement will prescribe the frequency and scope of surveillance to demonstrate such performance." Provide information that demonstrates that each function, scram or interlock has a corresponding surveillance, and ensures that each of the following issues are addressed.

   A. Proposed TS 4.2.2, Specification c., states, "Channel calibration shall be made of the power level monitoring channels annually, not to exceed 15 months." However, no definition for power level monitoring channels is provided.

      List the specific neutron measurement instrumentation channels (linear power channel, log power channel and power pulsing channel) that constitute the "power level monitoring channels" as proposed in TS 4.2.2, Specification c. Provide a revision to proposed TS 4.2.2, Specification c., to clarify the definition of power level monitoring channels, or state why it is not necessary.

   B. Proposed TS 4.2.2, Specification a., states, "A channel test of the scram function of the high-flux safety channels shall be made each day that the reactor is to be operated."

      The measuring channels—linear power channel, log power channel and power pulsing channel—have a TS for calibration (proposed TS 4.2.2, Specification c.), but the linear power channel, log power channel and power pulsing channel do not have either a channel check or channel test for the protective functions which they provide.

      Revise proposed TS 3.2 and 4.2 to demonstrate the checking and testing of the operability of the measuring channels or justify why no change to the TSs are needed. In addition, describe why a channel check for high flux safety channel is more appropriate than a channel test.

   C. Proposed TS 4.2.2, Specification b., states, "A channel test of each of the reactor safety system channels for the intended mode of operation shall be performed weekly, whenever operations are planned."

      Define reactor safety system channels and identify which specific channels are included in this definition. State which specific reactor safety system channels are applicable in proposed TS 4.2.2, Specification b., or justify why no change to the TS is needed. In addition, explain what a channel check of the scram function is, considering the definition in proposed TS 1.4, "Channel Check."

   D. State whether proposed TS 4.2.2, Specification a., provides justification for the lack of inclusion of a channel check for fuel temperature safety channels, or revise the TS to include a channel check for fuel temperature safety channels.

10. The following questions pertain to proposed TS 3.2.2, "Reactor Safety System," and proposed TS 4.2.2, "Reactor Safety Systems."

    A. Proposed TS 3.2.2, Table 2, "Minimum Reactor Safety Systems Scrams," requires a preset timer to initiate a scram of the reactor 15 seconds after the initiation of a pulse. Table 3, "Minimum Reactor Safety System Interlocks," requires an interlock to prevent pulsing when the reactor power level is 1 kW or above. This scram and interlock system is described in Section 4.10, "Reactor Control Components," of the SAR.

    The proposed TSs do not contain surveillance testing of the interlocks for the reactor safety system channels.

    Provide information on the testing of the pulse timer scram and the pulse initiation interlock. Describe the surveillance testing of the functions and provide a surveillance TS, or justify why no TS is needed.

    B. In Section 4.11.3 of the SAR, "High Flux Safety Channels 1 and 2," mention is made of the high flux safety channels forming part of the scram logic circuitry. Included is a statement that during pulsing operation, when reactor power level, as measured by the high flux safety Channel 2, reaches the maximum pulse power level specified in TSs, a scram logic circuit is activated which caused an immediate reactor scram. Proposed TS 3.2.2, Table 2, "Minimum Reactor Safety System Scrams," does not provide a minimum performance level for the pulsing power scram. Explain its absence or make appropriate corrections to TS 3.2.2.

11. Proposed TS 6.2.5, "Audit Function," Item f., states the following: "Reactor Facility ALARA [as low as reasonably achievable] Program. This program may be a section of the total AFRRI program." Describe the "total AFRRI program" or revise this specification to clarify the requirements of this action.

12. In the December 4, 2014, RAI responses, AFRRI performed an analysis to calculate the Ar-41 dose to workers in the reactor bay. This analysis was based on a measured Ar-41 production rate at 1 MWt of 0.5 microcuries per second (with reactor at mid-pool). Also, in the December 4, 2014, RAI responses, AFRRI performed an analysis to calculate Ar-41 effluent release to the public. That analysis provided Ar-41 production rates for reactor operation at varying core positions. The lowest Ar-41 production rate was 0.0024 millicuries per kilowatt-hour (with reactor at core position 500), which would be equivalent to a production rate at 1 MWt of 0.67 microcuries per second. In the September 21, 2012, responses to RAIs, AFRRI performed an analysis of the dose to members of the public from the radiation shine from an Ar-41 plume leaving the facility stack. That analysis assumed an Ar-41 production rate of 5.1 microcuries per second.

    Clarify the differences in the assumptions made and/or conditions required for each of these three Ar-41 production rates. Additionally, explain why the production rate of 0.5 microcuries per second is conservative for the calculation of worker doses in the

reactor bay, given that the licensed power of AFRRI is 1.1 MWt and that Ar-41 production increases when the reactor core is at a location other than mid-pool.

13. The NRC staff issued RAI 3b., on September 13, 2010, related to the regulations in 10 CFR Section 20.1301(a)(1). This question discussed limits to the total effective dose equivalent to individual members of the public likely to receive the highest dose from licensed operation. The question, RAI 3b., was as follows:

> Where is this person located? If this dose is from immersion in the Ar-41 plume when it reaches ground level, confirm that a higher dose is not possible from radiation shine from the plume passing over a person closer to the facility than the point at which the plume reaches ground level or from a person exposed to direct radiation shine from the Ar-41 source before release from the AFRRI research reactor facility.

In the September 21, 2012, RAI responses, AFRRI performed an analysis to calculate the theoretical dose to a person, exposed to direct radiation shine from the Ar-41 source released through the stack, standing 10 feet from the AFRRI exterior wall.

Clarify whether the person was assumed to be downwind and directly under the plume in a position maximally exposed to the shine from the overhead plume.

14. Proposed TS 3.5.2, “Effluents: Argon-41 Discharge Limit,” Specification b., states:

> If calculations, which shall be performed at least quarterly but not to exceed 20 MWh of operation, indicate that argon-41 release in excess of 313.5 curies to the unrestricted environment could be reached during the year as a result of reactor operations, reactor operations that generate and release measurable quantities of argon-41 shall cease for the remainder of the calendar year.

Proposed TS 4.5.2, “Effluents,” Specification c., states:

> A gaseous effluent release report shall be generated quarterly or every 20 MWh of reactor operation (whichever is first) to ensure radioactive effluent will not exceed the annual limit.

A. Proposed TS 3.5.2, Specification b. might be excessively conservative. Consider proposing an alternative TS which would provide greater operational flexibility, for example, reducing the number of hours to be operated instead of ceasing operation, while ensuring that Part 20 limits will not be exceeded.

B. Clarify whether the gaseous effluent release report in proposed TS 4.5.2 would be based on actual measurement of Ar-41 releases, or on calculations of estimated Ar-41 releases based on operating history.

15. The regulations in 10 CFR Section 20.2003, “Disposal by release into sanitary sewerage,” paragraph (a)(1) state that a licensee may discharge licensed material into

sanitary sewerage if, among other conditions, the material is readily soluble (or is readily dispersible biological material) in water."

Section 3.4.2 of the SAR, "Liquid Radioactive Wastes," does not explicitly state compliance with 10 CFR 20.2003. Discuss AFRRI's compliance with 10 CFR Section 20.2003 (a)(1).

16. Proposed TS 3.5.1, "Monitoring System," states, in part, the following:

Specifications

The reactor shall not be operated unless the following radiation monitoring systems are operable:

a. Radiation Area Monitoring System. The radiation area monitoring (RAM) system shall have two detectors located in the reactor room and one detector placed near each exposure room plug door to detect streaming radiation;
b. Stack Gas Monitor. The stack gas monitor (SGM) will sample and measure the gaseous effluent in the building exhaust system;
c. Continuous Air Particulate Monitor. The continuous air particulate monitor (CAM) shall sample the air above the reactor pool. This unit shall be sensitive to radioactive particulate matter. Alarm of this unit shall initiate closure of the ventilation system dampers, restricting air leakage from the reactor room; and
d. Table 4 specifies the alarm and readout system for the above monitors.

**Table 4. Locations of Radiation Monitoring Systems**

| Sampling Location | Readout Location(s) (Audible and Visual) |
|---|---|
| **RAM** | |
| Reactor Room (2 require | Reactor and Control Rooms |
| Exp. Room 1 Area | Prep Area and Control Rooms |
| Exp. Room 2 Area | Prep Area and Control Rooms |
| **SGM** | |
| Reactor Exhaust | Reactor and Control Room |
| **CAM** | |
| Reactor Room | Reactor and Control Room |

A. Describe how proposed TS 3.5.1 is inclusive of other activities, performed when the reactor is not operating (i.e., removing an experiment with reactor shutdown, handling of fuel, etc.), which have the potential for airborne radiological release.

B. The guidance in NUREG-1537, Part 1, Chapter 14, Appendix 14.1, "Technical Specifications," Section 3.7, "Radiation Monitoring Systems and Effluents," contains Table 14.4, "Typical required radiation measuring channels," with illustrative setpoint value maximums.

Proposed TS 3.5.1 does not include applicable alarm or actuation setpoints for the RAM, CAM, and SGM. Provide a revision to TS 3.5.1 that includes applicable alarm or actuation setpoints for the RAM, CAM, and SGM and an appropriate basis.

17. The following questions pertain to proposed TS 6.6, "Operating Reports":

A. Proposed TS 6.6, "Operating Reports," Item b.7.a., requires liquid waste discharges to be summarized on a quarterly basis.

The regulations in 10 CFR 20.2003(a)(2) state that a licensee may discharge licensed material into sanitary sewerage if, among other conditions, the quantity of licensed or other radioactive material that the licensee releases into the sewer in one month, divided by the average monthly volume of water released into the sewer by the licensee, does not exceed the concentrations listed in Table 3 of Appendix B to 10 CFR Part 20.

Revise TS 6.6, Item b.7.a., to require monthly averaging of liquid waste discharges to ensure compliance with 10 CFR 20.2003(a)(2), or justify why no revision is needed.

B. Proposed TS 6.6, "Operating Reports," Item b.7.a.i., states the annual report will contain, for liquid waste, "Concentration limits used and isotopic composition if greater than $3 \times 10^{-6}$ microcuries/ml for fission and activation products."

Provide an explanation of the meaning of this requirement, and an explanation and justification for the value $3 \times 10^{-6}$ microcuries/ml for fission and activation products.

C. Proposed TS 6.6, "Operating Reports," states, in part:

> …the following reports shall be submitted to USNRC Office of Nuclear Reactor Regulation unless otherwise noted: . . . b. Annual Operating Report: . . . Each annual report shall include: . . . 7. A summary of the nature and amount of radioactive effluents released . . .
>
> c. Solid Waste (summarized on a quarterly basis)
>
> Total cubic feet of atomic number 3 to 83 materials in solid form disposed of under license R-84;"

Explain and provide a regulatory basis for why proposed TS 6.6 Item b.7., Specification c., applies only to atomic number 3 to 83 materials, or expand the applicability of this proposed TS if appropriate. In addition, expand the proposed TS to include the total activity (in Curies), as well as the total volume, disposed under license R-84.

18. In the January 17, 2012, responses to RAIs, AFRRI analyzed doses to AFRRI facility occupants ("Receptors A, B, and C") and workers in the reactor room for the maximum hypothetical accident involving failure of a fueled experiment. AFRRI's analyses assumed that a portion of the halogens released from the fueled experiment would plate out within the reactor room, and would not be available for release to the environment. It is not clear whether the external dose contribution to workers in the reactor room, and to AFRRI facility occupants, from halogens that are plated out within the reactor room was considered in these analyses.

    Clarify whether the doses provided in Tables 4, 5, and 6 of the RAI responses dated January 17, 2012, included the external dose contribution from halogen plate out.

19. NUREG-1537, Part 1, Chapter 13, Section 13.1.3, "Loss of Coolant," provides guidance to licensees to systematically analyze and discuss credible accidents in each accident category.

    AFRRI's revised SAR Chapter 13 (provided to NRC by letter dated March 4, 2010), Section 13.2.1.4, describes the radiation dose rates in the reactor floor and roof areas due to the unshielded reactor core after a postulated large loss-of-coolant accident (LOCA).

    In its RAI dated July 19, 2010, the NRC staff requested that AFRRI provide accumulated doses to the reactor building occupants and to the maximally exposed member of the public, considering evacuation procedures and potential residence time for staff, and asked AFRRI to discuss compliance of these doses with the regulations in 10 CFR Part 20.

    AFRRI's response, dated February 7, 2011, provided accumulated doses, estimated based on the analysis in an older version of the AFRRI SAR that was provided to NRC as part of AFRRI's initial license renewal application submittal in 2004.

    Provide accumulated doses for the LOCA accident that are based on the analysis provided in AFRRI's revised SAR, Section 13.2.1.4, that was submitted to NRC on March 4, 2010.

20. ANSI/ANS 15.1-2007 guidance contains a definition for confinement. The proposed TSs do not contain this definition. Provide a definition for confinement or justify why it is not necessary.

21. ANSI/ANS 15.1-2007 guidance contains a definition for control rods that includes the functions that control rods provide. The proposed TSs do not cover the functions of control rods. Provide a definition for control rods that includes the types of functions that control rods provide, or justify why it is not necessary.

22. Proposed TS 1.8, “Excess Reactivity,” states:

> Excess reactivity is that amount of reactivity that would exist if all control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical ($k_{eff}$ = 1) at reference core conditions or at a specific set of conditions.

Define what is meant by “or at a specific set of conditions” and why it is necessary to include in the TS.

23. Proposed TS 1.22, “Reactor Safety System,” states:

> Reactor safety systems are those systems, including their associated input channels, that are designed to initiate a reactor scram for the primary purpose of protecting the reactor or to provide information for initiation of manual protective action.

Proposed TS 1.22 accords, in part, with ANSI/ANS-15.1-2007. However, ANSI/ANS 15.1-2007 also contains a definition of “protective action.” The term “protective action” is not defined in the proposed TSs. Provide a definition for the term “protective action.”

24. The AFRRI updated SAR, Chapter 7, dated September 27, 2010 (ADAMS Accession No. ML110260024), provides general information about the design of instrumentation and control systems, but does not describe specific details associated with the operation or reactivity control aspects of the servo system.

NUREG-1537, Part 1, Chapter 7.3, “Reactor Control System,” provides guidance that the license should analyze the operation and performance of the system, including the bases for any technical specifications and surveillance requirements, and provide a description of the evaluation of any accident scenarios that may be created by a malfunction of the system (e.g., a malfunction of the servo bounded by another reactivity insertion event).

A. Provide details of the servo system operation including the normal reactivity control range, regulating rod position, interlocks, and any other significant design and safety information, or explain why no additional information is necessary.

B. Explain if additional technical specifications are needed for the servo system, or justify why no changes are necessary.

C. According to proposed TS 1.33, “Steady State Mode,” operation of the reactor can be manual or automatic. Provide a description of the number of rods that can be simultaneously withdrawn and the interlocks which prevent insertions of excess reactivity. If three control rods can be withdrawn simultaneously, analyze this rod withdrawal accident and discuss how the analysis affects the results of the analysis of a ramp insertion accident.

25. For proposed TS 3.2.1, “Reactor Control System,” explain how the notes to Table 1 apply to the Pulsing Power Channel, or modify the notes to exclude applicability to the Power Pulsing Channel.

26. For proposed TS 3.2.1, Reactor Control System,” explain how the notes to Table 2 apply, or modify the notes.

27. Proposed TS 3.2.2, “Reactor Safety System,” Table 2, refers to the high flux safety channel; however, this term is not defined. Provide a definition for high flux safety channel.

28. Proposed TS 3.2.2, “Reactor Safety System,” Table 2, refers to the “emergency stop.” However, “emergency stop” is not defined. Provide a definition of “emergency stop” and describe how an “emergency stop” differs from a manual scram.

29. Proposed TS 3.2.2, “Reactor Safety System,” Table 3, lists the minimum reactor safety system interlocks, but does not discuss the prevention of an inadvertent pulse. Describe how application of air to the transient rod (an inadvertent pulse) is prevented from occurring.

30. Proposed TS 3.2.2, “Reactor Safety System,” Table 3, uses the terminology “operational channel,” but “operational channel” is not defined. Define operational channel or state why it is not necessary.

31. Proposed TS 3.2.2, “Reactor Safety System,” does not contain a scram for pool water temperature. Proposed TS 3.3, “Coolant System,” has as the basis that the pool temperature limit is designed to protect the demineralizer beds in the water purification system.

    A. Explain how proposed TS 3.3, “Coolant System,” prevents operation if the pool temperature is above 60 degrees C.

    B. Explain how an automatic or manual scram is initiated for pool temperature, or explain how this TS for pool temperature keeps the reactor within analyzed conditions.

    C. Explain if the pool temperature protects the core during operations, and is in accord with the assumptions used for the thermal hydraulics analysis.

    D. Proposed TS 3.3, Specification a., states that the reactor should not be operated above 5 kWt when the coolant temperature measured at the core outlet is greater than 60 degrees C. Explain, analytically, at what coolant temperature above 60 degrees C does 5 kWt operation reach a thermal-hydraulic limit and add that temperature limit to the TS; or remove the ability to operate above 60 degrees C from the TS.

32. Proposed TS 3.4, “Ventilation System,” states, in part:

> The reactor shall not be operated unless the facility ventilation system is operating, except for periods of time not to exceed two continuous hours to permit repair, maintenance, or testing. In the event of a release of airborne radioactivity in the reactor room above routine reactor operation and normal background values, the ventilation system to the reactor room shall be automatically secured via closure dampers by a signal from the reactor deck continuous air particulate monitor.

Proposed TS 4.4, “Ventilation System,” states, in part:

> The operating mechanism of the ventilation system dampers in the reactor room shall be verified to be operable and visually inspected monthly, not to exceed 6 weeks.

A. Propose a TS requirement to maintain a controlled air pathway (negative pressure) of the reactor room with respect to the adjacent rooms and surrounding building when the reactor is operating and during a postulated accident, or explain why it is not necessary. If a TS requirement to maintain negative pressure in the reactor room by a controlled air pathway is necessary, then propose a surveillance requirement to confirm that negative pressure is present.

B. Explain how continuous air monitor setpoints are determined and verified for operability. Explain if the operating mechanism of the ventilation system dampers is verified to be operable with a valid signal from the radiation monitors to the dampers, causing the dampers to close.

C. Proposed TS 3.4, “Ventilation System,” discusses operating conditions for which the facility ventilation system must be operational. Revise the TS to require the ventilation system to be operating when radiation material is being handled in the reactor room with the potential for airborne radioactive material or justify why the TS is not needed.

33. Proposed TS 4.0, “Surveillance Requirements,” states:

> No surveillance requirements shall be deferred during normal reactor operational periods. Any surveillance requirements that cannot be performed due to a reactor outage shall be performed prior to resuming normal reactor operations.

ANSI/ANS 15.1-2007, Section 4, “Surveillance Requirements,” states, in part:

> For each surveillance requirement (SR), it should be specified if the surveillance activity can or cannot be deferred during reactor shutdown. It should also be specified for those that can be deferred, which must be performed prior to reactor operations.

Revise proposed TS 4.0 to include for each surveillance requirement, whether it is possible to defer during shutdowns, and if it is required prior to resuming operations.

34. Proposed TS 5.3, "Special Nuclear Material Storage," states, in part:

> All fuel elements not in the reactor core shall be stored and handled in accordance with applicable regulations. Irradiated fuel elements and fueled devices shall be stored in an array that *will* [emphasis added] permit sufficient natural convective cooling by water or air, and the fuel element or fueled device temperature *will* [emphasis added] not exceed design values. Storage shall be such that groups of stored fuel elements *will* [emphasis added] remain subcritical under all conditions of moderation and reflection in a configuration where $k_{eff}$ is no greater than 0.90.

A. Provide TS 5.3 with "shall" statements, or justify why it is not necessary to do so.

B. Define the meaning of "groups" or delete the term from the proposed TSs.

35. Proposed TS. 6.1.1, "Structure," states, in part:

> The organization of personnel for the management and operation of the AFRRI reactor facility is shown in Figure 1. Organizational changes may occur based on AFRRI requirements and will be depicted in internal documents.

The organization chart is part of the facility operating license, and therefore changes to the organization chart require a license amendment. Provide a TS consistent with 10 CFR 50.36c.(5), or explain why it is unnecessary.

36. Guidance in ANSI/ANS 15.1-2007, Section 6.1.2, "Responsibility," states, in part:

> Responsibility for the safe operation of the reactor facility shall be with the chain of command established in Figure 1. Individuals at the various management levels, in addition to having responsibility for the policies and operation of the reactor facility, shall be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adherence to all requirements of the operating license or charter and technical specifications.

A. Proposed TS. 6.1.2, "Responsibility," states, in part, that "The AFRRI Licensee shall have license responsibility for the reactor facility." The "AFRRI Licensee" has not been defined. Define who, by title, the licensee is, or explain why it is not necessary to do so.

B. Proposed TS. 6.1.2, "Responsibility," does not explicitly state who is responsible for meeting the conditions of the license, and who is responsible for the protection of public health and safety. Provide a revised proposed TS 6.1.2, that clearly states the

individuals who are responsible for meeting the conditions of the license and who are responsible for the protection of public health and safety.

37. Proposed TS do not contain a section similar to ANSI/ANS 15.1-2007, Section 6.1.1, "Structure," which contains a description of the organization for the management and operation of the reactor facility, including Levels 1-4 and their responsibilities.

Provide a TS with a description of the responsibilities of Levels 1-4, or explain why no changes are necessary.

38. Proposed TS 6.1.3.2, "Operations," Specification b., states, in part:

> A Senior Reactor Operator shall be present at the reactor during the following operations: . . . 2. Initial reactor startup and approach to power

Provide a definition for the term "initial startup" or state why it is not necessary.

39. Proposed TS 6.1.3.3, "Training of Personnel," states:

> Training and retraining program shall be maintained, to ensure adequate levels of proficiency in persons involved in the reactor and reactor operations.

However, the TSs do not state that the training program shall be consistent with the requirements in 10 CFR 55.59 or the standards related to training in ANSI/ANS-15.4-2007. Propose a revision to proposed TS 6.1.3.3 to require that the training program shall be consistent with the requirements in 10 CFR 55.59 and/or the standards in ANSI/ANS 15.4-2007, or state why it is not necessary to do so.

40. Proposed TS 6.2.1.1, "Composition," does not specify the minimum number of members of the review and audit group (The Reactor and Radiation Facilities Safety Subcommittee (RRFSS)). The guidance in ANSI/ANS 15.1-2007, Section 6.2.1, "Composition and Qualifications," states, in part, that "The review and audit functions shall be composed of a minimum of three members. . . ." Propose a modification to proposed TS 6.2.1.1 that specifies the minimum number of members, or justify why it is unnecessary.

41. Proposed TS 6.2.2, "Function and Authority," does not contain a required action with respect to reporting requirements for the RRFSS to the Level 1. ANSI/ANS 15.1-2007, Section 6.2.3, "Review function," states, "A written report or minutes of the findings and recommendations of the review group shall be submitted to Level 1 and the review and audit group members in a timely manner after the review has been completed." Propose a required action for reporting requirements for TS 6.2.2, or justify why it is not necessary to do so.

42. Proposed TS 6.2.3.1, "Alternates," uses the terms "alternate members" and "alternates." Proposed TS 6.2.1.1, Specification b.1., defines special RRFSS members (Temporary members) as "Other knowledgeable persons to serve as alternates in section

6.2.1.1.a.2.b. above as appointed by the AFRRI Licensee."

Provide a modification to proposed TS 6.2.3.1 and proposed TS 6.2.1.1, Specification b.1., that contain terms that are defined, define the terms used, or justify why it is not necessary to do.

43. Proposed TS 6.2.3.3, "Quorum," states, in part, that "A majority of those present shall be regular members." Proposed TS 6.2.3.4, "Voting Rules," states, in part, that "The majority is 51% or more of the regular and special members present and voting and concurrence between the Radiation Safety Officer and the reactor facility director."

ANSI/ANS 15.1-2007 guidance states that for a quorum to be reached, not less than one-half of the voting membership shall vote, and the operating staff does not constitute a majority.

In question 35 of the AFRRI RAI responses dated October 20, 2011, AFRRI stated:

> Under TS 6.2.1.1, the Reactor Facility Director is the only regular member who is a member of the "operating staff." Theoretically, other members of the operating staff could be appointed as special voting members. But since under TS 6.2.3.3 a majority of those present and voting must be regular members, the operating staff can never constitute a majority. Under TS 6.2.3.3, four specific people must be present for a quorum. Depending on the number of outside regular members under TS 6.2.1.1.a(2)(b), the total regular membership could be 4-6 people. In either case, the four required people would be not less than one-half of the voting membership. In rare cases, special voting members may be appointed under TS 6.2.1.1.b. Since, as discussed earlier, a majority of those present and voting must be at least the four specific regular members, no more than three special members can be appointed for any one meeting. Here also, the four required people would be not less than one-half of the voting membership. The TS as written satisfy the ANSI/ANS-15.1 requirements.

A. Propose a clarification to proposed TS 6.2.3.3 that identifies clearly and explicitly that the guidance is met such that the operating staff does not constitute a majority, or state why it is unnecessary to provide this clarification.

B. Define "concurrence" and state whether this means that the votes cast by the Radiation Safety Officer and Reactor Facility Director need to agree for any item to pass the committee. Explain why a dissimilar vote between the RSO and Director should be allowed to override a majority vote from the other members or remove this limitation from the TS.

44. Proposed TS 6.2.1.1, "Composition," Specification a.2.a., states that the AFRRI Licensee shall appoint the Chairman of the RRFSS. Clarify whether the Facility Director or the Radiation Safety Officer is allowed to be the Chairman, or state why it is not necessary to do so.

45. The following questions pertain to the use of shall statements, or are editorial questions pertaining to grammatical or spelling:

A. Proposed TS 6.2.3.5, "Minutes," Specification b., states, "Once approved by the committee, final minutes will be submitted to level one management for review." Provide proposed TS 6.2.3.5, Specification b., in the form of a "shall" statement, or justify why it is not necessary to do so.

Provide a correction to the spelling of the word "minuites" or clarify what the term "minuites" means.

B. Proposed TS 6.2.2.1, "Function," states:

> The RRFSS *is* [emphasis added] directly responsible to the AFRRI Licensee. The committee shall review all radiological health and safety matters concerning the reactor and its associated equipment, the structural reactor facility, and those items listed in Section 6.2.4.

Propose a modification to proposed TS 6.2.2.1 in the form of a "shall" statement, or justify why it is not necessary to do so.

C. Proposed TS 6.7.1, "Records to be Retained for a Period of at Least Five Years," and proposed TS 6.7.3, "Records to be Retained for the Life of the Facility," are not stated with shall statements.

Revise proposed TS 6.7.1 and proposed TS 6.7.3 to include a "shall" statement or state why it is not necessary to do so.

46. The following questions pertain to proposed TS 6.2.4, "Review Function."

A. Proposed TS 6.2.4, "Review Function," does not closely resemble ANSI/ANS 15.1-2007 guidance. For instance, proposed TS 6.2.4, "Review Function," Specification a., states, in part, that the RRFSS shall review:

> Safety evaluations for (1) changes to procedures, equipment, or systems having safety significance . . .

The regulations in 10 CFR 50.59 are not restricted in applicability to changes that are safety significant. Provide an explanation of how proposed TS 6.2.4 and ANSI/ANS 15.1-2007 are functionally equivalent, provide revisions to proposed TS 6.2.4 which more closely follow the guidance in ANSI/ANS 15.1-2007, or explain why it is not necessary to do so.

B. Proposed TS 6.2.4, "Review Function," Specification c., states that the RRFSS shall review:

> Proposed tests or experiments that are significantly different from previously approved tests or experiments, or those that might meet any of the criteria in paragraph (c)(2) of Section 50.59 of 10 CFR Part 50.

The phrase "experiments that are significantly different from previously approved tests or experiments" is used; however, no definition is provided. Provide criteria defining "experiments that are significantly different from previously approved tests or experiments," or explain why it is not necessary.

C. Explain whether AFRRI will comply with 10 CFR 50.59 in its entirety, or paragraph (c)(2) of Section 50.59 of 10 CFR Part 50.

47. ANSI/ANS 15.1-2007 guidance for TS 6.2.3, "Review Function," Item (5), states, in part, that the following items shall be reviewed: "violations of technical specifications, licenses, or charter. Violations of internal procedures or instructions having safety significance."

Proposed TS 6.2.4, "Review Function," Specification e., states, "Violations of applicable statutes, codes, regulations, orders, technical specifications, license requirements, or of internal procedures or instructions having nuclear safety significance."

The term "nuclear safety significance" is used; however, no definition is provided. Clarify whether the term "nuclear safety significance" in proposed TS 6.2.4, is the same as the term "safety significance" used in ANSI/ANS 15.1-2007, Section 6.2.3, Item (5) or explain how these are different. Propose a revision to TS 6.2.4, Specification e., that is inclusive of other types of safety, including radiation safety, or explain why it is not necessary to do so.

48. ANSI/ANS 15.1-2007 guidance for TS 6.2.3, "Review Function," Item (3), states, "all new experiments or classes of experiments that could affect reactivity or result in the release of radioactivity."

Proposed TS 6.2.4, "Review Function," Specification f., does not specify the release of radiation.

Propose a revision to TS 6.2.4, Specification f., that includes the release of radiation, or explain why it is not necessary to do so.

49. ANSI/ANS 15.1-2007 guidance for TS 6.2.3, "Review Function," Item (8), states, "audit reports [shall be reviewed]."

Proposed TS 6.2.4, "Review Function," Specification h., specifies that audit reports of the reactor facility operations shall be reviewed.

Provide a revision to proposed TS 6.2.4, Specification h., that conforms to the guidance, or provide an explanation why it is unnecessary to do so.

50. Proposed TS 6.2.5, “Audit Function,” states, in part, that “A report of the findings and recommendations resulting from the audit shall be submitted to the AFRRI Licensee,” but does not specify the timing.

ANSI/ANS 15.1-2007, TS 6.2.4, “Audit Function,” guidance states that a written report of the findings of the audit shall be submitted to Level 1 management and the review and audit group members within 3 months after the audit has been completed.

Provide a revision to proposed TS 6.2.5 that is consistent with the guidance, or justify why it is not necessary. Provide specificity as to which audits are included in reactor facility operations (i.e., whether the radiation protection program audits, TS compliance audits, etc.) are included.

51. Proposed TS 6.2.5, “Audit Function, “Specification d., does not mention the physical security plan.

NUREG 1537, Part 1, Chapter 14, Appendix 14.1, Section 6.2.4, “Audit Function,” guidance states, in part, that “In addition to the emergency plan, all other required plans, such as physical security and operator requalification, should be specified for auditing.”

Provide an explanation and basis for the exclusion from TS 6.2.5, or provide a revision to proposed TS 6.2.5, Specification d., that is consistent with the guidance.

52. The proposed TS do not have a TS similar to the guidance in ANSI/ANS 15.1-2007 TS 6.3, “Radiation Safety;” although, parts of the guidance is followed by AFRRI in the proposed TS 6.1.2, “Responsibility.”

The proposed TSs are not consistent with the guidance because there is no TS stating that an individual or group shall implement the radiation protection program using the guidelines of American National Standard, “Radiation Protection at Research Reactor Facilities,” ANSI/ANS 15.11-1993 (R2004).

Either propose a TS similar to the guidance that consolidates this specification and conforms to the guidance, or modify the proposed TS so that this information is included. Alternatively, justify why it is not necessary.

53. Proposed TS 6.3, “Procedures,” does not propose procedures to address the use, receipt, and transfer of byproduct material or surveillance procedures for shipping radioactive materials.

NUREG-1537, Part 1 guidance includes these procedures, as does ANSI/ANS 15.1-2007, Section 6.4, “Procedures,” Item (8).

Propose a TS that includes these procedures or justify why it is not necessary.

54. Proposed TS 6.5.1, "Actions to be Taken in Case of Safety Limit Violation," is only partially consistent with ANSI/ANS 15.1-2007 with respect to reporting criteria for safety limit violations. Proposed TS 6.5.1 does not include the phrases, "when known, the cause, and contributing factors;" or "structures, or systems, the health and safety of personnel and the public."

    ANSI/ANS 15.1-2007 guidance uses these reporting criteria.

    Propose a revision to proposed TS 6.5.1 that is consistent with the guidance and contains these reporting criteria or provide additional information to explain how proposed TS 6.5.1 is consistent with the guidance.

55. Proposed TS 6.5.2, "Reportable Occurrences," Specification e., discusses requirements for reporting observed inadequacies that could have caused unsafe conditions. However, no mention is made of requirements for reporting observed inadequacies that are *currently* causing unsafe conditions, as ANSI/ANS 15.1-2007 guidance states.

    Provide a revision to proposed TS 6.5.2 that requires reporting observed inadequacies that are *currently* causing unsafe conditions, or justify why it is unnecessary.

56. The following questions pertain to proposed TS 6.6, "Operating Reports":

    A. Proposed TS 6.6, "Operating Reports," Specification b.4., states that each annual operating report shall include: "Discussion of the major safety-related corrective maintenance performed during the period, including the effects (if any) on the safe operation of the reactor, and the reasons for the corrective maintenance required;" however, the tabulation of preventative maintenance operations having safety significance is not required by the proposed TS.

        Revise proposed TS 6.6, Specification b.4., to be consistent with ANSI/ANS 15.1-2007 guidance which includes preventative maintenance operations having safety significance or justify why it is unnecessary.

    B. Proposed TS 6.6, Specification b.4. contains the term "safety-related corrective maintenance," but does not include a definition. ANSI/ANS 15.1-2007, Section 6.7.1, "Operating Reports," Item (3) uses the term "safety significance." The term "safety-related" has a specific definition provided in 10 CFR Part 50, Appendix B. However, 10 CFR Part 50, Appendix B is not applicable to non-power reactors. Revise proposed TS 6.6, Specification b.4., using terms applicable to your facility [e.g., safety significant.] Explain how proposed TS 6.6, Specification b.4., is consistent with the guidance, or propose a revision that is consistent with the guidance.

57. Proposed TS 6.6, Specification c., "Other Reports," states that "A report shall be submitted within 30 days …" but does not specify to whom the report should be submitted. To be consistent with ANSI/ANS 15.1-2007 guidance, specify the required recipient of the report, or justify why it is unnecessary.

58. On February 7, 2011, AFRRI responded to the NRC staff's RAI, dated July 19, 2010. Question 9 asked AFRRI to demonstrate that external event consequences show compliance with the regulations in 10 CFR Part 20. AFRRI's response stated, "Therefore, seismic events in the D.C. area are not a viable threat to the integrity of the AFRRI reactor facility." In consideration of the 5.6 magnitude earthquake that struck 14km SSE of Louisa, VA on August 23, 2011, and was detectable in Bethesda, MD, state whether your response to the July 19, 2010, RAI question 9, remains valid (i.e., remains bounded by the seismic analysis of record for the AFRRI reactor facility). If not, provide the necessary revision.

59. NUREG-1537, Part 1, Chapter 13, Section 13.2, "Accident Analysis and Determination of Consequences," states that when evaluating accident consequences, licensees should account for consequences that could occur to reactor staff or members of the public until the accident has terminated, or these individuals have been evacuated or moved.

In its RAI dated July 19, 2010, the NRC staff requested that AFRRI provide accumulated doses to the reactor building occupants and to the maximally exposed member of the public, considering evacuation procedures and potential residence time for staff, and asked AFRRI to discuss compliance of these doses with the regulations in 10 CFR Part 20.

In its response, dated January 17, 2012, AFRRI analyzed doses to individuals ("Receptor A," "Receptor B," and "Receptor C") from external radiation originating from airborne radioactive material inside the reactor room. AFRRI's response stated, in part, that:

> …Receptor C is located 100 ft. from any reactor wall, with an additional concrete block wall between Receptor C and the reactor wall…
>
> …Receptor C represents the closest location of an emergency evacuation assemblage point. For the purposes of this calculation, it was assumed that a member of the public could stay at this assemblage point for 2 hours following the accident. In reality, personnel would be evacuated to a more distant location in this type of accident…

A. Clarify whether Receptor C represents a member of the AFRRI staff evacuated from the AFRRI facility, or a member of the public.

B. The emergency evacuation assemblage points for individuals evacuated from the AFRRI facility are not discussed in the AFRRI Emergency Plan. Provide a basis for the assumption that the closest emergency evacuation assemblage point would be 100 feet from any reactor wall, with an additional concrete block wall between Receptor C and the reactor wall. Additionally, provide a basis for the assumption that individuals would remain at this emergency evacuation assemblage point for two hours following the accident.