UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 22, 2021

Dr. Steven R. Reese, Director
Oregon State University
100 Radiation Center
Corvallis, OR 97331-5903

SUBJECT: OREGON STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION RE: AMENDMENT 26 – REQUEST TO REMOVE TECHNICAL SPECIFICATION REQUIREMENTS RELATED TO THE INSTRUMENTED FUEL ELEMENT AND GRAMMATICAL CHANGES (EPID L-2020-NFA-0005)

Dear Dr. Reese:

By letter dated June 17, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20171A576 and ADAMS Package Accession No. ML20171A575), as supplemented on May 21, 2021 (ADAMS Accession No. ML21141A289), Oregon State University (OSU) applied for an amendment to Facility Operating License No. R-106 for the Oregon State University TRIGA (Training, Research, Isotopes, General Atomics) nuclear research reactor. The requested licensing action would amend the facility technical specifications (TSs) to remove the TS requirements related to the instrumented fuel element. Additionally, OSU proposes to make numerous grammatical and editorial changes to the TSs.

The U.S. Nuclear Regulatory Commission (NRC) staff identified additional information needed to continue its review of the OSU's license amendment request (LAR) to remove the TS requirements related to the instrumented fuel element, as described in the enclosed request for additional information (RAI). As discussed by telephone on October 22, 2021, provide a response to the RAI or a written request for additional time to respond, including the proposed response date and a brief explanation of the reason, by November 22, 2021. Following receipt of the complete response to the RAI, the NRC staff will continue its review of the OSU's LAR to remove the TS requirements related to the instrumented fuel elements and make numerous TSs grammatical and editorial changes.

The response to the RAI must be submitted in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.4, "Written communications," and pursuant to 10 CFR 50.30(b), "Oath or affirmation," be executed in a signed original document under oath or affirmation. Information included in the response that you consider sensitive or proprietary, and seek to have withheld from public disclosure, must be marked in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Any information related to safeguards should be submitted in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Based on the response date provided above, the NRC staff expects to complete its review and make a final determination on the OSU's LAR to remove the TS requirements related to the instrumented fuel elements and make numerous TS grammatical and editorial changes by March 21, 2022. This date could change due to several factors including a need for further

requests for additional information, unanticipated changes to the scope of the review, unsolicited supplements to the LAR, and others. If the forecasted date changes, the NRC staff will notify you in writing of the new date and an explanation of the reason for the change. In the case that the NRC staff requires additional information beyond that provided in the response to this RAI, the NRC staff will request that information by separate correspondence.

If you have any questions regarding the NRC staff's review or if you intend to request additional time to respond, please contact me at (301) 415-2856, or by electronic mail at Michael.Balazik@nrc.gov.

Sincerely,

Signed by Balazik, Michael
on 10/22/21

Michael F. Balazik, Project Manager
Non-Power Production and Utilization Facility
Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-243
License No. R-106

Enclosure:
As stated

cc: See next page

cc:

Mayor of the City of Corvallis
Corvallis, OR 97331

Maxwell Woods, Assistant Director
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Mr. Daniel Harlan, Chairman
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Test, Research and Training
Reactor Newsletter
Attention: Amber Johnson
Dept of Materials Science and Engineering
University of Maryland
4418 Stadium Drive
College Park, MD 20742-2115

SUBJECT: OREGON STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION RE: AMENDMENT 26 – REQUEST TO REMOVE TECHNICAL SPECIFICATION REQUIREMENTS RELATED TO THE INSTRUMENTED FUEL ELEMENT AND GRAMMATICAL CHANGES (EPID L-2020-NFA-0005) DATED: OCTOBER 22, 2021

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ADAMS Accession No. ML21258A073 **NRR-088**

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING AMENDMENT 26 TO

FACILITY OPERATING LICENSE NO. R-106

OREGON STATE UNIVERSITY

OREGON STATE UNIVERSITY TRIGA NUCLEAR RESEARCH REACTOR

DOCKET NO. 50-243

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the license amendment request (LAR) for compliance with the appropriate regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) using the following guidance and standard(s):

- NUREG-1537 Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content," issued February 1996 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML042430055)

- NUREG-1537 Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria," issued February 1996 (ADAMS Accession No. ML042430048)

- American National Standard ANSI/ANS-15.1-2007 (R2013), "The Development of Technical Specifications for Research Reactors"

Based on its review, the NRC staff requires the following additional information to continue its review of OSU's LAR dated June 17, 2020 (ADAMS Accession No. ML20171A576), as supplemented on May 21, 2021 (ADAMS Accession No. ML21141A289). The following regulatory requirement is applicable to the request for additional information (RAI)-1 through RAI-5:

> Section 50.34, "Contents of applications; technical information," paragraph (b)(2) of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that a final safety analysis report include a description and analysis of the structures, systems, and components of the facility, with emphasis upon performance requirements, the bases, and the evaluations required to show that safety functions will be accomplished. The description shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations.

RAI-1 NUREG-1537, Part 1, Appendix 14.1, Section 3.1(3), "Reactor Core Parameters – Pulse Limits," states, in part, that the pulse limit value should be based on analysis for maintaining fuel integrity, which considers peak fuel temperature limitations.

During the conversion from highly enriched uranium (HEU) to low-enriched uranium (LEU) fuel, Oregon State University (OSU) stated, in part, in its response, dated June 20, 2008 (ADAMS Accession No. ML082350345), to the NRC's RAI, item 11, the following: "*The transient rod calibration (measured and simulated) consisted of a total of eight individual measurements. The MCNP5 error in total rod worth is ~5.5%. The measurement error in total rod worth, assuming eight measurements each with an uncertainty of 5% is ~14.1%.*"

OSU stated in its LAR, "Pulse Mode Analysis," that the analysis shows that the temperature limit of 830 degrees Celsius (C) (1526 degrees Fahrenheit [F]) temperature will be reached for a reactivity insertion of $2.33. Based on the analysis, the reactivity limit was set to $2.30. The NRC staff needs more information to ensure that the proposed pulsing technical specification (TS) limit of $2.30, considering the measurement uncertainty of the transient rod reactivity worth, does not exceed the 830 degrees C (1526 degrees F) temperature limit recommended by the fuel manufacturer.

a) Provide a description of the reactivity worth measurement method for the transient rod and explain any uncertainties associated with this measurement method.

b) Provide a discussion whether measurement error of the transient rod worth was considered in the analysis of the proposed TS pulse limit of $2.30.

RAI-2 NUREG-1537, Part 1, Section 4.6, "Thermal-Hydraulic Design," states, in part, that "any changes in fuel parameters resulting from steady-power operation that could affect pulse characteristics should be analyzed." NUREG-1537, Part 1, further states that these changes could include fuel burnup. The prompt temperature coefficient becomes less negative as the core ages, as shown in Figure 4-21, "Magnitude of the Prompt-Temperature Coefficient, α_F, as a Function of Temperature for the LEU 30/20 Fuel at Various Times in Core Life," of the OSU HEU/LEU fuel conversion safety analysis report (SAR) (ADAMS Accession No. ML080420546). The NRC staff needs more information to understand how core characteristics may impact the proposed reactivity limit for pulsing to prevent fuel temperature from exceeding 830 degrees C (1526 degrees F).

a) Provide an explanation on the resultant change in pulse peak power and maximum fuel temperature for the proposed pulse reactivity insertion TS limit of $2.30 considering the change in the prompt negative coefficient at core end-of-life.

b) Provide an explanation what other core characteristics that could change over core life that may affect the maximum fuel temperature for a pulse reactivity insertion of $2.30. As these other core characteristics change over core lifetime, clarify whether a $2.30 pulse at core end-of-life would exceed the 830 degrees C (1526 degrees F) temperature limit.

c) Provide an explanation of any differences between how the instrumented fuel element (IFE) is modeled in the reactor neutronics and thermal

hydraulic analyses compared to the standard TRIGA fuel element in the core. If any differences are identified, provide an explanation whether any events described in Chapter 13, "Accident Analysis," of the SAR are impacted.

d) Confirm the limiting core configuration of the OSU TRIGA reactor (OSTR) and briefly described how it was determined.

RAI-3 NUREG-1537, Part 1, Section 4.6, states, in part, the information should include a detailed analyses for a pulsing reactor containing descriptions of the calculational model and assumptions. In OSU's LAR, "Pulse Mode Analysis," OSU states, in part, that "although RELAP-3D [Reactor Excursion and Leak Analysis Program] is a deterministic code that does not provide uncertainty, the value of $2.30 of reactivity was chosen as the pulse limit based upon the understood conservatism." However, OSU's statement regarding "understood conservatism" was not explained in the LAR. The NRC staff needs more information to understand the conservativisms OSU applied to the pulse analysis to ensure the proposed $2.30 pulse reactivity insertion TS limit will not be exceeded.

Provide an explanation of the "understood conservatism" applied to the analysis for the determination of the $2.30 pulse limit.

RAI-4 NUREG-1537, Part 1, Section 7.3, "Reactor Control System," states, in part, that an interlock should be provided to ensure the position of the transient rod.

TS 3.1.4, "Pulse Mode Operation," states, in part, that "the reactivity to be inserted for pulse operation shall be determined and limited by a mechanical block and electrical interlock on the transient rod." The NRC staff needs more information to understand the operation of the mechanical block and electrical interlock associated with the transient rod.

Provide a description on how the mechanical block and electrical interlock for the transient rod is set, including any surveillances that are performed, to prevent pulse reactivity insertion from exceeding $2.30 thereby limiting maximum fuel temperature below 830 degrees C (1526 degrees F) as stated in TS 3.1.4, "Pulse Mode Operation."

RAI-5 NUREG-1537, Part 1, Chapter 7, "Instrumentation and Control Systems," states, in part, "that reactor facility instruments present operating parameter and system status information to the operator for monitoring reactor operation and for deciding on manual control actions to be taken." In the LAR, OSU proposed to remove the IFE that provides fuel temperature indication of a single element to the control room operator. The NRC staff needs more information to understand what other control room indications are readily available to the operator, if any, to determine whether a pulse operation resulted in expected indications.

For pulse mode operation, clarify any reactor parameters readily available to the operator to verify the inserted pulse reactivity does not exceed the proposed $2.30 limit thereby ensuring the maximum fuel temperature of 830 degrees C (1526 degrees F) is not exceeded. For any reactor parameters identified,

describe any associated instrumentation along with any surveillances performed on the instrumentation.

RAI-6 Section 50.90, ”Application for amendment of license, construction permit, or early site permit,” of 10 CFR Part 50, states, in part, that whenever a holder of a license, including an operating license under this part, desires to amend the license, application for an amendment must be filed with the Commission, as specified in Section 50.4, “Written communications,” of this chapter, as applicable, fully describing the changes desired.

NUREG-1537, Part 2, Section 7.4, “Reactor Protection System,” states, in part, that “the reactor should have operable protection capability in all operating modes and conditions as analyzed in the SAR.” In the LAR, OSU states that the purpose of the LAR is to remove all TS requirements related to the IFE and to allow pulsing without an IFE. However, OSU’s current TS 2.2, “Limiting Safety System Setting,” states, in part, that “if transient modes (square wave and pulsing) are precluded, the LSSS instead shall not exceed 1.1 MW as measured by the calibrated power level channels.” While the LAR contains information related to steady-state and pulse mode, the NRC staff could not identify any information in the LAR supporting square-wave mode of operation without the TS requirements for the IFE. Current TS 3.2.2, “Reactor Measuring Channels” and TS 3.2.3, “Reactor Safety System,” requires the fuel element temperature safety and measuring channel to be operable for square-wave mode of operation.

a) Provide a basis to support square-wave mode of operation without requiring the operation of the fuel element temperature safety and measuring channel provided by the IFE.

b) Provide an explanation of all calculational, measurement, operational, and trip setpoint setting uncertainties that are accounted for in establishing the power level scram setpoint that supports square-wave mode of operation.

c) Provide an explanation where any uncertainties are accounted for in the power level scram setpoint (for example, in the safety analysis calculations or in the physical scram setpoint).

d) For the events analyzed in OSU’s SAR, Chapter 13, confirm whether the fuel element temperature as provided by the IFE or the power level safety channel function would terminate the event.

e) For any identified events where the fuel element temperature safety channel currently terminates an event analyzed in OSU’s SAR, Chapter 13, provide an analysis of the power level safety channel trip that would terminate the event if the IFE safety function is removed.

f) Provide a description of any OSU procedures or documents that establish the power level scram setpoints.

RAI-7 Section 50.90 of 10 CFR Part 50 states, in part, that whenever a holder of a license, including an operating license under this part, desires to amend the license, application for an amendment must be filed with the Commission, as specified in Section 50.4, “Written communications,” of this chapter, as applicable, fully describing the changes desired.
NUREG-1537, Part 2, Chapter 13, “Accident Analyses,” states in part, that the information and analyses should show that facility system designs, limiting safety system settings, and limiting conditions for operation are selected to ensure that the consequences of analyzed accidents do not exceed acceptable limits. The LAR is not clear whether any events described in Chapter 13 or analyses in Chapter 4, Section 4.5, of the SAR were reanalyzed as a result of removing the IFE from TS.

a) Confirm whether any analysis or events described in Chapters 4 or 13 of the SAR were reanalyzed as a result of proposing to remove the IFE high temperature scram function.

b) Provide an explanation on which event described in Chapter 13 of the SAR has the minimum margin to current TS 2.1, “Safety Limit-Fuel Element Temperature,” that states “the temperature in a TRIGA® fuel element shall not exceed 2,100° F (1,150° C) under any mode of operation.”

c) Confirm that the removal of the IFE does not impact the reactor’s protective function to mitigate or detect the impacts of a blockage or significant flow reduction in a coolant flow channel regardless of the credibility of such an event in OSU’s fuel. If removal of the IFE at the OSTR is removing a protective function that would prevent the mitigation or detection of a blockage or significant flow reduction in a coolant flow channel, provide justification why it is acceptable to remove the IFE from the OSTR.

RAI-8 Section 50.90 of 10 CFR Part 50, states, in part, that whenever a holder of a license, including an operating license under this part, desires to amend the license, application for an amendment must be filed with the Commission, as specified in Section 50.4, “Written communications,” of this chapter, as applicable, fully describing the changes desired.

NUREG-1537, Part 1, Appendix 14.1, Section 3.1(3) states, in part, that “the maximum reactivity addition for a pulse is a license condition similar to maximum thermal power and is determined case by case. The value should be based on the SAR analysis for maintaining fuel integrity, which considers fuel type, limiting core configurations, reactivity feedback coefficients, operating history, heat capacity, and peak fuel temperature limitations. This LCO on the maximum reactivity addition administratively gives assurance that the maximum pulse reactivity addition license condition and the safety limit on maximum fuel temperature will not be exceeded.” License condition (LC) 2.C.(1) of License No. R-106 states the following:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady-state power levels not in excess of 1.1 megawatts (thermal), and in the pulse mode, with reactivity insertions not resulting in fuel temperature in excess of 830 degrees Celsius.

In the LAR, OSU didn't propose changing LC 2.C.(1) to reflect the proposed TS 3.1.4 reactivity insertion limit of $2.30.

Provide a proposal to LC 2.C.(1) to reflect the proposed TS reactivity insertion limit of $2.30 or justify why a change to LC 2.C.(1) is not needed.