



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

August 23, 2021

Dr. Ayman I. Hawari, Director
Nuclear Reactor Program
Department of Nuclear Engineering
North Carolina State University
Campus Box 7909
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Raleigh, NC 27695-7909

SUBJECT: NORTH CAROLINA STATE UNIVERSITY – REQUEST FOR ADDITIONAL
INFORMATION RE: LICENSE RENEWAL APPLICATION FOR FACILITY
OPERATING LICENSE NO. R-120 FOR THE PULSTAR NUCLEAR RESEARCH
REACTOR (EPID NO. L-2017-RNW-0026)

Dear Dr. Hawari:

The U.S. Nuclear Regulatory Commission (NRC) staff is continuing its review of the North Carolina State University (NCSU) PULSTAR Nuclear Research Reactor license renewal application (LRA) letter, dated February 24, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17088A819). Included with the NCSU LRA was the Safety Analysis Report (ADAMS Accession No. ML17201Q129 - redacted version), the Financial Qualifications Report (ADAMS Accession No. ML17088A828), the Environmental Report (ADAMS Accession No. ML17088A836), and the Reactor Operator Training and Qualification Program (ADAMS Accession No. ML17088A840).

The NRC staff has reviewed the NSCU proposed LRA and identified the items in the enclosure, which need additional information or clarification. We request that you provide responses within 90 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," NCSU must execute its response in a signed original document under oath or affirmation. The 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 safeguards information included in your response should be submitted in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements." Following receipt of the additional information, the NRC staff will continue its evaluation of the LRA.

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) 415-3724, or by electronic mail at Duane.Hardesty@nrc.gov.

Sincerely,

/RA/

Duane A. Hardesty, Senior 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. 50-297
License No. R-120

Enclosure:
As stated

cc: See next page

North Carolina State University

Docket No. 50-297

cc:

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Test, Research and Training
Reactor Newsletter
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SUBJECT: NORTH CAROLINA STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION RE: LICENSE RENEWAL APPLICATION FOR FACILITY OPERATING LICENSE NO. R-120 FOR THE PULSTAR NUCLEAR RESEARCH REACTOR (EPID NO. L-2017-RNW-0026) DATED: AUGUST 23, 2021

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NRR-088

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OFFICE OF NUCLEAR REACTOR REGULATION
REQUEST FOR ADDITIONAL INFORMATION
REGARDING LICENSE RENEWAL FOR THE
NORTH CAROLINA STATE UNIVERSITY-PULSTAR REACTOR
LICENSE NO. R-120; DOCKET NO. 50-297

The U.S. Nuclear Regulatory Commission (NRC) staff is continuing its review of the North Carolina State University (NCSU) PULSTAR Nuclear Research Reactor license renewal application (LRA) letter, dated February 24, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17088A819). The NRC staff has reviewed the NCSU proposed LRA and identified the items below which need additional information or clarification. We request that you provide responses within 90 days from the date of this letter.

These requests for additional information have been developed based on the following requirements and guidance applicable to the NCSU LRA:

- Title 10 of the *Code of Federal Regulations* (10 CFR).
- Part 20, "Standards for Protection against Radiation," of 10 CFR require that radiation doses to workers and members of the public be limited. To support meeting the public dose limits, 10 CFR Part 20, also limits the release of radioactive materials from the licensed facility to the environment (e.g., 10 CFR Part 20, Appendix B, Table 3).
- Section 50.9, "Completeness and accuracy of information," of 10 CFR require that information provided to the Commission by a licensee shall be complete and accurate in all material respects.
- NUREG-1537 Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content," issued February 1996 (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).
- NUREG/CR-6846, ANL-03/32, "Air Oxidation Kinetics for Zr-Based Alloys," published June 2004 (ADAMS Accession No. ML041900069).
- NUREG/CR-7215, "Spent Fuel Pool Project Phase I: Pre-Ignition and Ignition Testing of a Single Commercial 17x17 Pressurized Water Reactor Spent Fuel Assembly under Complete Loss of Coolant Accident Conditions," published April 2016 (ADAMS Accession No. ML16112A022).

Enclosure

- NUREG/CR-7216, "Spent Fuel Pool Project Phase II: Pre-Ignition and Ignition Testing of a 1x4 Commercial 17x17 Pressurized Water Reactor Spent Fuel Assemblies under Complete Loss of Coolant Accident Conditions," published April 2016 (ADAMS Accession No. ML16112A084).

Based on its review, the NRC staff requires the following additional information to continue its review of the LAR.

The Pool Inlet Break and Pool Outlet Break Loss-of-Coolant Accident scenarios performed by NCSU for their PULSTAR reactor safety analysis drain the reactor pool and result in air cooling of the fuel. The safety analysis did not consider the effect of air oxidation in the calculations. Breakaway oxidation of Zirconium alloys in air is a significant effect and causes thermal runaway from lower cladding temperatures than oxidation in steam. The thermal runaway leads to severe fuel damage.

- (a) Perform calculations and safety analysis of the Pool Inlet Line break that include the effect of oxidation in air (including breakaway oxidation) with and without any mitigative measures or assumptions to restrict operations (and decay heat) that demonstrate that the fuel does not suffer damage that exceeds the assumptions used in the maximum hypothetical accident.
- (b) Alternately, explain why an analysis of oxidation in air is not required to be considered and describe the mitigative features that preclude the effect of oxidation in air (including breakaway oxidation), and update the model and safety analysis for steam oxidation.