



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

April 1, 2024

Dr. Ayman I. Hawari, Director
Nuclear Reactor Program
Department of Nuclear Engineering
North Carolina State University
Campus Box 7909
2500 Stinson Drive
Raleigh, NC 27695-7909

SUBJECT: NORTH CAROLINA STATE UNIVERSITY – U.S. NUCLEAR REGULATORY
COMMISSION SAFETY INSPECTION REPORT NO. 05000297/2024201

Dear Dr. Hawari:

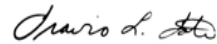
From February 12-15, 2024, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the North Carolina State University PULSTAR Reactor. The enclosed report presents the results of that inspection, which were discussed on February 15, 2024, with you and members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records, observed various activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. A follow-up inspection of an event was completed during this inspection and assessed in this report as a violation of minor significance. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

If you have any questions concerning this inspection, please contact Andrew Waugh at (301) 415-0230, or by email at Andrew.Waugh@nrc.gov.

Sincerely,



Signed by Tate, Travis
on 04/01/24

Travis L. Tate, Chief
Non-Power Production and Utilization Facility
Oversight 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

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SUBJECT: NORTH CAROLINA STATE UNIVERSITY – U.S. NUCLEAR REGULATORY
COMMISSION SAFETY INSPECTION REPORT NO. 05000297/2024201
DATED: APRIL 1, 2024

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**U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION**

Docket No.: 50-297

License No.: R-120

Report No.: 05000297/2024201

Licensee: North Carolina State University

Facility: PULSTAR Nuclear Research Reactor

Location: Raleigh, NC

Dates: February 12-15, 2024

Inspector: Andrew Waugh

Approved by: Travis L. Tate, Chief
Non-Power Production and Utilization Facility
Oversight Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

North Carolina State University
PULSTAR Nuclear Research Reactor
Inspection Report No. 05000297/2024201

The primary focus of this routine announced inspection was the onsite review of selected aspects of North Carolina State University's (NCSU, the licensee's) Class II research reactor facility safety program, including: (1) procedures; (2) experiments; (3) health physics (HP); (4) design changes; (5) committees, audits, and review; and (6) transportation activities. The U.S. Nuclear Regulatory Commission (NRC) staff determined that the licensee's program was acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

Procedures

- The inspector determined that procedures were controlled, maintained current, implemented, and followed in compliance with technical specifications (TSs) and procedural requirements.

Experiments

- The inspector determined that experiments were reviewed, approved, and conducted in accordance with TS, procedural, and regulatory requirements.

Health Physics

- The inspector determined that the licensee's HP program was conducted in accordance with TS, procedural, and regulatory requirements.

Design Changes

- The inspector determined that design changes were conducted in accordance with TS, procedural, and regulatory requirements.

Committees, Audits and Reviews

- The inspector determined that the licensee's oversight programs were conducted in accordance with TS and procedural requirements.
- The inspector determined that contrary to TS 3.3 the licensee operated with the safety power level channel inoperable on June 2, 2023.

Transportation Activities

- The inspector determined that the licensee's radioactive material transportation program was in accordance with regulatory and procedural requirements.

REPORT DETAILS

Summary of Facility Status

The NCSU, 1,000-kilowatt PULSTAR nuclear research reactor continued to be operated in support of graduate and undergraduate research and laboratory instruction, service irradiations, reactor operator training, and periodic surveillance. During the inspection, the reactor was started up, operated, and shut down to support these ongoing activities.

1. Procedures

a. Inspection Scope (Inspection Procedure [IP] 69001, Section 02.03)

The inspector reviewed various procedures and observed their implementation including the completion of a startup checklist, reactor startup, reactor operations at power, reactor shutdown, and neutron radiography experiments. The inspector also reviewed the following regarding the licensee's procedures to ensure that the requirements of the licensee's administrative procedures and TS 6.4 were met:

- special procedure 2.1, "Review and Approval of Documentation," revision 11
- operations procedure 101, "Reactor Startup and Shutdown," revision 17
- operations procedure 103, "Reactor Operation," revision 5
- operations procedure 301, "Reactor Fuel Handling," revision 2
- select change packets, dated 2022-present
- Reactor Safety and Audit Committee (RSAC) meeting minutes, dated 2022-present
- 2022 annual operating report

b. Observations and Findings

The inspector observed that the licensee maintained written procedures covering the areas specified in TS 6.4. The inspector found that the procedures in use by the licensee were current, reviewed and approved as required by TS 6.4, able to be implemented as intended, and adhered to by reactor personnel.

c. Conclusion

The inspector determined that procedures were controlled, maintained current, implemented, and followed in compliance with TS and procedural requirements.

2. Experiments

a. Inspection Scope (IP 69001, Section 02.06)

The inspector observed neutron radiography experiments and reviewed the following to ensure that experiments were reviewed and conducted as required by TS 3.7, 3.8, and 6.5:

- special procedure 2.1, "Review and Approval of Documentation," revision 11
- operations procedure 104, "Reactor Experiments," revision 4
- select change packets, dated 2022-present

- RSAC meeting minutes, dated 2022-present
- Radiation Safety Committee (RSC) meeting minutes, dated 2022-present
- qualified user lists for various experiments
- experimental request forms, dated 2022-present
- 2022 annual operating report

b. Observations and Findings

The inspector found that experiments were reviewed and approved as required by TS 6.5 and Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Changes, tests and experiments." The inspector also found that experiments were conducted in accordance with the licensee's procedures and TS 3.7 and 3.8.

c. Conclusion

The inspector determined that experiments were reviewed, approved, and conducted in accordance with TS, procedural, and regulatory requirements.

3. Health Physics

a. Inspection Scope (IP 69001, Section 02.07)

The inspector toured the facility, observed contamination surveys, observed water samples, and observed radiological signs and postings. The inspector also reviewed the following to ensure the licensee's HP program adheres to the requirements of 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 10 CFR Part 20, "Standards for Protection against Radiation," and TS 3.5 and 4.4:

- HP procedure 1, "Radiation Protection Program," revision 8
- HP procedure 3, "Radiological Surveys," revision 3
- HP procedure 6, "Transport of Radioactive and Hazardous Material," revision 1
- HP procedure 9, "Respirator Use and Bioassay," revision 3
- periodic surveillance 6-13-1, "Primary and Secondary Water Chemistry," revision 3
- personnel dosimetry records from 2022-present
- radiation safety training records 2022-present
- select weekly, monthly, and quarterly radiation surveys from 2022-present
- select radiation work permits from 2022-present
- select calibration records for various radiation monitoring equipment, dated 2022-present
- select records for respirator training and maintenance, dated 2022-present
- 2022 annual operating report

b. Observations and Findings

The inspector found that practices regarding the use of dosimetry, radiation monitoring equipment, placement of radiological postings, posting of notices, use of protective clothing, and the handling and storing of radioactive material or contaminated equipment was in accordance with regulations and the licensee's radiation protection program. The inspector found that the licensee met the regulatory requirements concerning

radiological effluent releases and radiation survey, sampling, and monitoring. The inspector also found that training was conducted for radiation workers and as low as reasonably achievable principles were implemented as required by licensee procedures.

c. Conclusion

The inspector determined that the licensee's HP program was conducted in accordance with TS, procedural, and regulatory requirements.

4. Design Changes

a. Inspection Scope (IP 69001, Section 02.08)

The inspector reviewed the following to ensure that modifications to the facility were made in accordance with the requirements of 10 CFR 50.59 and TS 6.2:

- special procedure 2.1, "Review and Approval of Documentation," revision 11
- RSAC meeting minutes, dated 2022-present
- RSC meeting minutes, dated 2022-present
- select change packets, dated 2022-present
- 2022 annual operating report

b. Observations and Findings

The inspector found that design changes were reviewed and approved as required by 10 CFR 50.59. The inspector also found that the performance of modified equipment and the procedures and drawings related to that equipment met regulatory, TS, and procedural requirements.

c. Conclusion

The inspector determined that design changes were conducted in accordance with TS, procedural, and regulatory requirements.

5. Committees, Audits and Reviews

a. Inspection Scope (IP 69001, Section 02.09)

The inspector reviewed the following to ensure that committees, audits and reviews were conducted as required by the licensee's procedures and TS 6.2:

- RSAC and RSC membership appointments, dated 2022-present
- RSAC and RSC meeting minutes, dated 2022-present
- RSAC audit summary for calendar year 2022
- 2022 annual operating report
- NRC event notification 56553
- report for event notification 56553, dated June 12, 2023
- unscheduled scram and shutdown log entries, dated 2022-present
- select change packets, dated 2022-present

b. Observations and Findings

The inspector found that the licensee's RSC and RSAC met and provided reviews as required by the TS. The inspector also found that problems identified from the licensee's required reviews and audits were resolved in accordance with the licensee's procedures and TS.

While conducting an inspection follow-up of an issue reported by the licensee to the NRC Operations Center on June 2, 2023, in Event Notification No. (EN) 56553, the inspector determined that a violation (VIO) of TS 3.3 occurred and is assessed in this inspection. Specifically, TS 3.3 states, in part, "The reactor shall not be operated unless the reactor safety system channels described in Table 3.3-1 are operable." Safety power level is one of the reactor safety system channels listed in table. 3.3-1.

Contrary to the above, the licensee operated on June 2, 2023, with the safety power level channel inoperable. During a reactor startup on June 2, 2023, the reactor operator observed a discrepancy in power indication by the linear power level and safety power level channels during power ascension. The reactor operator stopped the power ascension, notified the designated senior reactor operator, and subsequently initiated a reactor shutdown. The reactor staff investigated the safety power level channel and determined that the high voltage power supply was faulty. The safety power level channel was declared inoperable, the power supply was replaced, and the safety power level channel was calibrated prior to resuming normal operations.

The channel was inoperable for approximately one minute before the reactor was shutdown. All other power monitoring channels were operable during that time which have redundant scram capabilities and the power level stayed within the licensed limits. Because of the above, the NRC staff determined the failure to meet the operational requirements of TS 3.3 constitutes a VIO of minor significance in accordance with section 2 of the Enforcement Policy. This minor VIO (VIO 05000297/2024201-1) was corrected by the licensee and this issue is closed.

c. Conclusion

The inspector determined that the licensee's oversight programs were conducted in accordance with TS and procedural requirements.

The inspector determined that contrary to TS 3.3, the licensee operated with the safety power level channel inoperable on June 2, 2023.

6. Transportation Activities

a. Inspection Scope (IP 86740)

The inspector reviewed the following to ensure the licensee's program for transporting radioactive materials met NRC and Department of Transportation (DOT) requirements:

- select radioactive shipment records 2022-present
- HP procedure 6, "Transport of Radioactive and Hazardous Material," revision 1

b. Observations and Findings

The inspector found that the licensee's procedures and records concerning the transportation of radioactive material were in accordance with NRC and DOT requirements.

c. Conclusion

The inspector determined that the licensee's radioactive material transportation program was in accordance with regulatory and procedural requirements.

7. Exit Interview

The inspection scope and results were summarized on February 15, 2024, with members of licensee management and staff. The inspector described the areas inspected and discussed the inspection results. The licensee acknowledged the results of the inspection.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

C. Fleming	Manager of Engineering and Operations
A. Deak	Reactor Health Physicist
A. Wells	Senior Reactor Operator
K. Williamson	Reactor Operator
A. Hawari	Director, Nuclear Reactor Program

INSPECTION PROCEDURES USED

IP 69001	Class II Research and Test Reactors
IP 86740	Inspection of Transportation Activities

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened:

VIO 05000297/2024201-1	Contrary to technical specification (TS) 3.3 the licensee operated with the safety power level channel inoperable on June 2, 2023.
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Closed:

VIO 05000297/2024201-1	Contrary to TS 3.3 the licensee operated with the safety power level channel inoperable on June 2, 2023.
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Discussed:

None