



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

January 25, 2024

Dr. James Adams, Acting Director
National Institute of Standards and Technology
NIST Center for Neutron Research
U.S. Department of Commerce
100 Bureau Drive, Mail Stop 8561
Gaithersburg, MD 20899-8561

SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY – U.S. NUCLEAR
REGULATORY COMMISSION 1st and 2nd 2023 QUARTER SUPPLEMENTAL
INSPECTION REPORT NO. 05000184/2023201

Dear Dr. Adams:

From January 1, 2023 – June 30, 2023, the U.S. Nuclear Regulatory Commission (NRC) staff conducted supplemental inspection activities at the National Institute of Standards and Technology (NIST) Center for Neutron Research facility in accordance with the NIST Supplemental Inspection Plan dated August 1, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22206A008). The NRC is implementing the supplemental inspection plan based on the violations identified in the NRC special inspection report dated March 16, 2022 (ML22066B312), and the confirmatory order (CO) dated August 1, 2022 (ML22202A423). The supplemental inspections covered in the enclosed report reviewed and assessed the licensee's implementation of corrective actions.

The supplemental inspection plan consists of activities specified in Inspection Manual Chapter (IMC) 2545, "Research and Test Reactor Inspection Program," additional inspection activities necessary to determine that the licensee has implemented adequate corrective actions, and inspection activities to support confirmation that the licensee has met the requirements of the CO. The NRC conducted supplemental inspections identified in this report using the following procedures:

- Inspection Procedure (IP) 69006, "Class I Research and Test Reactors Organization and Operations and Maintenance Activities"
- IP 69007, "Class I Research and Test Reactor Review and Audit and Design Change Functions"
- IP 69008, "Class I Research and Test Reactor Procedures"
- IP 69009, "Class I Research and Test Reactor Fuel Movement"
- IP 92701, "Followup"

The NRC will continue to conduct supplemental inspections, in accordance with the plan, to provide increased post-restart oversight until the staff determines that reasonable assurance of the safety of the NIST test reactor operations can be achieved through routine inspections, in accordance with IMC 2545.

The supplemental 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 activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

In accordance with 10 CFR 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 NRC's document system ADAMS. ADAMS is accessible from the NRC website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,



Signed by Shams, Mohamed
on 01/25/24

Mohamed K. Shams, Director
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-184
License No. TR-5

Enclosure:
As stated

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SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY – U.S. NUCLEAR REGULATORY COMMISSION 1st and 2nd 2023 QUARTER SUPPLEMENTAL INSPECTION REPORT NO. 05000184/2023201 DATED: JANUARY 25, 2024

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

Docket No.: 50-184

License No.: TR-5

Report No.: 05000184/2023201

Licensee: National Institute of Standards and Technology

Facility: National Bureau of Standards Test Reactor

Location: Gaithersburg, MD

Dates: January 1, 2023, through June 30, 2023

Inspectors: Kevin M. Roche, Reactor Inspector (Team Lead)
Juan A. Arellano, Reactor Inspector
Sara Bernal-Taylor, Allegation Specialist
Carleen Parker, Allegation Specialist
Dori Willis, Headquarters Allegation Team Lead

Approved by: Mohamed K. Shams, Director
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

National Institute of Standards and Technology
National Bureau of Standards Test Reactor
Supplemental Inspection Report No. 05000184/2023201

The U.S. Nuclear Regulatory Commission's (NRC, the Commission) program for overseeing the safe operation of research and test reactors is described in Inspection Manual Chapter 2545, "Research and Test Reactor Inspection Program." A supplemental inspection was established in accordance with the National Institute of Standards and Technology Supplemental Inspection Plan issued on August 1, 2022 (Agencywide Documents Access and Management System Accession No. ML22206A008). Inspectors conducted the supplemental inspection in accordance with the objectives described in the plan which includes: (1) emergency plan and event response; (2) fuel handling; (3) reactor startup; (4) operator licensing; (5) management oversight; (6) corrective actions; (7) safety committee oversight; (8) procedures; (9) design change process; (10) safety culture; and (11) material control and accounting.

This supplemental inspection report documents the NRC staff's inspection activities in accordance with the supplemental inspection plan objective areas outlined above. No violations were identified in this report.

For a summary of the status of the supplemental inspection objectives see table 1 in appendix A of this report.

REPORT DETAILS

1. Introduction

NIST operates the National Bureau of Standards test reactor (hereinafter the NIST test reactor) at the NIST Center for Neutron Research (NCNR) located on the NIST campus in Gaithersburg, MD. The NIST test reactor is a heavy-water (D₂O)- moderated-and-cooled, enriched-fuel, tank-type reactor designed to operate at 20 megawatts thermal power. The facility normally operates continuously during a seven-week operational cycle that consists of approximately 38 days of operation, followed by 10-day refueling and maintenance outages. The facility remained shut down following the February 3, 2021, event.

The 4th quarter 2022 supplemental inspection report issued on March 7, 2023 (ML22066B312), informed the NRC staff's decision on the request to restart the NCNR reactor submitted by NIST on October 1, 2021 (ML21274A018). On March 9, 2023, following completion of an in-depth technical evaluation (ML23040A342), the NRC authorized NIST to operate the test reactor via a letter and accompanying technical evaluation report. NIST restarted the test reactor on March 16, 2023, and has since intermittently operated the reactor a low power levels.

This supplemental inspection report describes the supplemental inspections conducted from January 1, 2023, through June 30, 2023. The NRC will update the supplemental inspection plan, continue supplemental inspections, and issue subsequent supplemental inspection reports. The supplemental inspection plan lists the objectives that will be conducted at the NCNR test reactor until the NRC staff determines routine inspections in accordance with NRC Inspection Manual Chapter 2545 are adequate to ensure safety.

2. Emergency Plan and Event Response

a. Observations and Findings

The inspectors did not review this area during this period and will continue to review emergency plan and even response as part of the continued supplemental inspections.

b. Conclusion

The inspectors concluded that previously reviewed supplemental inspection objectives documented in the 4th quarter 2022 report remain closed as noted in table 1 of appendix A. One objective remains open and will be inspected at a later date.

3. Fuel Handling

a. Observations and Findings

The inspectors observed several fuel operations. Specifically, inspectors observed fuel inventory, fuel loading, and fuel transfer system maintenance activities. The inspectors also reviewed the results of the post-fuel movement visual inspection that is performed to confirm that the fuel elements are latched in accordance with technical specifications (TSs). During the special inspection, inspectors identified an inspector follow-up item (IFI) 05000184/2022201-15 related to the design of the latching mechanism and controls in place to ensure elements can be properly latched. Based upon the inspectors' observation of the visual inspection performed by the licensee to verify the elements are latched in addition to the inspectors' observation of refueling evolutions in this inspection and those documented in the previous supplemental inspection report, the inspectors determined that appropriate corrective actions have been implemented to prevent recurrence and IFI-05000184/2022201-15 is now closed.

The inspectors observed several shifts and sessions of the fuel handling training and noted that the licensee staff followed Administrative Rule 5.0, "Procedure Use and Adherence," guidance on continuous use of procedures during the refueling evolution and that all workers were trained in fuel movement operations. Inspectors will continue to assess the licensee's training and implementation of the use and adherence to procedures to ensure the licensee's corrective actions are sustained in order to inform the staff's decision to restore the routine inspection program.

b. Conclusion

The inspectors concluded that the refueling/fuel handling supplemental inspection objectives as referenced in table 1 of appendix A are closed. The inspectors will continue to assess the licensee's performance in this area in future supplemental inspections.

4. Reactor Startup

a. Observations and Findings

NIST was authorized to restart the test reactor on March 9, 2023. The inspectors observed startup preparations activities along with the reactor startup. The NIST test reactor was successfully restarted on Thursday, March 16, 2023. The inspectors observed the licensee briefing and conducting pre-critical reactor protection system checks that ensure the projective systems were functioning in accordance with TSs, and the inspectors observed the operators performing valve lineups to support restart. Other than the licensees' difficulty locating a small number of valves, the valve lineup the inspectors observed was completed in accordance with the procedure. The inspectors also reviewed a sample of completed TS required surveillances, specifically exercising of the emergency coolant system, and measuring of the shim arm speeds. The inspectors found the surveillance paperwork was consistent with the procedures and documented the satisfactory completion of the surveillances.

The inspectors observed the licensees' pre-evolution briefs and noted that thorough briefs were conducted and included time for questions by operator staff. In addition, the

inspectors noted that the operators were consistently referring to procedures and marking steps using the circle slash method. When training operators were at the console, the overseeing senior reactor operator demonstrated good coaching methods and appropriately challenged the trainee's knowledge. In all, the inspectors noted that positive methods of work processes were used.

The inspectors observed that during reactor operation, effluent radiation levels in the reactor building for a given power level were higher than pre-accident radiation levels. Although radiation levels are higher than previous levels during operation, the inspectors found that they are below the lowered effluent monitoring setpoints that the licensee conservatively set to address operations with fuel debris to ensure that action is taken prior to exceeding regulatory limits. The inspectors reviewed effluent sample results and found that effluent concentrations were well within regulatory limits. The inspectors determined that the increased effluent levels are likely a result of the remaining unclad fuel material that the licensee was not able to remove from the primary system prior to the reactor restart. Based on a review of the licensee's trending analysis of the radiation levels with reactor power, the inspectors noted that increasing power to 20 megawatts would likely exceed the alarm setpoints for radiation effluents and action would need to be taken prior to exceeding regulatory limits. The inspectors found the licensee conservatively limited power to lower power levels to allow for operator training while ensuring the effluent levels remained below the alarm setpoints. The inspectors observed the licensee has a team working through the various issues associated with power ascent and inspectors will continue to inspect this area.

b. Conclusion

The inspectors observed that the precritical and reactor startup procedures continue to be adequate to ensure safe operation of the facility as observed during reactor startup. The inspectors concluded previously reviewed supplemental inspection objectives documented in the 4th quarter 2022 report remain closed as documented in table 1 in appendix A. Due to the higher than pre-accident radiation effluent levels, the inspectors will continue to assess the licensee's performance in this area in future supplemental inspections.

5. Operator Licensing

a. Observations and Findings

The inspectors did not review this area and will continue to review operator licensing as part of the continued supplemental inspections.

b. Conclusion

The inspectors concluded previously reviewed supplemental inspection objectives documented in the 4th quarter 2022 report remain closed as noted in table 1 of appendix A. Two objectives remain open and will be inspected at a later date.

6. Management Oversight

a. Observations and Findings

The inspectors did not review this area and will continue to review management oversight as part of the continued supplemental inspections.

b. Conclusion

The inspectors concluded previously reviewed supplemental inspection objectives documented in the 4th quarter 2022 report remain closed as noted in table 1 in appendix A. Inspectors will continue to assess management oversight to ensure the licensee's corrective actions are sustained in order to inform the staff's decision to restore the routine inspection program.

7. Corrective Actions

a. Observations and Findings

In accordance with the CO, the licensee agreed to implement their corrective action program (CAP) using a staggered approach completing the final stage on March 28, 2023. The licensee's contractor is in the process of performing an independent assessment of that CAP.

The inspectors noted that the CAP is meant to fill in the gaps of the other problem identification and resolution processes that the licensee has in place such as the trouble ticket system. Through discussion with operators, the inspectors found that operators were not sure which process to use when they encountered problems, but after discussion and consultation, they ended up submitting a CAP document for the issues. The inspectors did note that the licensee was in the early stages of CAP implementation. The inspectors also noted that the independent assessment and resulting corrective actions have yet to be completed so the inspectors will continue to follow implementation of the CAP.

b. Conclusion

The inspectors concluded previously reviewed supplemental inspection objectives documented in the 4th quarter 2022 report remain closed as noted in table 1 in appendix A. Three objectives remain open and will be inspected at a later date. The inspectors will continue to evaluate the licensee's CAP in future inspections.

8. Safety Committee Oversight

a. Observations and Findings

The inspectors observed the Safety Evaluation Committee (SEC) meeting on June 28, 2023. The inspectors found that the SEC discussed a range of issues from technical issues related to the shim arm gear box lubricant to when the outstanding CO assessments will occur. The SEC discussed the status of several ongoing projects, as well as open CAP documents for issues operators identified. The inspectors found that the SEC discussed the status of various independent assessments with the root cause

assessment the closest to completion. The inspectors also noted that the SEC discussed that the licensee will develop a performance improvement plan that they are scheduled to complete before the end of the year.

b. Conclusion

During this inspection period, the inspectors did not inspect the open objective of reviewing the Safety Assessment Committee recommendations disposition. The inspectors will review this item during a later inspection.

9. Procedures

a. Observations and Findings

The inspectors observed several evolutions and identified that while the licensee made numerous procedure changes, they still need to update procedures as they return to operations and use them.

During a startup, the inspectors observed the withdrawal of the four shim blades, and operators discovered that the gang switch (switch used to move all four shim blades at one time) was causing feedback and alarms to go off. To address this, the operator switched to withdrawing one shim at a time using the individual shim switches. While inspectors determined this choice was conservative, the procedure did not specify this option. Similarly, the inspectors observed that when the shims are less than one degree from the calculated shim position for criticality, the procedure says to move all the shims to the final estimated critical position. The operator continued to move each shim a small amount, stop, calculate the shim position for criticality, and repeat. While this was a more conservative approach, the procedure did specify that operation. The inspectors determined that while the procedure adherence guidance does allow for pen and ink changes to procedures, and the necessary people discussed both changes, the licensee needs to ensure that operators continue to follow the procedural adherence process.

b. Conclusion

The inspectors will continue to evaluate the licensee program to write, approve, and use procedures. Specifically, the inspectors will review the independent procedure assessment and corrective actions resulting from that assessment. The inspectors concluded the previously reviewed supplemental inspection objective documented in the 4th quarter 2022 report remains closed as noted in table 1 of appendix A. One inspection objective in this area remains open and will be inspected at a later date.

10. Design Change Process

a. Observations and Findings

The inspectors did not review this area and will continue to review design change process as part of the continued supplemental inspections.

b. Conclusion

The inspectors concluded the previously reviewed supplemental inspection objective documented in the 4th quarter 2022 report remains closed as noted in table 1 of appendix A. Two objectives remain open and will be inspected at a later date.

11. Safety Culture

a. Observations and Findings

The inspectors did not inspect this area at this time. The inspectors noted that the licensee's independent safety culture assessment was completed and submitted to the NRC in July 2023 (ML23207A039), along with a letter in which NIST committed to complete all the recommendations. Since the submittal is outside the scope of this inspection period, the inspectors will assess the safety culture objectives and will continue to evaluate the licensee's safety culture as part of subsequent supplemental inspections.

b. Conclusion

The inspectors concluded the previously reviewed supplemental inspection objective documented in the 4th quarter 2022 report remains closed as noted in table 1 in appendix A.

12. Material Control and Accounting

a. Observations and Findings

The inspectors did not review this area and will continue to review material control and accounting as part of the continued supplemental inspections.

b. Conclusion

The inspectors concluded the previously reviewed supplemental inspection objective documented in the 4th quarter 2022 report remains closed as noted in table 1 of appendix A.

13. Exit Meeting

The NRC inspectors discussed the inspection with NIST at the conclusion of this portion of the special inspection on December 15, 2023.

REFERENCES

Administrative Rule (AR) 4.0, "Fuel Manipulation Proficiency Requirements," Revision 1
AR 4.2, "Fuel Manipulation Requalification Requirements," Revision 1
AR 5.0, "Procedure Us and Adherence," Revision 2
AR 5.4, "Observation Program and Checklist," August 21, 2022
AR 7.1, "Conduct of System Review Teams, dated August 24, 2022
AR 7.1.2, "System Walkdown Guidelines," August 24, 2022

Operating Instruction (OI) 1.1.0, "Reactor Startup Checklist," Revision 2 and Revision 3
OI 1.1.1, "Reactor Startup Up to 20 MW," Revision 2
OI 1.1.2, "Low Power Reactor Startup," Revision 1
OI 1.1.3, "Recovery from Reactor Shutdown Less than 24 Hours," Revision 1
OI 1.1.5, "Reactor Normal Operation," Revision 1

OI 4.2.9, "CO2 Gas Valve Lineup Checklist, "Revision 1

OI 6.1.5, "Insertion of Fresh Fuel into the Core," Revision 3, and Revision 4
OI 6.1.8, "Visual Check of Fuel Element Latch Bar," Revision 2, and Revision 3
OI 6.1.9, "Visual Inspection Analysis," Revision 4
OI 6.3.1, "1/M Core Loading and Approach to Critical," Revision 1, and Revision 2

Technical Specification Procedure (TSP) 4.3.2(1), "Exercising of Control Valves in Emergency Coolant System," Revision 1 completed January 17, 2023
TSP 4.2.1(2), "Scram Time of Each Shim Arm's First 5 Degree Drop," Revision 2, completed December 7, 2022
TSP 4.1.2 Rod Cals and Excel Tools
TSP 4.1.2, Core Excess Reactivity/Shutdown Margin Reactivity Worth of each Shim Arm and Reg Rod, Revision 1

Appendix A: Table 1

STATUS	ACTIVITY	PRE-STARTUP	PROCEDURE	CLOSURE REPORT
Emergency Plan and Event Response				
Closed	Evaluate adequacy of emergency response equipment identified in the Emergency Plan	Yes	IP 69011	4Q2022
Closed	Evaluate adequacy of emergency plan implementation procedures	Yes	IP 69011	4Q2022
Open	Observe implementation of emergency plan procedures	No	IP 69011	TBD
Closed	Review availability of items or systems for operators to check prior to control room evacuation	No	IP69011	4Q2022
Closed	Review availability of Post-evacuation Checklist	No	IP69011	4Q2022
Closed	Evaluate adequacy of guidance in Emergency Instructions for confinement re-occupation	Yes	IP69011	4Q2022
Fuel Handling				
Closed	Evaluate adequacy of fueling and defueling procedures	Yes	IP69009	4Q2022
Closed	Observe implementation of fueling procedures	Yes	IP69009	4Q2022
Closed	Observe implementation of defueling procedures	No	IP69009	4Q2022
Closed	Evaluate adequacy of procedures used for latch checking	Yes	IP92702	4Q2022
Closed	Observe implementation of procedures for latch checking	Yes	IP92702	4Q2022
Closed	Evaluate adequacy of loaded restart core for consistency with TSs and analysis	Yes	IP92702	4Q2022
Reactor Startup				
Closed	Evaluate adequacy of reactor startup procedures determined necessary for restart	Yes	IP69008	4Q2022
Closed	Observe implementation of reactor startup procedures	Yes	IP69008	4Q2022
Closed	Review pre-critical start-up procedures	Yes	IP69008	4Q2022

Operator Licensing				
Closed	Evaluate adequacy of proficiency training of reactor operations personnel identified to be completed prior to startup (including fuel handling, refueling and latch checking proficiency of operators)	Yes	IP69008	4Q2022
Open	Evaluate adequacy of licensed operator proficiency training	No	IP69003	TBD
Open	Observe implementation of licensed operator proficiency training	No	IP69003	TBD
Closed	Evaluate adequacy of operator training on off-normal conditions during startup and operations conditions	Yes	IP92702	4Q2022
Management Oversight				
Closed	Evaluate adequacy of qualification training for supervisors overseeing refueling operations	Yes	IP92702	4Q2022
Closed	Evaluate adequacy of policies and procedures in place to ensure training of Reactor Operations and Engineering personnel on procedure adherence	Yes	IP92702	4Q2022
Corrective Actions				
Open	Evaluate program to ensure expectations, processes, and procedures are in place to identify and implement safety improvements	No	IP92702	TBD
Open	Evaluate the adequacy of corrective actions for re-evaluated root cause analysis performed with emphasis on nuclear safety culture	No	IP92702	TBD
Closed	Confirm primary system characterization/readiness following fuel debris cleanup	Yes	IP92701	4Q2022
Closed	Confirm that the appropriate shielding is in place to ensure safe access for maintenance.	Yes	IP92701	4Q2022

Open	Confirm consideration of CO2 build up potential in safety documentation and emergency plan	No	IP92701	TBD
Closed	Review root cause of #2 shutdown pump failure and corrective actions, including evaluation of the extent of condition	No	IP92701	4Q2022
	Safety Committee Oversight			
Open	Review disposition of SAC recommendations	No	IP69007	TBD
	Procedures			
Open	Evaluate program and processes in place to ensure quality of written procedures, to ensure procedures can be effectively executed, and to ensure procedures are periodically evaluated to implement improvements.	No	IP69009	TBD
Closed	Evaluate startup procedures for consistency with INPO-1103, Guideline for Excellence in Procedure and Work Instruction Use and Adherence	Yes	IP92702	4Q2022
Closed	Evaluate reactor startup procedures to instruct operators to identify abnormal fluctuations in nuclear instrumentation	Yes	IP92702	4Q2022
	Design Change Process			
Closed	Review refueling tool wear and replacement program	No	IP69008	4Q2022
Open	Review change process program and procedures for compliance with Title 10 of the <i>Code of Federal Regulations</i> (10 CFR) 50.59	No	IP69008	TBD
Open	Evaluate effectiveness of Engineering Change Management Program for ensuring changes are made consistent with 10 CFR 50.59	No	IP92701	TBD

	Safety Culture			
Closed	Conduct safety-conscious work environment follow-up inspection prior to startup	Yes	IP93100	4Q2022
Open	Conduct safety culture inspection following 3 rd party 1 st assessment	No	IP93100	TBD
Open	Conduct safety culture inspection following 3 rd party 2 nd assessment	No	IP93100	TBD
Open	Conduct safety culture inspection following 3 rd party 3 rd assessment	No	IP93100	TBD
	Material Control and Accounting			
Closed	Evaluate adequate implementation of nuclear material accounting for damaged fuel element	No	IP85102 IP92701	4Q2022

PARTIAL LIST OF PERSONS CONTACTED

Licensee

J. Adams	(Acting) Director, NCNR
R. Arneson	Senior Reactor Operator
S. Barvitskie	Health Physicist
P. Brand	Chief, Engineering
J. Burmeister	Senior Reactor Operator – Crew Chief
S. Dewey	Chief, Health Physics
D. Griffin	Senior Reactor Operator
M. Jones	Senior Reactor Operator
S. MacDavid	Supervisory Electronics Technician
D. Mattis	Engineer
T. Newton	Deputy Director, NCNR and Chief, Reactor Operations and Engineering
D. Pierce	Chair, NCNR Safety Evaluation Committee
B. Remley	Health Physicist
J. Seiter	Senior Reactor Operator, Training Coordinator
R. Strader	Chief, Reactor Operations

INSPECTION PROCEDURES USED

IP 69006	Class I Research and Test Reactors Organization and Operations and Maintenance Activities
IP 69007	Class I Research and Test Reactor Review and Audit and Design Change Functions
IP 69008	Class I Research and Test Reactor Procedures
IP 69009	Class I Research and Test Reactor Fuel Movement
IP 92701	Follow-up

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

See table 1

05000184/2022201-15 IFI	Design of the latching mechanism and controls in place to ensure elements can be properly latched.
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