



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

March 7, 2023

Dr. Robert Dimeo, Director
National Institute of Standards and Technology
NIST Center for Neutron Research
U.S. Department of Commerce
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SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY – U.S. NUCLEAR
REGULATORY COMMISSION 4TH 2022 QUARTER SUPPLEMENTAL
INSPECTION REPORT NO. 05000184/2022202

Dear Dr. Dimeo:

From August 15, 2022 – December 31, 2022, 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 in response to the February 3, 2021, event (EN 55094), and subsequent notification (EN 55120), the request to restart reactor operations submitted by NIST on October 1, 2021 (ML21274A018), the violations identified in the NRC special inspection report dated March 16, 2022 (ML22066B312), the NRC's technical review of the facility licensing basis, and the confirmatory order (CO) dated August 1, 2022 (ML22202A423). The supplemental inspections covered in this report reviewed and assessed the licensee's implementation of corrective actions, including all corrective actions identified to inform the NRC's decision on the request to restart. NIST is required to receive authorization from the NRC to restart the reactor in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.36(c)(1) because the technical specification fuel temperature safety limit was exceeded during the event.

The supplemental inspection plan consists of activities specified in Inspection Manual Chapter 2545, "Research and Test Reactor Inspection Program," additional inspection activities necessary to determine that adequate corrective actions have been implemented, 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 Procedures (IP) 69003, "Class I Research and Test Reactor Operator Licenses, Qualification, and Medical Examinations"
- 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 69010, "Class I Research and Test Reactor Surveillance"
- IP 69011, "Class I Research and Test Reactor Emergency Preparedness"
- IP 69012, "Class I Research and Test Reactors Radiation Protection"
- IP 92701, "Follow-up"
- IP 92702, "Follow-up on Traditional Enforcement Actions Including Violations, Deviations, Confirmatory Action Letters, and Orders," and
- IP 81606, "Material Control and Accounting – Non-Power Reactors"

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

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 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 03/07/23

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

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

Enclosure:
Supplemental Inspection Report
No. 05000184/2022202

cc w/enclosure: See next page

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SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY – U.S. NUCLEAR
REGULATORY COMMISSION 4TH 2022 QUARTER SUPPLEMENTAL
INSPECTION REPORT NO. 05000184/2022202 DATED: MARCH 7, 2023

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ADAMS Accession Package No.: ML22066B312**NRC-002**

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

Docket No.: 50-184

License No.: TR-5

Report No.: 5000184/2022202

Licensee: National Institute of Standards and Technology

Facility: Center for Neutron Research
National Bureau of Standards Test Reactor
National Institute of Standards and Technology Test Reactor

Location: Gaithersburg, MD

Dates: August 15, 2022, through December 31, 2022

Inspectors: Kevin Roche, Reactor Inspector (Team Lead)
Amy Beasten, Reactor Inspector/Examiner
Dan Bradley, Reactor Inspector
Juan Arellano, Reactor Inspector
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Sandra Mendez, Allegation Specialist
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Assisted by: Benjamin Parks, Senior Reactor Engineer
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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. 05000184/2022202

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." In response to the event notification (EN 55094) by the National Institute of Standards and Technology (NIST, the licensee) and subsequent notification (EN 55120), a supplemental inspection was established in accordance with the NIST 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 has remained shutdown since the February 3, 2021, event.

In response to the event, the NRC conducted a Special Inspection between February 9, 2021, through March 16, 2022. The NRC issued a special inspection report dated March 16, 2022 (ML22066B312), which identified seven apparent violations of NRC requirements. In response, the NRC and NIST participated in an alternative dispute resolution process to resolve the identified violations, and on August 1, 2022, the NRC issued a confirmatory order (CO) (ML22202A423) documenting both near-term and long-term corrective actions required to be implemented by NIST to preclude re-occurrence of the event. Because the event involved a violation of the fuel temperature safety limit, NIST is required to receive authorization from the NRC to restart the reactor in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.36(c)(1).

This quarterly supplemental inspection report describes the supplemental inspections conducted from August 15, 2022, through December 31, 2022. The NRC will continue supplemental inspections and issue subsequent supplemental inspection reports quarterly. 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.

The supplemental inspections documented in this report will inform the NRC staff's decision on the request to restart the NCNR reactor submitted by NIST on October 1, 2021 (ML21274A018).

2. Emergency Plan and Event Response

a. Observations and Findings

The inspectors reviewed new and updated procedures and interviewed personnel to assess NIST's implementation of CO section III 1.e.iii. The inspectors noted that the licensee created Emergency Instruction (EI) 3.8, "Recovery Operations," which provides guidance to assess how recovery from a reactor event shall be instituted and EI 3.9 "Confinement Re-entry," to provide detailed guidance on building reoccupation. In addition, EI 0.4, "Control Room Evacuation," and EI 0.5, "Post-evacuation Checklist," were created to assist reactor personnel during an evacuation and ensure confinement is safe for operator re-entry. The inspectors also noted that reference to the checklists to be utilized in other procedures.

The licensee revised EI 4.1, "Airborne Release Assessments During Emergencies," to enhance the guidance for making measurements, interpreting results, performing calculations, and making dose projections.

During response to the event, the licensee found that a piece of the radiological sample equipment was contaminated. Inspectors identified assessment of the adequacy of emergency response equipment as an Inspector Follow-up Item (IFI) 05000184/2022201-08 in the special inspection report. Through interviews with the Health Physics personnel, the inspectors found that the licensee took the contaminated survey equipment out of service during the event response and used other equipment to obtain the necessary surveys. Although the equipment was contaminated, the licensee recognized it and took appropriate actions. The inspectors found that the licensee did not have additional equipment issues during the event response. The licensee has multiple pieces of survey equipment, so they were able to quickly obtain another survey sample. During recovery from the event, the licensee's high range survey meter was found to be inadequate for measuring hot spot radiation levels found in the primary system. The inspectors found that the licensee ordered a high range extendable detector that can measure up to 10,000 rads/hour which exceeds radiation levels found during the event. However, because of supply chain issues, the licensee has not received the detector. Also, there is only one company in the U.S. that can calibrate an instrument that detects up to that range. However, the licensee can calculate hot spot levels from lower area readings using the distance to the point source. The NRC found the licensee can assess radioactive contamination and radiation levels potentially experienced during an event and has taken actions to enhance equipment available to response personnel. The inspectors found the available response equipment to be acceptable, therefore, this IFI 05000184/2022201-08 is closed.

b. Conclusion

Based on the discussion above, the inspectors concluded that emergency plan and the event response corrective actions to be implemented prior to restart are acceptable, and the applicable supplemental inspection objectives in Table 1 in Appendix A are closed.

3. Fuel Handling

a. Observations and Findings

The inspectors observed fuel handling operations conducted from August through October of 2022. During the week of September 12, 2022, inspectors observed field training on refueling where non-fuel surrogates, specifically filter elements, were removed from the core. Across several crews and sessions of the training, the inspectors noted that some licensee staff did not always follow Administrative Rule (AR) 5.0, "Procedure Use and Adherence," guidance on continuous use of procedures. These observations were shared by the inspectors with licensee management. In response, the licensee management reinforced adherence to AR 5.0; and during subsequent inspector observations of fuel handling evolutions, the inspectors observed operators adhering to AR 5.0. 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.

The inspectors also noted that one of the procedures in use, operating instruction (OI) 6.1.3, "Spent Fuel Transfer to the Storage Pool," had a typo on step 8.16 stating "raise the dropout tool ... to the stowed position," when the intended position is "received." This issue was identified by the licensee on the afternoon of September 13, 2022, and observed by the inspectors. On the following day, the inspectors observed that the morning crew did not know about this issue and had similar discussion. The inspectors shared an observation with licensee management that the crews identified the issue. However, this information needed to be captured and transferred to future crews. The inspectors found that the licensee revised the procedure and communicated the issue to the operations staff. Inspectors will continue to assess the licensee's implementation of procedure changes to ensure good practices are sustained.

The inspectors reviewed several refueling procedures revised in accordance with licensee corrective actions taken in response to the February 3, 2021, event. The inspectors found the licensee made the changes outlined in the CO. The inspectors noted that the licensee's corrective actions rely on the procedure change process to ensure these changes carry forward, rather than annotating in the procedure itself to ensure that requirements are subsequently changed or removed. For the specific procedure revisions, see Table 1 in Appendix A under the "Refueling/Fuel Handling," section. The NRC inspectors found the licensee's corrective action satisfies the CO requirement and routine inspections will continue to assess the licensee's procedure change process.

The inspectors reviewed the licensee's assessment of the tools used in refueling to determine if the tools were adequate to meet all new refueling and latch check requirements in accordance with CO section III 1.e.v. This included design change documentation, procedures, PowerPoints, and interviews with individuals involved in the design change.

After the fuel elements are placed in the core and secured, the licensee uses a different refueling tool for rotational latch verification. The tool uses a latch verification sleeve and latch verification sleeve collar as shown in figure 1. The tool gives indication of when an element is in the latched or unlatched position. This change has eliminated the previous technique used by the licensee, prior to the event, which was based on feel by the operator, and replaced it with a quantitative measurement of latch orientation. The licensee performs the verification in accordance with OI 6.1.7, "Rotational Latch Check," and will have a test and measurement program for the tool governed by maintenance procedure (MP) 2.83, "Latch Verification Sleeve and Collar Alignment." The rotational latch verification is followed by an independent video verification.

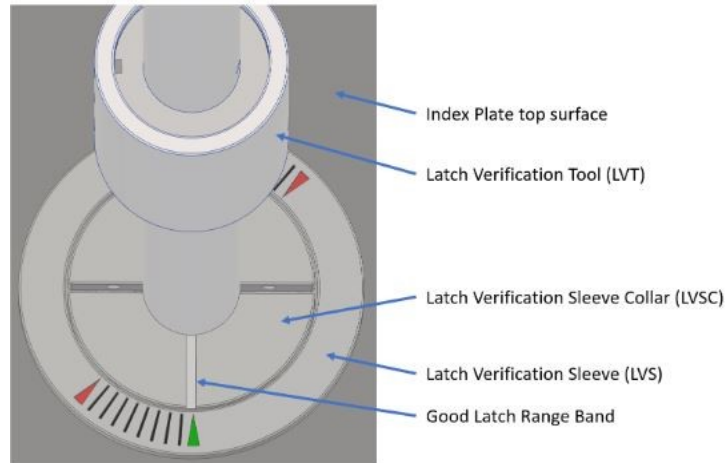


Figure 1. Refueling tool for latch verification.

The inspectors noted that documentation and corrective action of the wear and tear of the refueling tool was implemented into a commenting process in the refueling loading plan sheets. These comments will be addressed to management and dispositioned accordingly. Based on the review of the tools used in refueling, and given the discontinuation of height checks, the inspectors found that the tools are adequate to meet all refueling and latch check requirements.

Through discussions with the licensee, the inspectors found that the licensee initially analyzed the core they planned to use for restart under the provisions of 10 CFR 50.59, "Changes, test and experiments." However, the licensee later determined that a license amendment request (LAR) was required to analyze the restart core. The licensee submitted a LAR dated February 1, 2023 (ML23033A114), which requests revision to the safety analysis report (SAR) to update the core analysis methodology. The inspectors consider this item closed as it will be evaluated as part of the LAR process.

b. Conclusion

The inspectors concluded that the refueling/fuel handling supplemental inspection objectives as referenced in Table 1 of Appendix A are closed, except for assessment of the adequacy of the restart core. This item is being evaluated by the staff's review of the LAR which will be documented in a safety evaluation report and inform the restart decision.

4. Reactor Startup

a. Observations and Findings

The inspectors found that the current revisions of procedures, as compared with procedures in effect at the time of the event, have more detailed steps, limitations, and precautions. The inspectors observed that some procedures contain actions with generalized statements such as "All Technical Specifications must be met/be adhered to." The inspectors found the procedures did not specify the required TSs as they relate to startup or operation. The inspectors found that it is incumbent on the operator to understand what those requirements are and where to find them to

ensure they are met. The inspectors observed that this additional information is covered in the startup training, but the written procedure relies on operator experience and knowledge of the existence of the TS binder to meet this procedural requirement. The inspectors provided this observation to the licensee and observed that subsequent operator training lectures related to startup placed strong emphasis on these areas.

The inspectors found that some steps in the procedures lack apparent context, such as the status of D₂O pump operation since latch checks were completed. These steps are required per the CO, but the revision of the procedure inspectors reviewed did not explain the significance of this requirement. The inspectors found that the significance of these steps was discussed in the startup training for operators, including instruction for actions that need to be taken in the event pumps are stopped (e.g., reperform latch check). The inspectors found the procedure revision addressed the CO requirement. However, the inspectors noted that without including the significance of the context behind these steps in the procedure, operators could perform the action of the step (circle and line through) and move on with the procedure without reperforming latch checks or knowing latch checks needed to be reperformed. This observation was provided to the licensee, and the licensee expressed confidence that the significance of the steps in the procedure would be captured in the licensed operator training. Additional context for these steps would be a procedural enhancement, and inspectors will continue to evaluate the licensed operator training program to verify the regulatory basis for these steps is addressed.

Inspectors reviewed the most recent revision to the reactor startup procedures and found instructions to “shut down the reactor” under certain abnormal or unexpected conditions, but the inspectors found no indication in the procedure that initiating a major scram is an acceptable means of shutting the reactor down. Through conversations with the NCNR staff, inspectors found that, during the event on February 3, 2021, operators took action to shut the reactor down when abnormal conditions were identified by attempting to drive all rods into the core rather than initiating a major scram. The inspectors observed that the licensee staff seemed reluctant to identify a major scram as a valid method of shutting the reactor down. Based on inspectors’ observations, the licensee’s subsequent operator training in these areas emphasized the acceptability of initiating a major scram in response to abnormal conditions.

b. Conclusion

The inspectors determined that the revised reactor startup procedures contain adequate information and detail for operators. Inspection observations communicated to the licensee were incorporated into new procedure revisions and/or operator training lectures. The inspectors determined that the precritical and reactor startup procedures are adequate to ensure safe operation of the facility. The inspectors concluded that reactor startup procedures required prior to restart are implemented, and the applicable supplemental inspection objectives in Table 1 in Appendix A are closed. Training on reactor startup meets the regulatory requirements in the CO and will be a continued focus area as inspectors evaluate the operator training program.

5. Operator Licensing

a. Observations and Findings

Prior to the February 3, 2021, event, fuel movements within the core were predominantly performed by experienced personnel, operators rarely referenced procedures during activities on the reactor top, refueling procedures were inadequate, operators filled multiple roles, and communications were minimal. During this most recent inspection period, the inspectors observed filter element removal and other core manipulations and found that the Reactor Supervisor had the applicable procedure in hand and operators followed the procedural use and adherence guidance. Inspectors observed communications between qualified fuel handlers, the supervisor, and the trainee. Based on these observations, the inspectors found that the proficiency training of reactor operators in this area is adequate.

Prior to the February 3, 2021, event, training was self-led with no stress points for refueling or other aspects of operation, refueling was usually performed by the same crew, and classroom training consisted of informal briefs that were reactionary to specific issues that occurred. Since the February 3, 2021, event, inspectors found that the licensee staff is implementing a new year-long continuous training program; and this continues to be an evolving process in which lesson plans are expanded and additional training materials are added as needed. The licensee stated that they will enhance the training to implement a drill program to encompass normal and off-normal operational issues. Inspectors observed that classroom lectures currently consist of PowerPoint slides and walkthroughs of procedures. The inspectors also found that lectures discussed a history of use of the relevant procedures and past operational issues related to the subject were topics of discussion during the training sessions. The inspectors observed that operators were engaged and actively participated in the training.

The inspectors found operators are expected to independently complete and maintain their training via detailed lesson plan review, review of additional references, and online activities. These additional tools (lesson plans, online, etc.) are intended to supplement formal classroom training, and are encouraged to be utilized, but are not mandatory or tracked training items.

b. Conclusion

The inspectors concluded that operator proficiency training on fuel handling and core manipulations, as well as training on operational issues is acceptable, and the applicable licensing supplemental objectives in Table 1 in Appendix A are closed.

6. Management Oversight

a. Observations and Findings

The inspectors reviewed the licensee's training and procedures covering procedure adherence. Licensee procedures AR 5.0 dated August 11, 2021, and AR 5.1, "Procedure Writer's Guide," dated November 14, 2021, were updated after the February 3, 2021, event to increase the rigor and level of formality around procedure

use. Per section V.4 of the CO, the inspectors also compared the licensee's procedures to industry standards that provide guidelines for excellence in procedure use and adherence.

The inspectors noted that AR 5.0 empowers all workers to stop work when unsure about procedure steps and seek supervisory input when procedures cannot be performed as written. Likewise, AR 5.0 requires place keeping, such as circling a step when started and cross the circle out when the step is complete, when performing continuous use procedures. Both are consistent with industry standards.

The inspectors also reviewed licensee supervisory training materials and records related to procedure use and adherence. The inspectors noted that the training included instructors from outside NCNR, classroom instruction, and small-group exercises. No additional issues related to the CO were identified.

In reviewing licensee supervisory guidance on procedure adherence, the inspectors noted several positive aspects of the program.

- AR 5.4, "Observation Program and Checklist," dated August 21, 2022, serves as a useful tool to drive continuous improvement, from a procedure perspective, in that there is a management focus on observing activities as-written and as-performed to look for any gaps.
- AR 1.1, "Human Performance Tools," dated August 21, 2022, provides a wide selection of tools to assess and prompt discussion of a worker's proficiency with the task being performed. As a result, the right level of support can be provided prior to beginning the task.

The inspectors did note a few minor instances where the newly developed guidance was not completely aligned with the industry standards, such as Institute of Nuclear Power Operations (INPO)-1103, "Guideline for Excellence in Procedure and Work Instruction Use and Adherence." However, after discussion with the inspectors, the licensee revised the procedures eliminating the discrepancies.

b. Conclusion

The inspectors concluded that the supervisory training and procedures for management oversight are acceptable, and the supplemental inspection objectives in Table 1 in Appendix A are closed.

7. Corrective Actions

a. Observations and Findings

The inspectors began evaluating the following two objectives: confirm primary system characterization/readiness following fuel debris cleanup and confirm that the appropriate shielding is in place to ensure safe access for maintenance. The licensee submitted a LAR dated October 19, 2022 (ML22293B808), as supplemented by letter December 13, 2022 (ML22350A064), which revises the SAR to characterize the radiological conditions during operations with the debris in the primary system that was unable to be removed. In this LAR, the licensee evaluates

potential occupational dose consequences due to operation with the estimated remaining fuel debris. The NRC staff evaluated and approved this license amendment in a safety evaluation report dated February 1, 2023 (ML23020A911).

Following the February 3, 2021, event, the licensee experienced a failure of the #2 shutdown cooling pump. Inspectors identified an IFI (05000184/2022201-11) during the special inspection because of the potential connection to the debris in the primary system. Upon review of NIST Trouble Ticket 00174447, "#2 Shutdown Pump Troubleshooting and Repair," the inspectors found that the failure of the #2 Shutdown Cooling Pump was unrelated to the February 3, 2021, event. The licensee determined that the root cause of the pump failure was a mechanical coupling failure, so the licensee staff replaced mechanical couplings on both #1 and #2 Shutdown Cooling Pumps. The inspectors determined that corrective actions implemented by the licensee are adequate and IFI 05000184/2022201-11 is closed.

b. Conclusion

The inspectors concluded that corrective actions discussed above are acceptable, and the applicable supplemental inspection objectives in Table 1 in Appendix A are closed.

8. Safety Committee Oversight

a. Observations and Findings

None.

b. Conclusion

The inspectors did not inspect this area at this time and none of these inspection objectives are required to be closed prior to startup.

9. Procedures

a. Observations and Findings

The inspectors reviewed several startup procedures to ensure they were consistent with the INPO-11-003 guidance and found they were consistent with the industry guidance (see sections 4 and 6 of this report). Inspectors also reviewed the startup procedures to ensure they provided instructions to aid the operators in identifying abnormal indications.

b. Conclusion

The inspectors concluded that the reviewed startup procedures discussed above are acceptable, and the applicable supplemental inspection objectives in Table 1 in Appendix A are closed.

10. Design Change Process

a. Observations and Findings

None.

b. Conclusion

The inspectors did not inspect this area at this time and none of these inspection objectives are required to be closed prior to startup.

11. Safety Culture

a. Observations and Findings

To conduct an independent assessment of the environment at NIST, the inspectors conducted focus groups and interviews of all available staff and managers and conducted behavioral observations of ongoing activities. The inspectors determined that while weaknesses in safety culture still exist, progress has been made in improving the work environment. The licensee will continue to implement corrective actions in safety culture to include hiring a third-party, independent nuclear consultant (consultant) to conduct an independent third-party nuclear safety culture assessment in accordance with the schedule outlined in the CO. Inspectors will continue to assess the licensee's nuclear safety culture in future inspections.

1. Leadership Safety Values and Actions

Based on the interviews and observations, the inspectors continued to identify weakness under Leadership Safety Values and Actions in the attribute of resources. Specifically, the licensee staff reported that resources continue to be a challenge and an area for improvement for the NCNR. The inspectors noted that NCNR is understaffed in operations, training, aging management, and security and doesn't have adequate resources for equipment in health physics. Due to this deficiency in adequate resources, the NRC is focused on the sustainability of NISTs corrective actions. Specifically, the sustainability of continuous training and continuation of corrective actions. The licensee has agreed that resources are a priority for the organization, and in the CO, the licensee committed that NCNR leadership has initiated hiring actions to establish a fifth operating shift dedicated to training and maintenance. Inspectors will continue to assess the licensee's implementation of this commitment to ensure that continuous training and corrective actions are adequately implemented.

The inspectors found that the licensee staff believe that change management has improved. Specifically, the inspectors believe that the licensee staff are appropriately evaluating changes so that nuclear safety remains the overriding priority. However, the inspectors did hear from many individuals that the restart of the reactor appears to be the primary focus of management rather than ensuring that the next step is appropriately evaluated for safety, contrary to the Strategic Commitment to Safety attribute. The licensee stated that they would

continue to review communications provided to staff to ensure that safety was the primary focus. Inspectors will continue to assess licensee communications as part of behavioral observations during future inspections.

In addition, based on behavioral observations of fuel movement and interviews with the licensee staff, NCNR field presence of management has improved. Management was seen in working areas of the reactor observing and reinforcing standards and expectations in accordance with the field presence attribute.

2. Work Processes

Based on the interviews with the licensee staff, the inspectors found that the licensee actions in the area of work processes, specifically updating procedures and ensuring procedural adherence, is viewed by the licensee staff as having improved. All licensee staff discussed that the changes to the procedures were a positive enhancement.

3. Self-Assessment

The inspectors found that NIST would benefit from further benchmarking with similar reactor facilities outside of NIST. While one manager has conducted visits at other facilities for purposes of benchmarking, others in the organization have not participated in benchmarking opportunities. This limited benchmarking has prevented the licensee from learning from other organizations to enhance continuous knowledge, skills, and safety performance. The licensee has committed to benchmark one program (e.g., training, procedure process, corrective action program, configuration control/change management, etc.) each calendar year, to include site visits and observations at other facilities. Inspectors will continue to assess the licensee's implementation of this commitment to ensure that benchmarking is completed in accordance with the CO.

4. Environment for Raising Concerns (Safety Conscience Work Environment)

Based on interviews and observations, the inspectors found that the environment for raising concerns at NCNR has improved. Specifically, all personnel stated they would raise a concern. Most personnel stated that management is very engaged in resolving concerns as concerns are raised. However, some personnel stated that they were not confident that all concerns would be resolved, and they did not always receive feedback on the resolution of concerns. In addition, the licensee did institute a method to anonymously provide concerns to management using a drop box. Also, management seemed to be utilizing their "good catch" program to reward the licensee staff for raising concerns. The inspectors found that although the corrective action program was not fully implemented, it would be implemented in accordance with the schedule outlined in the CO.

b. Conclusion

The inspectors concluded that the safety culture assessment of safety conscience environment at NIST has improved, and the applicable supplemental inspection objective in Table 1 in Appendix A is closed.

12. Material Control and Accounting

a. Observations and Findings

The inspectors conducted a security inspection at NIST in September 2022. Because security inspection reports contain security related information, the details of this inspection will not be discussed in this report. During the special inspection, the inspectors identified two IFIs related to material control and accounting. The first was identified to follow-up on the material accounting for the damaged fuel element (IFI 05000184/2022201-09). The second was identified to review the licensee's procedures related to inventory of unirradiated fuel (IFI 05000184/2022201-12). The inspectors were able to close the IFIs 05000184/2022201-09 and 05000184/2022201-12 as part of this inspection and did not identify any additional issues.

b. Conclusion

The inspectors concluded that material control and accounting is acceptable, and the supplemental inspection objectives in Table 1 in Appendix A, and the above IFIs are closed.

13. Exit Meeting

The NRC inspectors discussed the inspection with NIST at the conclusion of the special inspection on Thursday, January 5, 2023.

REFERENCES

AR 1.0, "NBSR Conduct of Operations," Revision 2
AR 1.1, "Human Performance Tools," dated August 26, 2022
AR 2.0, "Conduct of Operations Training," Revision 1
AR 2.1, "ROE Training Practices," Revision 0
AR 2.2, "NSBR Operations and Initial and Continuous Training Program," Revision 0 (DRAFT)
AR 2.2.2, "RO/SRO Qualification," Revision 1
AR 2.2.3, "Reactor Supervisor Qualification," Revision 1
AR 4.0, "Fuel Manipulation Proficiency Requirements," Revision 1
AR 4.2, "Fuel Manipulation Requalification Requirements," Revision 1
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

Emergency Instruction (EI) 0.4 checklist, "Control Room Evacuation," Revision 1
EI 0.5 checklist, "Post-Evacuation Checklist," Revision 1
EI 3.6 SA, "Essential Personnel Evacuation," Revision 1
EI 3.8 SA, "Recovery Operations," Revision 1
EI 3.9 SA, "Confinement Re-entry," Revision 1
EI 4.1, "Airborne Release Assessments During Emergencies," Revision 1

Instrumentation and Control Procedure (ICP) 6.1, "ICP 6.1, "Reactor Thermal Power Temperature Calibration," dated August 17, 2022
ICP 6.13.2, "Reactor Differential Temperature Calibration B," dated August 17, 2022

Operating Instruction (OI) 1.1.0, "Reactor Startup Checklist," Revision 2
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 6.1.2, "Restoration of the Reactor Top from Refueling," 9/5/22
OI 6.1.4, "Core Fuel Shuffle," Revision 3 and Revision 4
OI 6.1.5, "Insertion of Fresh Fuel into the Core," Revision 3, and Revision 4
OI 6.1.6, "Fuel Element Insertion from Cannon to Vessel," Revision 1, and Revision 2
OI 6.1.7, "Rotational Latch Check," Revision 3
OI 6.1.8, "Visual Check of Fuel Element Latch Bar," Revision 2, and Revision 3
OI 6.1.9, "Visual Inspection Analysis," dated August 3, 2022
OI 6.3.1, "1/M Core Loading and Approach to Critical," Revision 1, and Revision 2

Maintenance Procedure (MP) 5.55, 1/M for Initial Criticality, Revision 1
MP 2.83, "Latch Verification Sleeve and Collar Alignment," Revision 1

NCNR Training Program Lesson Plan
NCNR Reactor Operations and Engineering Lesson Plan, Reactor Refueling
NCNR Reactor Operations and Engineering Lesson Plan, Reactor Startup (NBSR)

Technical Specification Procedure (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

Element latching system overview and tolerance analysis PowerPoint dated April 9, 2021

Tolerance stackup Tool and Element R1 PowerPoint dated March 31, 2021

Memo on refueling tool wear and replacement dated August 15, 2022

Refueling loading plan blank sheets

Engineering Change Notice latch verification sleeve analysis

Engineering Change Request (ECR) 1217, "Latch Verification Sleeve"

ECR 1217, "Latch Verification Sleeve and Collar"

Appendix A: Table 1

STATUS	ACTIVITY	PRE-STARTUP	PROCEDURE	CLOSURE REPORT
Emergency Plan / 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
Refueling / 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
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
			IP92702	
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 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
	Security			
Closed	Evaluate adequate implementation of nuclear material accounting for damaged fuel element	No	IP85102 IP92701	4Q2022

PARTIAL LIST OF PERSONS CONTACTED

Licensee

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
R. Dimeo	Director, NCNR
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
B. Remley	Health Physicist
J. Seiter	Senior Reactor Operator, Training Coordinator
R. Strader	Chief, Reactor Operations

INSPECTION PROCEDURES USED

IP 92701	Follow-up
IP 69003	Class I Research and Test Reactor Operator Licenses, Requalification, and Medical Activities
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 69010	Class I Research and Test Reactor Surveillance
IP 69011	Class I Research and Test Reactor Emergency Preparedness
IP 69012	Class I Research and Test Reactors Radiation Protection
IP 92701	Follow-up
IP 92702	Follow-up on Traditional Enforcement Actions Including Violations, Deviations, Confirmatory Action Letters, and Orders,” and
IP 85102	Material Control and Accounting – Non-Power Reactors.

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

See table 1

05000184/2022201-08	IFI	Emergency equipment issues
05000184/2022201-09	IFI	The licensee needs to measure the damaged fuel element S-1175 and account for any displaced material from S-1175 the required annual reporting of its SNM inventory to the NMMSS.
05000184/2022201-11	IFI	#2 Shutdown cooling pump troubleshoot and repair
05000184/2022201-12	IFI	Review procedures required by 10 CFR Part 74, Subpart B, "General Reporting and Recordkeeping Requirements regarding the licensee's ability to account for all SNM in its possession.