



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

August 1, 2022

EA-21-148

Dr. Robert Dimeo, 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, CENTER
FOR NEUTRON RESEARCH – CONFIRMATORY ORDER

Dear Dr. Dimeo:

The enclosed Confirmatory Order is being issued to you as a result of a successful alternative dispute resolution (ADR) mediation session. The commitments outlined in the Confirmatory Order were made as part of a settlement agreement between the National Institute of Standards and Technology (NIST), Center for Neutron Research (NCNR or licensee) and the U.S. Nuclear Regulatory Commission (NRC). The settlement agreement concerns seven apparent violations of NRC requirements by the licensee, as discussed in our letter dated March 16, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22056A361).

Our March 16, 2022, letter provided you with the results of an NRC special inspection that was conducted in response to an event at NCNR. Specifically, on February 3, 2021, NCNR made an emergency declaration (Alert) in response to an automatic reactor shutdown initiated by the detection of high radiation from the confinement exhaust stack. Subsequently, NCNR determined that a damaged fuel element caused the exhaust stack radiation alarm. The NCNR reactor has not been operated since the event. NCNR is currently conducting clean-up and repair activities. In accordance with Title 10 of the *Code of Federal Regulations* 50.36(c)(1) and NCNR Technical Specifications, NCNR must obtain NRC approval prior to resuming operations. The NRC's decision to approve any restart would be informed by, but would not be solely reliant upon, the Confirmatory Order discussed below.

The NRC's special inspection for the February 3, 2021, event documented seven apparent violations, the most significant being an apparent violation of NCNR Technical Specification 2.1, "Safety Limit," which states that the reactor fuel cladding temperature shall not exceed 842°F for any operating conditions of power and flow. The NRC inspectors observed once-molten material in and around a fuel element indicating that the fuel cladding temperature safety limit had been exceeded.

In our March 16, 2022, letter, the NRC offered NCNR the opportunity to (1) attend a predecisional enforcement conference or (2) participate in an ADR mediation session. In response, NCNR requested to participate in an ADR mediation session.

A full-day ADR mediation session was held on May 10, 2022, with shorter virtual meetings held on May 19, 2022, and June 2, 2022. The NRC and NCNR reached a preliminary settlement agreement on June 3, 2022, as confirmed by the signed "Consent and Hearing Waiver Form" (Enclosure 2), dated July 21, 2022, in which NCNR agreed that a Confirmatory Order would be issued as settlement of the apparent violations. The Confirmatory Order confirms the commitments made as part of the preliminary settlement agreement. The elements of that agreement, formulated and agreed to at the mediation sessions, are incorporated in the enclosed Confirmatory Order (Enclosure 1). In light of corrective actions that NCNR has taken and subject to the satisfactory completion of the additional actions that NCNR has committed to take, as described in the Confirmatory Order, the NRC will not issue a Notice of Violation for the apparent violations discussed in its letter dated March 16, 2022, and will not issue an associated civil penalty. The NRC's concerns associated with the apparent violations will be addressed by making the NCNR commitments legally binding through the Confirmatory Order.

Pursuant to Section 223 of the Atomic Energy Act of 1954, as amended, any person who willfully violates, attempts to violate, or conspires to violate, any provision of this Confirmatory Order shall be subject to criminal prosecution as set forth in that section. Violation of this Confirmatory Order may also subject the person to a civil monetary penalty.

The NRC staff plans to inspect the requirements in the Confirmatory Order through supplemental inspections. Additional inspections will also be performed to inform any decision by the NRC staff on the request to restart the reactor submitted by the licensee on October 1, 2021 (ADAMS No. ML21274A018) and to provide increased oversight after any such restart of reactor operations until the staff determines that routine inspections in accordance with NRC Inspection Manual Chapter 2545, "Research and Test Reactor Inspection Program," are adequate to ensure safe operations.

Apart from the actions required by the enclosed Confirmatory Order, you are not required to respond to this letter. However, if you choose to provide a response, please provide it to me within 30 days at the following address: Mailstop O14A50, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Should you have questions concerning the enclosed Confirmatory Order, please contact David Jones at 301-287-9525.

In accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," a copy of this letter and its enclosures will be made available electronically for public inspection in the NRC Public Document Room and in the NRC's ADAMS, accessible from the NRC website at <https://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response, if you choose to provide one, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction.

D. Dimeo

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The NRC also includes significant enforcement actions on its website at <https://www.nrc.gov/reading-rm/doc-collections/enforcement/actions/>.

Mark D. Lombard, Director
Office of Enforcement

Docket No. 50-184

License No. TR-5

Enclosures: As stated

SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, CENTER
FOR NEUTRON RESEARCH – CONFIRMATORY ORDER
DATED: August 1, 2022

cc:

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Test, Research and Training
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Attention: Amber Johnson
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ADAMS Accession No.: ML22206A213

ADAMS Package Accession No.: ML22202A419

OFFICE	OE/EB	OE/EB	NRR/DANU	OGC/NLO	OE/D
NAME	DJones	JPeralta	JBowen	RCarpenter	MLombard
DATE	07/26/22	07/26/22	07/27/22	07/28/22	08/01/22

OFFICIAL RECORD COPY

Enclosure A

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)
)
National Institute of Standards and Technology)
Center for Neutron Research)
U.S. Department of Commerce)

Docket No.: 05000184
License No.: TR-5

EA-21-148

CONFIRMATORY ORDER MODIFYING LICENSE
EFFECTIVE UPON ISSUANCE

The National Institute of Standards and Technology (NIST), Center for Neutron Research (NCNR or licensee), U.S. Department of Commerce (DOC) is the holder of License No. TR-5, issued by the U.S. Nuclear Regulatory Commission (NRC or Commission) pursuant to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR). NIST refers to the larger National Institute of Standards and Technology organization while NCNR refers specifically to the licensee and operator of the National Bureau of Standards Test Reactor (NBSR or reactor). The license authorizes the operation of the NBSR in accordance with conditions specified therein. The facility is located on the NIST campus in Gaithersburg, Maryland.

This Confirmatory Order (CO) is the result of an agreement reached during an Alternative Dispute Resolution (ADR) mediation session conducted on May 10, 2022, May 19, 2022, and June 2, 2022, to address seven apparent violations.

II

The NBSR is a heavy-water (D₂O)-moderated-and-cooled, enriched-fuel, tank-type reactor designed to operate at 20 megawatts thermal (MW(t)) power. The facility operates continuously during a 7-week operational cycle that consists of approximately 38 days of operation, followed by 10-day refueling and maintenance outages.

On December 20, 2020, operators shut down the reactor for a refueling outage. During the refueling outage on January 4, 2021, fuel elements were shuffled within the reactor vessel during day shift. After the fuel elements were placed in each core position, height verification was performed using a height gauge to ensure that the fuel elements were fully latched in the lower grid plate. Following the February 3, 2021, event discussed below, the NRC inspectors reviewed video footage of the placement of fuel element S-1175 in the J-7 core position and determined that the fuel element was initially latched after placement. However, the inspectors observed that operators had difficulty lowering the tool to fuel element S-1175 during the subsequent height verification. Performance of this height verification likely contributed to fuel element S-1175 becoming unlatched. Further, the inspectors observed that the operators improperly performed the latch verification rotation checks on the evening shift. Through post-event interviews and observation of the video footage of the refueling and latch verification evolutions, the inspectors determined that fuel element S-1175 was likely not fully latched in the J-7 core position at the end of fuel handling operations on January 4, 2021.

On February 3, 2021, following the refueling outage, NCNR reactor operators were performing a normal reactor startup when the reactor automatically shut down in response to indications of high confinement exhaust stack radiation. Once the reactor was placed in a safe condition, all personnel evacuated the control room and reactor confinement. The reactor was then monitored by operators from the remote Emergency Control Station. NCNR subsequently declared an alert in accordance with the facility emergency plan and procedures. During the event, six NCNR reactor personnel became externally contaminated and were monitored for internal exposure to radioactive materials. Following the event, NCNR personnel performed environmental monitoring at the confinement exhaust stack and at the 400-meter emergency planning site boundary, which is located within the fence line of the NIST Gaithersburg campus. Environmental sampling for radioactive material releases, as well as radiological surveys, confirmed that release amounts were a small fraction of the alert and notification of unusual event criteria in the emergency procedures, which led to event termination by NCNR later that day.

On March 2, 2021, NCNR submitted a related event notification (EN 55120) to inform the NRC that it had violated the fuel cladding temperature safety limit for damaged fuel element S-1175. During subsequent visual inspection activities where NCNR moved fuel elements from the reactor core to the fuel storage pool, the NRC inspectors observed melted material deposited on the lower grid plate. The inspectors also observed that the damaged fuel element S-1175 nozzle was almost completely blocked by melted material. The inspectors noted that additional tests would need to be performed to determine the exact composition of the melted material. The damaged fuel element S-1175 is currently in a container located within the fuel storage pool awaiting shipment for further analysis. The licensee has contracted with Framatome to

clean up the reactor vessel and remove the melted material from the lower grid plate, vessel, and primary piping. Framatome is assisting with various operations during this recovery.

On March 16, 2022, the NRC's Office of Nuclear Reactor Regulation, Division of Advanced Reactors and Non-Power Production and Utilization Facilities, issued a special inspection report to the licensee. The inspection report included the following seven apparent violations, five of which NCNR identified in its own review and reported to NRC staff:

1. Apparent Violation of Technical Specification 2.1, "Safety Limit," which states that the reactor fuel cladding temperature shall not exceed 842°F (420°C) for any operating conditions of power and flow. The NRC inspectors observed once-molten material in and around the fuel element nozzle of element S-1175 in the J-7 grid position indicating that the licensee exceeded the fuel temperature safety limit.
2. Apparent Violation of Technical Specification 3.1.3, "Core Configuration," which states that "[t]he reactor shall not operate unless all grid positions are filled with full length fuel elements or thimbles, except during subcritical and critical startup testing with natural convection flow." The NRC inspectors observed that the fuel element S-1175 was not latched, was raised approximately 3-4 inches above the upper grid plate, and was angled out of its proper position, causing it to rest on the lower grid plate surface.
3. Apparent Violation of Technical Specification 6.4, "Procedures," which states, in part, that "[w]ritten procedures shall be prepared, reviewed and approved prior to initiating any of the activities listed in this section [including] ... [f]uel loading, unloading, and

fuel movement within the reactor vessel.” The NRC inspectors determined that the procedure for fuel handling activities was not suitable for the circumstances and did not contain necessary information to ensure that the fuel elements were latched prior to startup. As a result, the inspectors determined that the fuel handling procedure was inadequate to ensure that the fuel element in question was latched during refueling activities on January 4, 2021.

4. Apparent Violation of Technical Specification 6.4, “Procedures,” which states, in part, that “[w]ritten procedures shall be prepared, reviewed and approved prior to initiating any of the activities listed in this section [including] ... [s]tartup, operation, and shutdown of the reactor.” The reactor startup procedure instructs the operators to monitor for abnormal fluctuations or oscillations on nuclear channel indications. However, the NRC inspectors found that the procedure does not provide amplifying guidance for operators to use when conducting this monitoring.
5. Apparent Violation of Technical Specification 6.4, “Procedures,” which states, in part, that “[w]ritten procedures shall be prepared, reviewed and approved prior to initiating any of the activities listed in this section [including] ... [i]mplementation of required plans such as emergency or security plans.” The NRC inspectors determined that NCNR emergency response procedures were not suitable for the circumstances and caused NCNR to unnecessarily (although still within the required timeframe) delay their response to the event.
6. Apparent Violation of Technical Specification 3.9.2.1, “Fuel Handling; Within the Reactor Vessel,” which states that “[f]ollowing handling of fuel within the reactor vessel, the reactor shall not be operated until all fuel elements that have been handled are inspected to determine that they are locked in their proper positions in

the core grid structure. This shall be accomplished by one of the following methods:

(1) Elevation check of the fuel element with main pump flow. (2) Rotational check of the element head in the latching direction only. (3) Visual inspection of the fuel element head or latching bar.” The NRC inspectors determined that NCNR operators failed to implement one of the methods required by the technical specifications to ensure that fuel element S-1175 was adequately latched.

7. Apparent violation of 10 CFR 50.59, “Changes, tests and experiments,” paragraph (c)(1), which states, in part, that a licensee may make changes in the facility without obtaining a license amendment only if a change to the technical specifications is not required. The NRC inspectors determined that NCNR made changes to the refueling tooling that should have required a change to the technical specifications because dimensional differences of the new tooling invalidated the capability of operators to verify that a fuel element was adequately latched.

For the seven apparent violations, the NRC offered NCNR an opportunity to (1) attend a pre-decisional enforcement conference or (2) to participate in an ADR mediation session to resolve this concern. In response to the NRC’s offer, NCNR requested the use of the NRC’s ADR process to resolve the seven apparent violations. On May 10, 2022, the NRC and NCNR conducted an ADR session mediated by a professional mediator, arranged through Cornell University’s Scheinman Institute on Conflict Resolution. The ADR process is one in which a neutral mediator, with no decision-making authority, assists the parties in reaching an agreement to resolve any differences regarding the dispute. This CO is issued pursuant to the agreement reached as a result of the full-day mediation session that occurred on May 10, 2022, and two subsequent virtual meetings that occurred on May 17, 2022, and June 2, 2022.

The NRC and NCNR signed the agreement in principle (AIP) for the mediation session on June 3, 2022.

III

NCNR and the NRC reached a preliminary settlement agreement during mediations. The elements of the agreement included (1) corrective actions completed by NCNR, (2) corrective actions planned by NCNR, (3) additional agreed upon future actions by NCNR, and (4) general provisions. Additionally, the NRC and NCNR agreed that the apparent violations described in Section II of this Order were violations of regulatory requirements. The NRC and NCNR agreed that the safety significance of these violations is normally characterized at Severity Level 1 in accordance with the NRC Enforcement Policy. Additionally, the NRC concluded that a civil penalty of up to \$432,000 would normally be proposed for this violation, as assessed in accordance with the civil penalty assessment process discussed in Section 2.3.4 of the NRC Enforcement Policy. However, due to the robust nature of corrective actions taken and planned by NCNR as documented in Sections III and V, the NRC determined that waiving a civil penalty is appropriate in this case.

The parties agreed in the AIP to refine the language of the AIP to reflect the appropriate level of detail when included in Section III of the CO. The following is the refined language:

1. Based on a review of the incident, NCNR completed corrective actions and enhancements to preclude recurrence of the violation, including but not limited to the following:
 - a. NIST/NCNR Safety Culture
 - i. NCNR staff secured additional funds for the Nuclear Safety Culture Improvement Program (NSCIP), with additional funds included in current budget proposals.

- ii. NCNR staff has drafted the NSCIP program documents addressing problem identification and resolution, root cause investigations, training, procedures, and oversight. These will be used to develop a request for proposals to assist the NCNR in program development and implementation.
- iii. NCNR has identified comparable reactor facilities for purposes of benchmarking various safety culture programs, with in-person visits planned or completed. Results from these benchmarking visits will be used to inform further development of the NSCIP.
- iv. NCNR staff reevaluated the root cause analysis with an emphasis on nuclear safety culture and is using this evaluation to develop the NSCIP plan.

b. Management

- i. NCNR leadership has engaged the NIST Director and Department of Commerce leadership for oversight and secured additional funding for corrective actions (including additional operations personnel) and reactor recovery and clean-up.
- ii. NCNR currently staffs four rotating shifts during normal operation and is challenged to complete additional work such as training, employee development, and emergent maintenance. NCNR leadership has initiated hiring actions to establish a fifth operating shift dedicated to training and maintenance.
- iii. Elevated Enterprise Risk Management of NCNR to institutional (NIST) level through the chartered NIST Enterprise Risk Management Council. The Council, which includes NIST Senior Executives, identifies NIST

enterprise-level risks, tracks those risks and their impacts, and reviews risk mitigation progress and strategy.

- iv. NCNR leadership appointed a permanent Chief of Reactor Operations to provide more continuity and stability.
- v. NCNR hired a new Chief of the Aging Reactor Management (ARM) program. This position will provide oversight of communications between engineering and operations to help ensure that identified issues are resolved.
- vi. NCNR confirmed or updated management Performance Plans to ensure that expectations for procedure use and adherence with consequences for failure to follow required procedures is part of employee reviews.
- vii. Licensee staff including Reactor Operations and Engineering leadership took part in safety culture training given by NCNR staff experienced in safety culture training. The training covered the following topics:
 - 1. Human Performance Tools
 - 2. Procedure Use and Adherence
 - 3. Procedure Writing and Routing Guides
 - 4. SharePoint Use
 - 5. Procedure Theory
 - 6. Hazard Review
 - 7. Risk Assessment
 - 8. Mitigation Actions
 - 9. Pre-Job Brief and Post-Job Critique
- viii. NCNR conducted leadership training for reactor supervisors. The training was led by the Chief of Reactor Operations and included the following modules of leadership training for the Commerce Learning Center:

1. Accountable Leadership
2. Influencing and Persuading Others
3. Becoming an Emotionally Intelligent Leader
4. Networking to Improve Leadership Effectiveness
5. New Leadership Transitions
6. Leading Others through Conflict

c. Corrective Action Program

- i. NCNR implemented "Safety Good Catch/Good Idea" program to incentivize staff to identify, raise, and address safety concerns in April 2021.
- ii. Established Safety Evaluation Committee (SEC) subcommittee to track and oversee corrective actions.
- iii. Established the Engineering Change Management Program to provide an administrative gate for 50.59 screening and execution for facility and procedure modifications.

d. Procedures

- i. NCNR modified Administrative Requirement (AR) 5.0, "Procedure Use and Adherence," which guides conduct of operations, to strengthen the oversight role supervisors must play and to require that all personnel be trained. The required procedure use and adherence training has been completed.
- ii. Drafted and approved AR 5.1, "Procedure Writer's Guide," related to procedure writing, which includes addressing improvements to writing quality.

- iii. Identified procedures that will be updated according to new guidance in AR 5.1 prior to reactor startup.
- iv. Updated procedure standards to comply with PPA AP-907-005, "Procedure Writers' Manual."
- v. Implemented AR 1.1, "Human Performance Tools," related to improving training on a continuous basis.
- vi. Modified Operating Instruction (OI) 1.1, "Reactor Startup," to provide detailed guidance on evaluation of abnormal fluctuations in nuclear instrumentation.

e. Technical

- i. NCNR conducted 40 hours of proficiency training for all Operations Staff, emphasizing the importance of latching and procedural compliance.
- ii. Established proficiency requirements for operators performing fuel handling, including core loading, shuffle, rotational latch checks, and visual latch checks.
- iii. Created Emergency Instructions (EI) 3.8, "Recovery Operations," and 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 include an evacuation checklist required to be used during an evacuation to ensure confinement is safe for operator re-entry.
- iv. Performed Latch Improvement Safety Analysis to document that improved latching and latch check processes provide adequate defense against unlatching.

- v. Assessed the efficacy of all tools used in refueling to determine whether improvements are needed and concluded that, given the discontinuation of height checks, the tools are adequate to meet all new refueling and latch check requirements.
- vi. Conducted analysis as to whether no-flow height checks should be continued and concluded that the equipment does not support height checks with sufficient precision; height-related latch checks are no longer prescribed.
- vii. Reinstated requirement for latch checks prior to final pump restart and modified OI 2.1.1, "Startup of the Primary System for Criticality," and OI 1.1.0, "Reactor Startup Checklist."
- viii. Instituted a required rotation latch check, performed by a second individual and modified OI 6.1, "Fueling and Defueling."
- ix. Instituted a redundant Technical Specifications required method of visual checks (using a digital camera plus image analysis software) and modified Operating Instruction (OI) 6.1.
- x. Verified that the index plate is consistently positioned by the use of alignment pins and that rotational fiduciary marks are clear to ensure fuel movement evolutions are performed properly.
- xi. Modified OI 6.1 series and OI 1.1A CL to ensure that there will be no tool contact with fuel head following final visual latch verification prior to reactor startup.
- xii. Submitted License Amendment Request to NRC to modify Technical Specification 3.9.2.1 to require latch verification through both mechanical rotational and visual methods.

2. Based on a review of the incident, NCNR plans to complete additional corrective actions, including but not limited to the following:

- a. Management Systems

- i. Conduct regular briefings of NIST and DOC leadership regarding the progress of operational safety and corrective actions, and review of safety culture.
 - ii. Participate in Enterprise Risk Management reviews twice a year to assess elevated risk impact of NCNR for NIST.
 - iii. Develop and implement a change management framework to evaluate sufficiency of existing change management processes and identify gaps and areas for improvement.
 - iv. Develop a system for knowledge and skills management in the presence of personnel attrition.
 - v. Develop a plan for involving staff in continuous improvement of reactor operations, through participation in a preventive action program that encourages and rewards proactive efforts to improve quality, safety, and efficiency of operations.
 - vi. Hire a Deputy Chief of Reactor Operations to provide additional oversight and consistent leadership.
 - vii. Increase management engagement by implementing AR 5.4, "Observation Program," which details requirements for management and others to perform observations with documentation of findings and suggested improvements.
 - viii. Define requirements for qualification as Crew Chief and implement Crew Chief leadership and development training.

b. Qualification and Training

- i. Develop a technical training program for robust qualification and training of supervisors, operators, and candidates for: moving and handling fuel; proficiency checks on key refueling tasks; and proficiency checks for core loading, shuffle, rotational latch checks and visual latch checks. The program will include training materials (e.g., qualification cards) and practical experience with the use of the fuel handling stand, reflecting stated learning objectives.
- ii. Provide consistent and structured training and immediate and continual feedback to Non-Licensed Operators (NLO) during on-the-job training to ensure comprehension of performance expectations.
- iii. Develop consistent standard by which all supervisors evaluate qualifications.
- iv. Develop a continuous formal operator training program to provide ongoing training through rotating assignments of operators to a “fifth shift” dedicated to training, procedure development, and maintenance.
- v. Implement mandatory oversight training for supervisors.
- vi. Require additional training in leadership training and reactor supervisor leadership training.
- vii. Conduct proficiency training prior to all future refueling events.

c. Procedures

- i. Rewrite Operating Instruction (OI) series 6.1, “Fueling and Defueling,” and OI 6.2, “Operation of the Fuel Transfer System,” to capture detail of fuel and latch movements to align with training.

- ii. Revise procedures necessary prior to any reactor restart to be consistent with INPO 11-003, "Guideline for Excellence in Procedure and Work Instruction Use and Adherence," and conducted training on procedure protocols.
- iii. Complete revision to procedures required for startup.
- iv. Design, test, and install noise gates on selected nuclear instrumentation channels to alert operator of abnormal signal in progress.

d. Event Response

- i. Develop guidelines that outline methods for making measurements, interpreting results, performing calculations, and making dose projections (e.g., dose projections that are used as basis for 10 radiological protective action recommendations and those used to upgrade and downgrade emergency classes).
- ii. Develop a process to communicate and track deficiencies in emergency drills and exercises identified during follow-up critiques; ensure corrective and preventive actions are assigned appropriately and tracked for timely resolution.
- iii. Implement an ethernet-based data display for the emergency control station, post-reactor startup to improve remote monitoring and control capabilities.

3. Based on NCNR's review of the incident and NRC's concerns with respect to precluding recurrence of the violation, NCNR agrees to implement corrective actions and enhancements in the following areas:

- a. Communications
- b. Nuclear safety program assessments to include:

- i. Nuclear safety culture assessment
 - ii. Nuclear program assessment(s)
 - iii. Problem Identification and Resolution program
 - iv. Employee concerns
 - v. Safety Culture Monitoring Panel
 - c. Training
 - d. Procedures
 - e. Benchmarking
 - f. Employee engagement
 - g. Leadership accountability
 - h. Technical issues
4. Based on the completed and planned actions described above, and the commitments described in Section V of this Order, the NRC agrees to reduce the civil penalty to \$0, refrain from issuing a cited notice of violation, and not pursue any further enforcement action based on the seven apparent violations identified in the NRC's March 16, 2022, letter.
5. The NRC will consider the Confirmatory Order an escalated enforcement action with respect to any future enforcement actions.
6. On July 21, 2022, NCNR consented to the issuance of this Confirmatory Order with the requirements, as described in Section V below. NCNR further agreed that this Confirmatory Order is to be effective upon issuance, the agreement memorialized in this Confirmatory Order settles the matter between the parties, and that the licensee has waived its right to a hearing.

IV

Any decision of the NRC to approve restart under 10 CFR 50.36(c)(1) would be informed by but not solely reliant upon this CO.

I find that the actions completed by NCNR, as described in Section III above, combined with the commitments as set forth in Section V are acceptable and necessary, and conclude that with these completed actions and commitments the public health and safety are reasonably assured. In view of the foregoing, I have determined that public health and safety require that NCNR's commitments be confirmed by this Order. Based on the above and NCNR's consent, this Confirmatory Order is effective upon issuance.

Accordingly, pursuant to Sections 104b, 161b, 161i, 161o, 182, and 186 of the Atomic Energy Act of 1954, as amended, and the Commission's regulations in 10 CFR 2.202 and 10 CFR Part 50 as applicable, IT IS HEREBY ORDERED, EFFECTIVE UPON ISSUANCE, THAT LICENSE NO. TR-5 IS MODIFIED AS FOLLOWS:

1. Communications

- a. Within 3 months of issuance of the Confirmatory Order, the NIST Director will issue a statement to NIST employees communicating the specific strategy to improve NCNR's nuclear safety culture. The communication will include (1) a summary regarding the Nuclear Safety Culture Improvement Program, (2) the NRC's concerns expressed in its Special Inspection Report, (3) specific lessons learned from previously applied corrective actions, and (4) corrective actions both taken and planned. At least 30 days prior to issuing the statement, NIST will provide the statement for NRC staff review. Within 15 days of receiving the statement, the NRC staff will provide feedback to NIST. NIST will incorporate NRC staff feedback and notify the NRC when the statement is issued.
- b. Within 2 months of the NIST Director's statement, the NCNR Director will hold an all-hands meeting with NCNR employees for management to discuss the importance of the above communication. NCNR will require and document attendance for the all-hands meeting and maintain that documentation in the NCNR employees training records.

2. Nuclear safety program assessments

- a. Nuclear safety culture assessment
 - i. Within 6 months of issuance of the CO, NCNR will hire a third-party, independent nuclear consultant (consultant) to conduct an independent

third-party nuclear safety culture assessment. The contract will specify that the consultant will assist NCNR in the implementation of the recommendations and corrective actions identified in the assessment to prevent recurrence of the February 3, 2021, event or similar events at the NBSR.

- ii. Prior to issuance of the Request for Quotations, NCNR will include criteria equivalent to the those described in Section 03.02.c.1, c.2, and c.3 of Inspection Procedure 95003, "Supplemental Inspection for Repetitive Degraded Cornerstones, Multiple Degraded Cornerstones, Multiple Yellow Inputs or One Red Input," dated June 7, 2022, to ensure a consultant with the appropriate qualifications is identified.
- iii. Within 6 months of contract award to the consultant, NCNR will submit a copy of the safety assessment report and NCNR's written response to the assessment report to the NRC. NCNR's written response will either address how it will implement the recommendations and corrective actions of the assessment report, including a proposed timeline; or provide an explanation and justification for why the recommendation(s) and corrective action(s) will not be implemented.
- iv. Within 2 months of submitting the assessment report to the NRC, the NCNR Director shall issue written and verbal communications providing the results of the assessment, recommendations, and corrective actions to the NCNR staff. At least 30 days prior to issuing the written communication, NCNR will provide the statement for NRC staff review. Within 15 days of receiving the statement, the NRC staff will provide feedback to NCNR staff. NCNR will notify the NRC when the statement is issued.

- v. The assessment will include employee surveys, the review of anonymous reports, and contractor-conducted interviews and focus groups to assess the effectiveness of the programs.
 - vi. NCNR will ensure this consultant is provided with all necessary materials, reports, and access to personnel to complete its assessment. The reports shall include the NRC special inspection report dated March 16, 2022, future NRC inspections reports regarding the February 3, 2021, event, and NCNR safety evaluation committee and safety assessment committee (SEC/SAC) reports.
 - vii. Within 12 months of completing the initial assessment, the consultant will perform a second assessment to ensure the sustainability and effectiveness of the corrective actions within the identified areas. Within 30 days of receiving the report, NCNR will submit a copy of the second assessment report to the NRC.
 - viii. Within 12 months of completing the second assessment, the consultant will conduct a third assessment to ensure long term sustainability and effectiveness of the identified recommendations and corrective actions. Within 30 days of receiving the report, NCNR will submit a copy of the third assessment report to the NRC.
- b. Nuclear program assessment(s)
- i. Within 12 months of the issuance of the CO, NCNR will hire one or more third-party, independent nuclear consultant(s) to conduct an independent third-party assessment(s) and notify the NRC of the timeline for the completion of the assessment(s). The contract will specify that the nuclear consultant(s) will assist NCNR in the implementation of the recommendations and corrective actions identified in the assessment(s)

to prevent recurrence of the February 3, 2021, event or similar events at the NBSR. The consultant's (or consultants') assessment(s) will include recommended corrective actions in the following areas:

1. Problem Identification and Resolution
 2. Event Root Cause
 3. Training
 4. Procedures
 5. Safety Assessment Committee
 6. Safety Evaluation Committee independence and effective oversight
- ii. Within 3 months of issuance of the assessment report(s) (or within 3 months of the issuance of the last report, if multiple contracts are awarded), NCNR will submit a copy of the safety assessment report(s) and NCNR's written response to the assessment report(s) to the NRC. NCNR's written response will either address how it will implement the recommendations and corrective actions of the assessment report(s), including a proposed timeline; or provide an explanation and justification for why the recommendation(s) and corrective action(s) will not be implemented.
- iii. Within 2 months of submitting the assessment report(s) to the NRC, the NCNR Director shall issue written and verbal communications providing the results of the assessment, recommendations, and corrective actions to the NCNR staff. At least 30 days prior to issuing the written communication, NCNR will provide the statement for NRC staff review. Within 15 days of receiving the statement, the NRC staff will provide

feedback to NCNR staff. NCNR will notify the NRC when the statement is issued.

- iv. NCNR will ensure this consultant is provided with all necessary materials and access to personnel to complete its assessment, including NRC inspection reports, SEC/SAC reports, and the interim and final special inspection reports.

c. Problem Identification and Resolution program

- i. By September 30, 2022, NCNR will develop an Observation program with program goals to provide for periodic management oversight of procedures and procedure adherence.
- ii. By September 30, 2022, NCNR will develop a System Review Team program with program goals of reviewing system changes, including but not limited to components and procedures, and generating reports for the Aging Reactor Management review.
- iii. By October 31, 2022, NCNR will develop and implement the Level 3 Corrective Action Program.
- iv. By December 31, 2022, NCNR will develop and implement the Level 2 Corrective Action Program.
- v. By March 31, 2023, NCNR will develop and implement the Level 1 Corrective Action Program.
- vi. Within 1 month of program finalization, NCNR will submit program documentation to the NRC for review and comment.
- vii. Within 3 months of NRC comment, NCNR will incorporate NRC staff feedback.
- viii. The NCNR will maintain these programs to track, trend, and correct failures and deficiencies to prevent recurrence.

d. Employee concerns

- i. Within 6 months of issuance of the CO, NCNR will develop a formal program for NCNR employees to raise concerns. The program will describe and include methods to address the following types of concerns:
 1. anonymous employee concerns
 2. employee protection
 3. nuclear safety culture
 4. chilling effect
- ii. Within 1 month of program development, NCNR will submit program documentation to the NRC for review and comment.
- iii. Within 2 months of NRC comment, NCNR will incorporate NRC staff feedback and implement and maintain the program.

e. Safety Culture Monitoring Panel

- i. Within 9 months of issuance of the CO, NCNR will develop a formal program to monitor the nuclear safety culture informed by the elements of NEI 09-07, "Fostering a Healthy Nuclear Safety Culture," Revision 1.
- ii. Within 1 month of program development, NCNR will submit program documentation to the NRC for review and comment.
- iii. Within 2 months of NRC comment, NCNR will incorporate NRC staff feedback and implement and maintain the program.

3. Training

In addition to the recommendations and corrective actions related to training identified during the above assessment (see Provision 2.b.i):

- a. Prior to any restart, NCNR will conduct training of all licensed operators on the performance of fuel loading and latch checking procedures in accordance with

ANSI/ANS-15.4-2016, “American National Standard Selection and Training of Personnel for Research Reactors.” NCNR will maintain records of training completion for all licensed operators.

- b. Within 3 months of issuance of the CO, NCNR will modify its requalification plan to specify that every “reactor operating test or evaluation” portion of NCNR licensed operator requalification training must include “other reactivity tasks including fuel movements, insertion and removal of experiments, and rod exchange or movements without power change” as one of the five tasks selected from Section 5.4 (as specified in Section 6.2.5) of ANSI/ANS-15.4-2016, “American National Standard Selection and Training of Personnel for Research Reactors.”

4. Procedures

- a. Prior to any restart, NCNR will develop, implement, and maintain a written procedure that covers procedural use and adherence in accordance with the most recent version of INPO 11-003, “Guideline for Excellence in Procedure and Work Instruction Use and Adherence.”
- b. Procedures referenced in paragraph 1.d of Section III of this CO will be subject to inspection prior to any restart.
- c. Within 30 months of issuance of the CO, NCNR will develop, implement, and maintain all procedures involving reactor operations activities in accordance with the most recent version of PPA AP-907-005, “Procedure Writers’ Manual.”

5. Benchmarking

- a. Starting 12 months after CO issuance, NCNR will 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 another facility. Because NCNR is much larger in both thermal output and staffing than most research and test reactors (RTRs) and operates at a cadence similar to commercial power reactors, NCNR will not solely benchmark RTRs. Conversely, the NCNR is a much smaller organization than a commercial power reactor, so NCNR will also not solely benchmark power reactors. NCNR shall be strategic when deciding the appropriate facility to benchmark, selecting a facility with a program commensurate to the one NCNR is benchmarking. NCNR should also consider input from the nuclear consultants identified in Provisions 2.a and 2.b on the appropriate facility programs to benchmark (i.e., a commercial power reactor's safety culture program; Advanced Test Reactor's problem identification and resolution program, etc.). Furthermore, benchmarking shall include multiple levels of NCNR staff and shall not be limited to NCNR senior management. NCNR will document this activity, observations, and decisions regarding changes to NCNR's programs.

- b. For 3 years following issuance of the CO, at least one NCNR staff member shall attend 2 of the following relevant industry conferences per calendar year:
 - i. National Organization of Test, Research and Training Reactors (TRTR)
 - ii. National Association of Employee Concerns Professionals (NAECP)
 - iii. NRC's Regulatory Information Conference (RIC)
 - iv. American Nuclear Society (ANS)
 - v. Department of Energy (DOE), if applicable

6. Employee engagement

Within 6 months of the issuance of the CO, NCNR will establish and maintain a rewards and recognition program to encourage employees to raise concerns and will incorporate

a safety recognition program into the performance evaluation process. The program will include the following:

- a. encourage informal recognition of safety achievements;
- b. establish a formal recognition program with tangible rewards;
- c. encourage the staff to seek advice and to proceed with caution;
- d. communicate expectations and ensure that safety correspondence such as near misses, good catches, operating experience, and safety flash communications are developed and communicated to the workforce.

7. Leadership accountability

- a. Within 12 months of consultant contract award, NCNR will provide the NRC with documentation of any revisions to the Safety Evaluation Committee charter as informed by the nuclear consultant(s) selected under item 2.b.
- b. Within 12 months of the contract award discussed in Provision 2.b, NCNR will conduct training for all senior leaders, with support of the nuclear consultant selected under Provision 2.b, and which will include training on NUREG-2165, "Safety Culture Common Language" (INPO 12-012, "Traits of a Healthy Nuclear Safety Culture," Revision 1). NCNR will incorporate this leadership training into an annual required safety culture refresher training for senior leaders.
- c. By the beginning of fiscal year 2023, NCNR will develop and maintain performance appraisal assessment criteria for periodic annual evaluations of NCNR supervisors and managers to assess their performance regarding nuclear safety culture.
- d. Within 12 months of the issuance of the CO, NCNR will present at a publicly attended annual conference (such as TRTR, NAECP, ANS). If asked by the NRC, NCNR will also present at the RIC. The presentation will address the

cause of the February 3, 2021, event and corrective actions taken by NCNR and will include a discussion of the NRC's findings. Two months prior to the conference, NCNR will submit the presentation to the NRC for review and comment, and NCNR will incorporate any comments from the NRC staff into the final presentation.

- e. Within 3 months of issuance of the CO, NCNR will provide a timeline to address staffing challenges to the NRC for review.

8. Technical issues

- a. Within 3 months of the issuance of the CO, NCNR will provide an assessment of options to replace NCNR's reliance upon administrative controls/actions to ensure that fuel assemblies are adequately latched.
- b. Within 6 months of any restart of regular reactor operations (defined as the return to 24 hour/day operations at 20 MW), NCNR will implement the condition-based monitoring systems for nuclear instrumentation that could provide a very early warning to control room operators of mechanical anomalies during reactor startup.
- c. Within 12 months of the issuance of the CO, NCNR will develop an engineered solution to automatically secure carbon dioxide following a major SCRAM. NCNR will implement the proposed solution using the appropriate regulatory process or provide the NRC with an engineering analysis that includes a justification for not implementing a design change.
- d. Within 12 months of issuance of the CO, NCNR will provide an assessment of the configuration management process and how it is incorporated with problem identification and resolution processes.

9. Upon completion of the terms of items of the CO, NCNR will provide the NRC with a letter discussing its basis for concluding that the requirements of this Order have been adequately implemented.

In the event of the transfer of the license of NCNR to another entity, the terms and conditions set forth hereunder shall continue to apply to the new entity and accordingly survive any transfer of ownership or license.

The Director, Office of Enforcement, may, in writing, relax, rescind, or withdraw any of the above conditions upon demonstration by NCNR or its successors of good cause.

VI

In accordance with 10 CFR 2.202 and 10 CFR 2.309, any person adversely affected by this CO, other than NIST/NCNR, may request a hearing within 30 calendar days of the date of issuance of this CO. Where good cause is shown, consideration will be given to extending the time to request a hearing. A request for extension of time must be made in writing to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and include a statement of good cause for the extension.

All documents filed in NRC adjudicatory proceedings, including a request for hearing and petition for leave to intervene (petition), any motion or other document filed in the proceeding prior to the submission of a petition, and documents filed by interested governmental entities that request to participate under 10 CFR 2.315(c), must be filed in accordance with the NRC's E-Filing rule (72 FR 49139; August 28, 2007, as amended at 77 FR 46562; August 3, 2012). The E-Filing process requires participants to submit and serve all adjudicatory documents over the internet, or in some cases to mail copies on electronic storage media. Detailed guidance on making electronic submissions may be found in the Guidance for Electronic Submissions to the NRC and on the NRC Web site at <https://www.nrc.gov/site-help/esubmittals.html>. Participants may not submit paper copies of their filings unless they seek an exemption in accordance with the procedures described below.

To comply with the procedural requirements of E-Filing, at least 10 days prior to the filing deadline, the participant should contact the Office of the Secretary by email at hearing.docket@nrc.gov, or by telephone at 301-415-1677, to (1) request a digital identification (ID) certificate, which allows the participant (or its counsel or

representative) to digitally sign submissions and access the E-Filing system for any proceeding in which it is participating; and (2) advise the Secretary that the participant will be submitting a petition or other adjudicatory document (even in instances in which the participant, or its counsel or representative, already holds an NRC-issued digital ID certificate). Based upon this information, the Secretary will establish an electronic docket for the hearing in this proceeding if the Secretary has not already established an electronic docket.

Information about applying for a digital ID certificate is available on the NRC's public website at <https://www.nrc.gov/site-help/e-submittals/getting-started.html>. Once a participant has obtained a digital ID certificate and a docket has been created, the participant can then submit adjudicatory documents. Submissions must be in Portable Document Format (PDF). Additional guidance on PDF submissions is available on the NRC's public website at <https://www.nrc.gov/site-help/electronic-sub-ref-mat.html>. A filing is considered complete at the time the document is submitted through the NRC's E-Filing system. To be timely, an electronic filing must be submitted to the E-Filing system no later than 11:59 p.m. Eastern Time on the due date. Upon receipt of a transmission, the E-Filing system time-stamps the document and sends the submitter an email notice confirming receipt of the document. The E-Filing system also distributes an email notice that provides access to the document to the NRC's Office of the General Counsel and any others who have advised the Office of the Secretary that they wish to participate in the proceeding, so that the filer need not serve the document on those participants separately. Therefore, applicants and other participants (or their counsel or representative) must apply for and receive a digital ID certificate before adjudicatory documents are filed so that they can obtain access to the documents via the E-Filing system.

A person filing electronically using the NRC's adjudicatory E-Filing system may seek assistance by contacting the NRC's Electronic Filing Help Desk through the "Contact Us" link located on the NRC's public website at <https://www.nrc.gov/site-help/e-submittals.html>, by email to MSHD.Resource@nrc.gov, or by a toll-free call at 1-866-672-7640. The NRC Electronic Filing Help Desk is available between 9 a.m. and 6 p.m., Eastern Time, Monday through Friday, excluding government holidays.

Participants who believe that they have good cause for not submitting documents electronically must file an exemption request, in accordance with 10 CFR 2.302(g), with their initial paper filing stating why there is good cause for not filing electronically and requesting authorization to continue to submit documents in paper format. Such filings must be submitted by (1) first class mail addressed to the Office of the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, Attention: Rulemaking and Adjudications Staff; or (2) courier, express mail, or expedited delivery service to the Office of the Secretary, 11555 Rockville Pike, Rockville, Maryland 20852, Attention: Rulemaking and Adjudications Staff. Participants filing adjudicatory documents in this manner are responsible for serving the document on all other participants. Filing is considered complete by first-class mail as of the time of deposit in the mail, or by courier, express mail, or expedited delivery service upon depositing the document with the provider of the service. A presiding officer, having granted an exemption request from using E-Filing, may require a participant or party to use E-Filing if the presiding officer subsequently determines that the reason for granting the exemption from use of E-Filing no longer exists.

Documents submitted in adjudicatory proceedings will appear in the NRC's electronic hearing docket which is available to the public at <https://adams.nrc.gov/ehd>, unless excluded pursuant to an order of the Commission or the presiding officer. If you do not have an NRC-issued digital ID certificate as described above, click "cancel" when the link requests certificates and you will be automatically directed to the NRC's electronic hearing dockets where you will be able to access any publicly available documents in a particular hearing docket. Participants are requested not to include personal privacy information, such as social security numbers, home addresses, or personal phone numbers in their filings, unless an NRC regulation or other law requires submission of such information. For example, in some instances, individuals provide home addresses in order to demonstrate proximity to a facility or site. With respect to copyrighted works, except for limited excerpts that serve the purpose of the adjudicatory filings and would constitute a Fair Use application, participants are requested not to include copyrighted materials in their submission.

The Commission will issue a notice or order granting or denying a petition, designating the issues for any hearing that will be held, and designating the Presiding Officer. A notice granting a hearing will be published in the Federal Register and served on the parties to the hearing.

If a person (other than NIST/NCNR) requests a hearing, that person shall set forth with particularity the manner in which his interest is adversely affected by this CO and shall address the criteria set forth in 10 CFR 2.309(d) and (f). If a hearing is requested by a person whose interest is adversely affected, the Commission will issue an order designating the time and place of any hearings. If a hearing is held, the issue to be considered at such hearing shall be whether this CO should be sustained.

In the absence of any request for hearing, or written approval of an extension of time in which to request a hearing, the provisions specified in Section V above shall be final 30 days from the date of this CO without further order or proceedings. If an extension of time for requesting a hearing has been approved, the provisions specified in Section V shall be final when the extension expires if a hearing request has not been received.

FOR THE NUCLEAR REGULATORY COMMISSION

Mark D. Lombard, Director
Office of Enforcement

Dated this 1st day of August 2022

CONSENT AND HEARING WAIVER FORM

Dr. Robert Dimeo and the National Institute of Standards and Technology Center for Neutron Research (NCNR), hereby agree to comply with the terms and conditions of the Confirmatory Order arising out of an alternative dispute resolution process to be issued relating to enforcement action No. EA-21-148. The Confirmatory Order will be effective upon its issuance. By signing below, Dr. Robert Dimeo in his capacity as Director, NCNR, consents to the issuance of the referenced Confirmatory Order, effective upon its issuance and, by doing so, agrees to waive the right to request a hearing on all or any part of the Confirmatory Order.

ROBERT
DIMEO

Digitally signed by
ROBERT DIMEO
Date: 2022.07.21
17:14:42 -04'00'

Dr. Robert Dimeo, Director National Institute of Standards and Technology NIST Center for Neutron Research	Date
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