



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

July 21, 2022

Dr. Thomas H. Newton, Deputy Director
National Institute of Standards and
Technology
NIST Center for Neutron Research
U.S. Department of Commerce
100 Bureau Drive, Mail Stop 6100
Gaithersburg, MD 20899-6100

SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY – ISSUANCE OF
AMENDMENT NO. 13 TO RENEWED FACILITY OPERATING LICENSE
NO. TR-5 FOR THE NATIONAL BUREAU OF STANDARDS TEST REACTOR
RE: REVISION TO THE LATCH VERIFICATION TECHNICAL SPECIFICATION
(EPID L-2021-LLA-0239)

Dear Dr. Newton:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 13 to Renewed Facility Operating License No. TR-5 for the National Institute of Standards and Technology (NIST) National Bureau of Standards Test Reactor (NBSR). This amendment consists of changes to the renewed facility operating license in response to the application dated December 23, 2021 (Agencywide Documents Access and Management System Package Accession No. ML21361A246), as supplemented by letters dated January 11, 2022 (ML22012A090), and June 8, 2022 (ML22160A285). Specifically, the amendment modifies the NIST NBSR technical specifications (TSs) by revising TS 3.9.2.1 fuel element latch verification requirements to require both rotational checks and visual inspection.

This license amendment will inform the decision of the Commission whether to approve restart under Title 10 of the *Code of Federal Regulations* Section 50.36(c)(1) related to the event on February 3, 2021 (ML21294A277), but the restart decision will not solely rely on this license amendment.

A copy of the related safety evaluation is also enclosed. The Notice of Issuance will be included in the Commission's monthly *Federal Register* notice. If you have any questions, please contact me at (301) 415-3936, or by email at Patrick.Boyle@nrc.gov.

Sincerely,

 Signed by Boyle, Patrick
on 07/21/22

Patrick Boyle, Project Manager
Non-Power Production and Utilization Facility
Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

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

Enclosures:

1. Amendment No. 13 to Renewed
Facility Operating License No. TR-5
2. Safety Evaluation

National Institute of Standards and Technology

Docket No. 50-184

cc:

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SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY – ISSUANCE OF AMENDMENT NO. 13 TO RENEWED FACILITY OPERATING LICENSE NO. TR-5 FOR THE NATIONAL BUREAU OF STANDARDS TEST REACTOR RE: REVISION TO THE LATCH VERIFICATION TECHNICAL SPECIFICATION (EPID L-2021-LLA-0239) DATED: JULY 21, 2022

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NRR-058

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

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

DOCKET NO. 50-184

NATIONAL BUREAU OF STANDARDS TEST REACTOR

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 13
License No. TR-5

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to Renewed Facility Operating License No. TR-5, filed by the National Institute of Standards and Technology (the licensee) on December 23, 2021, as supplemented by letters dated January 11, 2022, and June 8, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
 - E. The issuance of this amendment is in accordance with 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the license condition as indicated in the Attachment 1 to this license amendment and by changes to the technical specifications as indicated in Attachment 2. Paragraph 2.C.2. of Renewed Facility Operating License No. TR-5 is hereby amended to read as follows:
 2. The technical specifications contained in Appendix A, as revised by Amendment Nos. 9 through 13, are hereby incorporated in the license. The licensee shall operate the reactor in accordance with the technical specifications.
3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Joshua M. Borromeo, Chief
Non-Power Production and Utilization Facility
Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Attachments:

1. Changes to Renewed Facility
Operating License No. TR-5
2. Changes to Appendix A,
"Technical Specifications"

Date of Issuance: July 21, 2022

ATTACHMENT 1 TO LICENSE AMENDMENT NO. 13
RENEWED FACILITY OPERATING LICENSE NO. TR-5
DOCKET NO. 50-184

Replace the following page of Renewed Facility Operating License No. TR-5 with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Renewed Facility Operating License No. TR-5

Remove

3

Insert

3

- a. up to 45.0 kilograms of contained uranium-235 of any enrichment, provided that less than 5.0 kilograms of this amount be unirradiated;
 - b. to possess and use, but not to separate such special nuclear material as may be produced by operation of the reactor.
 3. Pursuant to the Act and 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," to receive, possess, and use in connection with the operation of the reactor: (1) a two-curie americium-beryllium neutron source which may be used for reactor startup, and (2) up to a total of 8 curies of byproduct material (Atomic number 1 through 83) and up to 100 micro curies of americium-241, in the form of instrument calibration sources.
 4. Pursuant to the Act and 10 CFR Part 30 to possess, use, and transfer but not to separate, except for byproduct material produced in non-fueled experiments, such byproduct material as may be produced by operation of the reactor.
- C. This license shall be deemed to contain and is subject to the conditions specified in Parts 20, 30, 50, 51, 55, 70, 73, and 100 of the Commission's regulations; is subject to all applicable provisions of the Act and rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified below:
1. The licensee is authorized to operate the reactor at steady-state power levels up to a maximum of 20 megawatts (thermal).
 2. The technical specifications contained in Appendix A, as revised by Amendment Nos. 9 through 13, are hereby incorporated in the license. The licensee shall operate the reactor in accordance with the technical specifications.
 3. The licensee shall maintain and fully implement all of the provisions of the Commission-approved physical security plan, including changes made pursuant to the authority of 10 CFR 50.54(p). The approved physical security plan consists of a National Institute of Standards and Technology document, withheld from public disclosure pursuant to 10 CFR 73.21, entitled, "National Institute of Standards and Technology Center for Neutron Research Physical Security Plan," dated June 12, 2020, transmitted by letter dated June 12, 2020.

ATTACHMENT 2 TO LICENSE AMENDMENT NO. 13

RENEWED FACILITY OPERATING LICENSE NO. TR-5

DOCKET NO. 50-184

Replace the following page of Appendix A, "Technical Specifications," with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Technical Specifications

Remove

30

Insert

30

3.9.2 Fuel Handling

3.9.2.1 Within the Reactor Vessel

Applicability: Fuel element latching

Objective: To ensure that all fuel elements are latched between the reactor grid plates.

Specifications

Following 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 both of the following methods:

- (1) Rotational check of the element head after final latching rotation by the refueling tool, followed by
- (2) Visual inspection of the fuel element head or latching bar verifying that the element is in the latched position.

Basis

Each NBSR fuel element employs a latching bar, which shall be rotated to lock the fuel element in the upper grid plate. Following fuel handling, it is necessary to ensure that this bar is properly positioned so that an element cannot be lifted out of the lower grid plate, which will lead to a reduction in flow to the element after pump flow is initiated. Use of both methods above provides redundancy in verifying latching bar position. The visual inspection must follow the rotational check so that no tool would be subsequently used to inadvertently unlatch an element.

3.9.2.2 All Other Conditions

Applicability: Refueling system

Objective: To ensure the integrity of the fuel element cladding.



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 13 TO

RENEWED FACILITY OPERATING LICENSE NO. TR-5

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NATIONAL BUREAU OF STANDARDS TEST REACTOR

DOCKET NO. 50-184

1.0 INTRODUCTION

By letter dated December 23, 2021 (Agencywide Documents Access and Management System Package Accession No. ML21361A246), as supplemented by letters dated January 11, 2022 (ML22012A090), and June 8, 2022 (ML22160A285), the National Institute of Standards and Technology (NIST) submitted a license amendment request (LAR) to modify the National Bureau of Standards Test Reactor (NBSR) technical specification (TS) 3.9.2, "Fuel Handling," to improve the verification of fuel element latching within the reactor vessel of the NBSR. The supplemental letter dated June 8, 2022, provided additional information that clarified the application and did not expand the scope of the application as originally noticed in the *Federal Register* (FR) on February 22, 2022 (87 FR 9647).

Prior to the submission of the LAR, by letter dated December 3, 2021 (ML21340A010), NIST described its plan to submit an LAR to revise TS 3.9.2 to improve the requirement for verifying that all fuel elements are fully latched. At a public meeting on December 7, 2021 (ML21349A377), NIST presented a draft plan for the proposed TS revision. The U.S. Nuclear Regulatory Commission (NRC) staff provided feedback regarding this draft plan. For example, the staff indicated that: (a) the wording of the TS requirements for the rotational check and visual check should be made more clear; (b) the sequence of the performance of these two TS requirements should be specified; (c) diagrams or photographs of the latch mechanism for the fuel elements would be helpful in explaining the proposed TS revision; and (d) high-level TS requirements may be acceptable provided that NIST prepares detailed procedures for the implementation of the TS requirements. In its December 23, 2021, LAR, NIST addressed this staff feedback and referenced draft procedures for the fuel element latching process. On June 8, 2022, NIST provided a supplement to the LAR that indicated that the procedures for the fuel element latching process were prepared and implemented.

2.0 REGULATORY EVALUATION

The NRC staff reviewed the LAR and evaluated the proposed changes to the TSs based on the following regulations and guidance:

- Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” which provides, in part, the regulatory requirements for the licensing of non-power reactors, and 10 CFR 50.36, “Technical specifications,” which requires TSs to be included in utilization facility licenses.
- Section 50.36(a)(1) of 10 CFR, which requires, in part, that each applicant for a license authorizing operation of a utilization facility include in its application proposed TSs and that a summary statement of the bases or reasons for such TSs, other than those covering administrative controls, also be included, but that these bases do not become part of the TSs.
- NUREG-1537, Part 1, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,” Appendix 14.1, “Format and Content of Technical Specifications for Non-Power Reactors” (ML042430055), which provides guidance to applicants and licensees on preparing non-power reactor license applications and TSs.
- NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria,” Chapter 14, “Technical Specifications” (ML042430048), which provides guidance to the NRC staff on reviewing non-power reactor license applications and TSs.

3.0 TECHNICAL EVALUATION

The NBSR is a 20-megawatt thermal reactor with aluminum clad plate fuel. The NBSR is a forced-flow reactor that is moderated and cooled by heavy water (D₂O). On February 3, 2021, the NBSR experienced damage to one of its fuel elements. The fuel element damage was caused by a lack of coolant entering the element during reactor power operations. The flow of coolant into the element was blocked by the lower grid plate because the fuel element was not properly seated in the flow orifice. The improper orientation of the fuel element resulted from the element not having been properly latched during the previous routine refueling outage.

As stated in the LAR, after this event, NIST proposed revising the NBSR TSs associated with the latch verification of fuel elements to improve the fidelity of latch determinations. Specifically, NIST proposed to remove the elevation check option from the TSs, and to require two checks: the existing rotational check followed by a new visual inspection of fuel elements. The December 23, 2021, submittal clarifies that the visual examination is performed after all tools (fuel handling equipment) are in their stowed position and that an operator and a second person will verify and document that each element was shown to be latched.

The NRC staff reviewed the proposed revisions to NBSR TS 3.9.2.1 to verify that the NBSR will 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. The proposed TS 3.9.2.1 would require verification that each fuel element that had been handled is locked in position by (1) a rotational check of the element head after final latching rotation by the refueling tool, followed by (2) a visual inspection of the fuel element head or latching bar verifying that the element is in the latched position. NIST stated in its document titled “Latch Improvement Safety

Analysis,” dated September 21, 2021 (ML21274A023) “The fidelity of height checks is inadequate to provide assurances of latching. Multiple measurements and checks determined that measurements of tool height were not a reliable indication of the latch state of an element. The tolerances in the measurements were not adequate to verify the latch state.” Since the height check does not provide an adequate assurance of latching, the NRC staff finds deletion of the height check, as a method to verify fuel element latch, to be appropriate.

As shown in the figures in the LAR, the rotational check and visual inspection process would verify that the fuel elements are properly latched. Although each of the rotational check and visual inspection independently is sufficient to verify that the fuel elements are properly latched, the rotational check involves the possibility of unlatching the fuel element being checked if the check is performed improperly. However, any such inadvertent unlatching would be identified by the visual inspection. Therefore, the staff concludes that the process of performing the rotational check followed by the visual inspection would ensure that the fuel elements are properly latched.

As part of an ongoing audit of the NIST documentation supporting the separate restart decision of the NBSR (see the audit plan at ML21341B353), the NRC staff reviewed, among other things, the procedures referenced in the LAR. Specifically, the staff reviewed OI 6.1.7 (Revision 2), OI 6.1.8 (Revision 2), and OI 6.1.9 (Revision 2), and found that these procedures provide acceptable instructions for fuel element latch verification. The staff will prepare a separate audit report describing this audit.

The NRC staff reviewed the format and content of the proposed TSs for consistency with the guidance in NUREG-1537, Part 1, Appendix 14.1. Consistent with NUREG-1537, Part 2, Chapter 14, the staff also evaluated the proposed TS revisions to determine if the proposed NBSR TSs meet the requirements in 10 CFR 50.36.

In its LAR, NIST proposed revisions to TS 3.9.2.1. Specifically, NIST proposed the deletion of the TS 3.9.2.1(1) elevation check, and revisions to and renumbering of the existing rotational check and visual inspection. The proposed TS changes are set forth below and are denoted using **bold** text to indicate additions and ~~strikethrough~~ text to indicate deletions.

Specifications

Following 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~~ **both** 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~~ **after final latching rotation by the refueling tool, followed by**

~~(3) Visual inspection of the fuel element head or latching bar~~ **verifying that the element is in the latched position.**

As described in this safety evaluation, the NRC staff finds that the proposed revisions to NBSR TS 3.9.2.1 will provide verification that each fuel element is locked in position during the refueling process. Verification that a fuel element is in its locked-in position will ensure that the core configuration provides adequate coolant flow in the fuel element. Since the proposed TS

revisions ensure proper core configuration, the NRC staff also finds that the revisions are consistent with the guidance in Section 3.1(4), "Core Configurations," of NUREG-1537, Part 1, Appendix 14.1 and the acceptance criteria in Chapter 14 of NUREG-1537, Part 2 since the conditions specified define how the fuel will be configured to provide reasonable assurance that the fuel will not exceed its safety limit temperature. Therefore, the NRC staff concludes that the proposed revisions to NBSR TS 3.9.2.1 are acceptable.

Section 50.36(a)(1) of 10 CFR states that a summary statement of the bases or reasons for TSs, other than those covering administrative controls, shall be included in the application for a license, but shall not become part of the TSs. Consistent with 10 CFR 50.36(a)(1), NIST submitted changes to the basis for TS 3.9.2.1 as part of the LAR, that provide the reasons for the TS, as revised.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Maryland State official was notified of the proposed issuance of the amendment on June 22, 2022. The State official did not provide any comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes requirements with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts and no significant changes in the types of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, as published in the FR on February 22, 2022 (87 FR 9647), and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: T. Scarborough, NRR
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P. Boyle, NRR

Date: July 21, 2022