

April 29, 2008

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

SUBJECT: NRC INSPECTION REPORT NO. 50-184/2008-201

Dear Dr. Gallagher:

This letter refers to the inspection conducted on April 15 to 18, 2008, at your Research Reactor Facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of that inspection.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations of activities in progress. Based on the results of this inspection, no safety concern or noncompliance of Nuclear Regulatory Commission (NRC) requirements was identified. No response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Document Access Management System (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Should you have any questions concerning this inspection, please contact Marcus Voth at 301-415-1210.

Sincerely,

**/RA/**

Johnny H. Eads, Chief  
Research and Test Reactors Branch B  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

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

Enclosure: NRC Inspection Report No. 50-184/2008-201

cc w/ enclosure:  
See next page

National Institute of Standards and Technology  
cc:

Docket No. 50-184

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Test, Research, and Training  
Reactor Newsletter  
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**U. S. NUCLEAR REGULATORY COMMISSION**  
**OFFICE OF NUCLEAR REACTOR REGULATION**

Docket No: 50-184

License No: TR-5

Report No: 50-184/2008-201

Licensee: National Institute of Standards and Technology (NIST)

Facility: National Bureau of Standards Reactor (NBSR)

Location: Gaithersburg, MD

Dates: April 15 to 18, 2008

Inspectors: Marcus H. Voth  
Gregory M. Schoenebeck

Approved by: Johnny H. Eads, Chief  
Research and Test Reactors Branch B  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

## EXECUTIVE SUMMARY

National Institute of Standards and Technology  
National Bureau of Standards Reactor  
NRC Inspection Report No. 50-184/2008-201

The primary focus of this routine, announced inspection of reactor operations was the onsite review of selected aspects of the licensee's Class I research reactor facility safety programs including operations and maintenance; review and audit and design change function; experiments; procedures; surveillance; fuel movement; operator licensing, requalification, and medical activities; and emergency preparedness. The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

### Organization and Operations and Maintenance Activities

- The reactor appeared to be well-maintained and operated with sufficient staffing of well-qualified operators.

### Review and Audit and Design Change Functions

- Within the scope of this review, the licensee's programs for overall safety review, review of new experiments, and review of changes to the facility were found to be in conformance with Technical Specification and regulatory requirements.

### Experiments

- The inspectors concluded that a functional infrastructure existed to verify compliance with the requirements placed on experiments by Technical Specification 4.0.

### Procedures

- Written procedures were being maintained in accordance with Technical Specification requirements.

### Surveillance

- Surveillance practices were being maintained in accordance with Technical Specification requirements.

### Fuel Movement

- The license maintained and followed procedures which effectively implemented Technical Specification requirements for fuel handling.

### Operator Licensing, Requalification, and Medical Activities

- The licensee was conducting the reactor operator requalification program in accordance with procedural and regulatory requirements.

Emergency Preparedness

- Emergency preparedness practices were being maintained in accordance with regulatory requirements and the licensee's commitments.

## REPORT DETAILS

### Summary of Facility Status

The licensee's National Institute of Standards and Technology (NIST) Center for Neutron Research (NCNR) Test Reactor, a 20-megawatt test reactor commonly known as the National Bureau of Standards Reactor (NBSR), continued to be operated in support of laboratory experiments and various types of research. During the inspection, the reactor was operated continuously on a 24-hour per day basis.

### 1. Organization and Operations and Maintenance Activities

#### a. Inspection Scope (Inspection Procedure (IP) 69006)

The inspectors reviewed the following regarding the licensee's organization and staffing to verify that the requirements of Technical Specifications (TS) were being met:

- Reactor Shift Supervisor Logbook # 34, November 25, 2007 to March 8, 2008
- Reactor Console Logbook # 127, April 30, 2007 to March 5, 2008
- Reactor Console Logbook # 128, March 6, 2008 to April 17, 2008
- NIST [Annual] Report # 60, January 1 through December 31, 2007, dated March 26, 2008
- Reactor Operations Daily File for 2007 Third Quarter
- Reactor Operations Daily File for 2008 First Quarter
- Reactor Operations Daily File for 2008 Second Quarter to April 16, 2008
- Reference Procedures for the NBSR
- Reactor Area Inspection Log for April 16, 2008

#### b. Observations and Findings

The inspectors verified that the minimum operations crew required by TS Section 7.1 was recorded in the Reactor Console Logbook. The licensee had hired and begun training new operator candidates in anticipation of impending retirements. The inspectors accompanied trainees as they performed the shift rounds from 1500 to 1600 hours on April 16, 2008, and observed the shift turnover at 1500 hours on April 17, 2008.

The licensee recorded maintenance required by TS in the Reactor Operations Daily File. Maintenance considered significant but not required by TS and observations being tracked for potential maintenance needs were logged in the Shift Supervisor Logbook. In all records that the inspectors reviewed, no indication was found that maintenance was not performed in a timely and appropriate manner.

#### c. Conclusions

The reactor appeared to be well-maintained and operated with sufficient staffing of well-qualified operators.

## 2. Review and Audit and Design Change Functions

### a. Inspection Scope (IP 69007)

The inspectors reviewed the following to ensure that the requirements of TS Sections 7.2, Safety Evaluation Committee (SEC), and 7.3, Safety Audit Committee (SAC), and 10 CFR Part 50.59 were being implemented effectively:

- NIST [Annual] Report # 60, January 1 through December 31, 2007, dated March 26, 2008
- NCNR Safety Evaluation Committee [Draft] Minutes, Meeting No. 364, November 2, 2007
- [Charter of the] NBSR Beam Experiment Subcommittee of the NBSR SEC, March 29, 2005
- [Charter of the] NBSR Irradiation Subcommittee of the NBSR SEC, undated
- Annual Report of the Safety Audit Committee, October 2007
- Guidelines for Preparation of Experiment Proposals
- Guidelines for Preparing an Experimental Control Procedures Summary
- Irradiation Request/Proposal File
- BT-4/FANS Experiment Control Procedures Summary
- Experimental Proposal 447: Experimental Proposal for Grating Phase Imaging at the NG-7 Neutron Interferometer and Optics Facility, Memo from D. Gilliam, NIST SEC Chairman, to P. Gallagher, NIST Director, January 8, 2008
- Engineering Change Notices (ECN) #510 (January 10, 2006) through #541 (April 1, 2008)

### b. Observations and Findings

The licensee's TS required a Safety Evaluation Committee which meets at least semi-annually and a Safety Audit Committee which performs on oversight review at least annually. Both committees were composed of members with credentials consistent with TS requirements and had met at the frequencies with quorums required by TSs. The SEC functioned with two standing subcommittees, the Beam Experiment Subcommittee and the Irradiation Subcommittee. The inspectors reviewed the charters of the two subcommittees and met with the chairmen of each subcommittee, being assured that the level of oversight provided by the committees was in accordance with TS and 10 CFR Part 50.59 requirements for both in-reactor and beam experiments.

In a previous inspection an inspector noted a question among SEC members regarding the applicability of past data to a new pneumatic tube configuration. Minutes of subsequent meetings indicated that during qualification of the new configuration additional testing had been performed to resolve the issue.

The inspectors also met with the Quality Assurance Engineer who managed the engineering change process. They briefly reviewed all ECNs produced over the past 15 months with specific emphasis on two projects. ECN # 532, Fuel Element Cart, dated October 5, 2007, had been classified Level 1, meaning that it did not warrant a 50.59 screening. ECN # 524, Removal of a Lead between Terminals in the Reactor Safety System, dated June 7, 2007, was classified Level 2, requiring a 50.59 screening. The screening concluded that the change was below the threshold defined by 10 CFR Part

50.59. The inspectors found no issues with the engineering change review process nor the decisions documented in the ECNs.

c. Conclusions

Within the scope of the inspection, the licensee's programs for overall safety review, review of new experiments, and review of changes to the facility were found to be in conformance with Technical Specification and regulatory requirements.

**3. Experiments**

a. Inspection Scope (IP 69005)

The inspectors reviewed the following to ensure that the requirements of TS Section 4.0, Experiments, were being met concerning experiments:

- Experimental Proposals Manual (Compilation of Experimental Proposals through #448)
- SEC Notebook (Compilation of SEC minutes, correspondence, and documents reviewed at SEC meetings)
- S. Weiss (NRC) to T. Raby (NIST), Control of Access to Radiation Beams, June 5, 1995
- T. Raby (NIST) to S. Weiss (NRC), Response to June 5, 1995 NRC Letter, December 18, 1995
- S. Weiss (NRC) to T. Raby (NIST), NIST Control of High Radiation Areas, March 18, 1996
- Guidelines for Preparation of Experiment Proposals
- Guidelines for Preparing an Experimental Control Procedures Summary
- Irradiation Request/Proposal File
- BT-4/FANS Experiment Control Procedures Summary
- Experimental Proposal 447: Experimental Proposal for Grating Phase Imaging at the NG-7 Neutron Interferometer and Optics Facility, Memo from D. Gilliam, NIST SEC Chairman, to P. Gallagher, NIST Director, January 8, 2008

b. Observations and Findings

Refer to the previous section, Review and Audit and Design Change Functions, for relevant information regarding the review process for experiments.

The licensee reported that the number of experiments done in the reactor had substantially decreased in number, especially those placed directly in thimbles in the reactor core. Pneumatic samples were the primary form of in-reactor experiments. Compliance with TS 4.0 consisted of limits being prescribed during the Irradiations Subcommittee review process. Limits were transferred to the Operations group in the form of a maximum irradiation time, reactor power level, and sample mass for each irradiation position and approved sample material. The inspectors observed a control room operator receiving a pneumatic sample for irradiation on April 16, 2008, and verifying that the irradiation request was within the established limits.

The inspectors noted record of an incident involving a violation of safety procedures by an experimenter. Contrary to procedures, a staff member familiar with neutron beam facilities began to remove an instrument from the beam without closing the beam. He immediately realized his error, stepped out of the area, and reported the incident. The estimated time that his hands were in the beam constituted an unplanned exposure of 40 millirem. Senior management met with the individual to stress the safety significance of this incident. All beam supervisors were reminded of their safety training responsibilities.

The licensee reported that the majority of new experimental activity had recently shifted to beam experiments. The inspectors reviewed a number of documents listed above; guidance for experimenters, analysis by experimenters, and review by oversight committees. In particular, the inspectors verified that in Experimental Proposal 447 the author addressed exposure to the beam, radiation levels in the vicinity, sample activation, fire and emergency issues, and emergency procedures.

c. Conclusions

The inspectors concluded that a functional infrastructure existed to verify compliance with the requirements placed on experiments by Technical Specification 4.0.

**4. Procedures**

a. Inspection Scope (IP 69008)

The inspectors reviewed the following to ensure that the requirements of TS Section 7.4, Procedures, were being met concerning procedures:

- Reference Procedures for the NBSR Manual
- Tech Spec Procedures Manual
- Administrative Rules (AR) for the NBSR Manual
- AR 5.0, Procedures and Manuals, Issued July 15, 2004
- AR 15.0, Temporary/Minor Changes, Issued July 15, 2004
- Annunciator Procedure (AP) Manual
- Procedure AP – Simplex – Fire, Issued April 25, 2005
- Operating and Refueling Procedures for the NBSR Manual
- Operating Instruction 6.3, Operation of the Spent Fuel Cutting Saw, Issued April 23, 1999
- Reactor Area Inspection Log (Record sheet for logging readings taking and observations made during shift rounds)
- Reactor Control Room Log (Record sheet for logging hourly readings of approximately 60 parameters)

b. Observations and Findings

The inspectors reviewed the licensee's process for developing, approving, and maintaining written procedures, finding that written procedures were maintained for each of the categories stipulated in TS Section 7.4, Procedures. New procedures and significant changes to existing procedures were observed to have been reviewed by the SEC in accordance with Procedure AR 5.0, Procedures and Manuals, and TS 7.4.

Modifications to existing procedures that did not significantly change the original intent of procedures were found to have been issued by the Chief of Reactor Operations in accordance with AR 5.0 and TS 7.4. The inspectors concurred that the changes they reviewed were minor and that the intent of the procedure was not changed. The inspectors verified that the Annunciator Procedure for response to a fire alarm was updated in a timely manner following a recent facility change; a March 18, 2008, pen and ink change was made by the Chief of Reactor Operations.

c. Conclusions

Written procedures were being maintained in accordance with Technical Specification requirements.

**5. Surveillance**

a. Inspection Scope (IP 69010)

The inspectors reviewed the following to ensure that the requirements of TS Section 5.0, Surveillance Standards, were being met concerning surveillances:

- Surveillance Master List, April 2008
- Technical Specification Procedures (TSP), specifically TSP 5.3.1, TSP 5.4.1, and TSP 5.4.2
- Reactor Console Logbook # 127, April 30, 2007 to March 5, 2008
- Reactor Console Logbook # 128, March 6, 2008 to April 17, 2008

b. Observations and Findings

The inspectors verified that surveillances were performed in accordance with the requirements in the TS; technical specification required surveillance procedures could be used to perform their intended function; parameters identified in the TS (e.g., limiting conditions of operation), were maintained within the bounds assumed in the TS or the safety analysis report; the records and logs were consistent with the results of the TS required surveillance records.

To provide an acceptable sample determination, the inspectors conducted a random sample of three surveillances, where TSP 5.4.1 and TSP 5.4.2 in particular had been cross referenced on two different dates to ascertain consistency.

	<b>TSP 5.4.1</b>	<b>TSP 5.4.2</b>	<b>Console Logs</b>
Date Performed	12/10/2007	12/10/2007	127
Date Performed	4/5/2008	4/5/2008	128

c. Conclusions

Surveillance practices were being maintained in accordance with Technical Specification requirements.

## 6. Fuel Movement

### a. Inspection Scope (IP 69009)

The following documents were reviewed to verify safe handling, storage, inspection, and use of reactor fuel elements in compliance with TS Sections 3.7, Fuel Handling and Storage, 3.8, Fuel Handling Within the Reactor Vessel, and 7.4 (6), [Procedures for] handling of irradiated and unirradiated fuel elements:

- Operating and Refueling Procedures for the NBSR
- Operating Instruction OI 6.1, Fueling and Defueling Procedures, Issued December 15, 2006
- Core Loading and D<sub>2</sub>O Samples Manual
- Core Loading 582 Performed December 18, 2007 (Approved December 18, 2007)
- Core Loading 583 Performed February 19, 2008 (Approved February 8, 2008)
- Health Physics Survey Record of New Fuel Receipt
- Transportation Quality Assurance Inspection of New Fuel Receipt
- Operations Checklist for New Fuel Receipt
- Reactor Console Logbook # 127, April 30, 2007 to March 5, 2008
- Reactor Console Logbook # 128, March 6, 2008 to April 17, 2008

### b. Observations and Findings

The inspectors reviewed the core loading designs and fuel handling records for the previous year. They also reviewed the procedures governing fuel handling activities. The procedures reviewed were found to meet the requirements of the TS cited above. The fuel handling records reviewed indicated that the written procedures were followed.

New fuel arrived during the inspection, allowing the inspectors to observe implementation of fuel receipt procedures and integration of activities by responsible personnel. Site security personnel managed custody of the shipment from the time of arrival of the delivery vehicle until fuel elements were removed from shipping containers and properly secured in the facility. Health physics personnel reviewed the shipping papers and surveyed the vehicle and shipping container for direct radiation and radioactive contamination. Transportation quality assurance personnel verified that packaging requirements and security seals were in order. Operations personnel removed the fuel from the shipping containers, performed a receipt inspection, placed the elements in storage, and initiated special nuclear material accountability activities. Personnel appeared knowledgeable of their roles and functions. While hold points were incorporated in the procedures (e.g., for counting smear samples), minimal time elapsed during the evolution; security was provided at all times.

### c. Conclusions

The license maintained and followed procedures which effectively implemented Technical Specification requirements for fuel handling.

## 7. Operator Licensing, Requalification, and Medical Activities

### a. Inspection Scope (IP 69003)

The following documents were review to verify that the licensee was in compliance with the facility requalification program and 10 CFR Part 55:

- Reactor Operator Requalification Program for NBSR, Rev. 2, April 24, 1975
- Operator License Requalification Files
- Operator Evaluations, December 2007
- NBSR Requalification Examinations, January to March 2008
- Requalification Program Document Review and Reactivity Changes
- Medical History and Examination Files

### b. Observations and Findings

The inspectors reviewed the operator requalification program, particularly the individual operator history files, operator evaluations performed in late 2007, and the operator examination given in early 2008. Files for operators were selected at random, one for an operator with a long tenure and another for a recently qualified operator, and examined in depth. Medical examiners used ANS/ANSI 15.4-2004, Selection and Training for Research Reactor Personnel, as a basis for their evaluations. Records indicated that each operator reviewed key procedures and additional information specified by the requalification program. The consultant who prepared the written examination and was coordinating the training of newly hired reactor operator trainees met with the inspectors. The inspectors considered the written examination to be of similar difficulty to an NRC-administered examination.

### c. Conclusions

The licensee was conducting the reactor operator requalification program in accordance with procedural and regulatory requirements.

## 8. Emergency Preparedness

### a. Inspection Scope (IP 69011)

The inspectors reviewed the following to determine if the licensee's emergency preparedness program was maintained in a state of operational readiness since the last inspection and to determine if the licensee's emergency preparedness program and changes to the program met 10 CFR Part 50.54(q) regulatory requirements and the licensee's commitments:

- NSBR Emergency Plan, September 30, 1982
- NBSR Emergency Instructions, December 20, 2000
- Reactor Area Inspection Log, Rev. July, 2006

b. Observations and Findings

The inspectors determined if revisions to the Emergency Plan (EP) and implementing procedures were made in accordance with 10 CFR Part 50.54(q) and the licensee's administrative controls; if implementing procedures were consistent with the EP requirements; through a reactor area inspection tour with facility staff, that key emergency response facilities, instrumentation, and supplies were readily available and maintained as required by the EP; that the licensee's key emergency response personnel could adequately implement the EP and implementing procedures; that agreements for assistance from offsite organizations were understood and could provide the needed support in an emergency as specified by the EP; if emergency alarms were operable and maintained by procedures; if the licensee conducted exercises, drills, and training as required by the EP.

c. Conclusions

Emergency preparedness practices were being maintained in accordance with regulatory requirements and the licensee's commitments.

**9. Exit Interview**

The inspection scope and results were summarized on April 18, 2008, with members of licensee management. The inspectors described the areas inspected and discussed the inspection findings. No dissenting comments were received from the licensee.

## **PARTIAL LIST OF PERSONS CONTACTED**

### **Licensee**

P. Brand, Chief of Reactor Engineering  
D. Brown, Senior Health Physicist and Irradiation Subcommittee Chairman  
R.G. Downing, Beam Experiment Subcommittee Chairman  
C. Drewry, Quality Assurance Engineer  
W. Eresian, Consultant for Reactor Operator Training  
P. Gallagher, Director, Center for Neutron Research  
T. Myers, Chief, Reactor Operations  
T. Raby, Retired Chief of Operations and Engineering  
W. Richards, Chief of Operations and Engineering  
S. Weiss, Consultant (Retired Chief of Operations and Engineering)

## **INSPECTION PROCEDURES USED**

IP 69003	Class 1 Research and Test Reactor Operator Licenses, Requalification, and Medical Examinations
IP 69005	Class 1 Research and Test Reactor Experiments
IP 69006	Class 1 Research and Test Reactors Organization and Operations and Maintenance Activities
IP 69007	Class 1 Research and Test Reactor Review and Audit and Design Change Functions
IP 69008	Class 1 Research and Test Reactor Procedures
IP 69009	Class 1 Research and Test Reactor Fuel Movement
IP 69010	Class 1 Research and Test Reactor Surveillance
IP 69011	Class 1 Research and Test Reactor Emergency Preparedness

## **ITEMS OPENED, CLOSED, AND DISCUSSED**

### **Opened**

None

### **Discussed**

None

### **Closed**

None

## **LIST OF ACRONYMS USED**

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ADAMS	Agencywide Document Access Management System

AP	Annunciator Procedure
AR	Administrative Rules
CFR	<i>Code of Federal Regulations</i>
ECN	Engineering Change Notice
EP	Emergency Plan
IP	Inspection Procedure
NBSR	National Bureau of Standards Reactor
NCNR	NIST Center for Neutron Research
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
PARS	Publicly Available Records
Rev.	Revision
SAC	Safety Audit Committee
SEC	Safety Evaluation Committee
TSP	Technical Specification Procedure
TS	Technical Specification