

October 16, 2007

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. 50-184/2007-203

Dear Dr. Gallagher:

This letter refers to the inspection conducted on September 26 to 28, 2007, 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 with 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 document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

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

Sincerely,

**/RA/**

Johnny H. Eads, Branch 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. 50-184/2007-203

cc w/enclosure:  
Please see next page

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

Docket No.: 50-184

License No.: TR-5

Report No.: 50-184/2007-203

Licensee: National Institute of Standards and Technology (NIST)

Facility: National Bureau of Standards Reactor (NSBR)

Location: Gaithersburg, Maryland

Dates: September 26 to 28, 2007

Inspector: Marcus H. Voth

Approved by: Johnny H. Eads, Branch 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 (NIST)  
National Bureau of Standards Reactor (NBSR)  
NRC Inspection Report No.: 50-184/2007-203

The primary focus of this routine, announced inspection was the onsite review of selected aspects and activities at the NIST Center for Neutron Research related to operation of the 20 Megawatt Class 1 test reactor. It included a review of the licensee's safety programs including: organization and operation and maintenance activities; review and audit and design change functions; procedures; radiation protection; effluent and environmental monitoring; and transportation activities. The licensee's programs were found to be acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

### Organization and Operations and Maintenance Activities

- The licensee's organization and the conduct of operations and maintenance remained in compliance with the Technical Specifications

### Review and Audit and Design Change Functions

- The licensee was in compliance with the Technical Specification requirements for review and audit oversight. Changes to the facility were being done in accordance with the applicable regulations.

### Procedures

- The licensee had prepared and maintained procedures that met the Technical Specification requirements.

### Radiation Protection

- Radiation protection practices were found to be in compliance with regulatory requirements and in accordance with ALARA practices as verified by low radiation readings on both area surveillance monitors and personnel dosimetry.

### Effluent and Environmental Monitoring

- Effluent monitoring verified that releases were in compliance with license and regulatory requirements. Environmental monitoring was performed in accordance with Technical Specification requirements; no adverse environmental impact was observed.

### Transportation Activities

- Radioactive material was shipped for offsite disposal in licensed disposal facilities pursuant to procedures and regulatory requirements.

## REPORT DETAILS

### Summary of Facility Status

The licensee's National Institute of Standards and Technology (NIST) Center for Neutron Research (NCNR) 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 basis.

#### 1. Organization and Operations and Maintenance Activities

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

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

- organizational structure
- Reactor Console Logbook #124, February 13, 2007 to May 19, 2007
- Reactor Console Logbook #125, May 19, 2007 to August 21, 2007
- Reactor Shift Supervisor Logbook #33, April 6, 2006 to April 30, 2007
- Reactor Shift Supervisor Logbook #34, April 30, 2007 to September 28, 2007
- Surveillance Test [and Preventative Maintenance] Master List, April 2007 to September 2007
- Administrative Rule AR2.0, "Personnel Requirements," issued April 30, 1998

##### b. Observations and Findings

Through discussions with licensee representatives, the inspector determined that management responsibilities and the organization at the facility had not changed since the previous NRC inspection. However, in anticipation of retirements among the licensed reactor operators, the licensee had recently hired two new reactor operator trainees and a part time consultant tasked with operator training.

The inspector observed the conduct of operations in the control room and records of past responses to alarms, some requiring equipment removed from service for repair. He also reviewed records of the shutdown, refueling and startup of May 27 to June 8, 2007. In all cases actions recorded were considered appropriate and in accordance with the TS requirements.

With respect to facility staffing, the inspector determined, after reviewing operating records and logs and discussing facility operations with licensee personnel, that the staffing at the facility was acceptable to support the ongoing activities. The staffing met the requirements specified in the TS Section 7.1 and Administrative Rule AR2.0. The inspector verified that the name of the Health

Physicist on duty after hours was posted in the control in accordance with Section I.B of AR2.0.

c. Conclusions

The licensee's organization and the conduct of operations and maintenance remained in compliance with the Technical Specifications.

## 2. Review and Audit and Design Change

a. Inspection Scope (IP 69007)

The inspector reviewed selected portions of the following records and met with NCNR management and the Chairman of the Safety Evaluation Committee (SEC) to ensure that the requirements of TS Sections 7.2, Safety Evaluation Committee, and 7.3, Safety Audit Committee, and NRC regulation 10 CFR 50.59 were being met:

- NCNR SEC Minutes, Meeting #362 (April 26, 2007), June 6, 2007 draft (Approved June 18, 2007)
- NCNR SEC Minutes, Meeting #363 (June 19 and 21, 2007), July 5, 2007 draft (Approved July 6, 2007)
- Engineering Change Request (ECR) file, ECR #480 to #526, May 5, 2006 to June 27, 2007
- ECR # 488, "Fuel Element Head Installation Procedure (ES-6B), [new [procedure]", April 17, 2006
- ECR # 497, "Clarification of NSBR Fuel Element Manufacturing Process," October 16, 2006
- ECR # 518, "Fuel Element Head Installation Procedure ES-6B, Rev. 2," February 26, 2007
- ECR # 527, "A Second Cold Neutron Source at BT-9," July 24, 2007
- NBSR-0007-DOC-01, Engineering Manual, Rev. 1, July 2006
- NBSR-0001-DOC-01, NBSR Reactor Engineering Document Control Plan, July 2006
- NBSR-0002-DOC-01, "Quality Assurance Program for Modifications to the NBSR Reactor," July 2006
- NBSR-0003-DOC-01, Guidelines for Completing Engineering Change Notices, May 2006

b. Observations and Findings

The SEC met the meeting quorum and frequency requirements of TS 7.2 with substantial margin. Another full SEC meeting was scheduled to discuss whether there should be conditions on adoption of Rabbit Tube 4 experiment approvals in Tube 2.

The report of the last annual Safety Audit Committee (SAC) was performed at a previous NRC inspection. It was reported that a fourth member has been appointed to the SAC, Dr. K. Rogers.

Design changes were reviewed and found to be in compliance with 10 CFR 50.59. The inspector reviewed ECR #527, "A Second Cold Neutron Source at BT-9," in detail. While the change did not require a full safety evaluation because it fell under the umbrella on the existing cold neutron source, the licensee treated it conservatively and did prepare a complete safety evaluation. The inspector agreed with the conclusions of the ECRs referenced above.

The inspector also reviewed selected recent engineering procedures and procedure revisions that control the change process and document changes; he found these instructions to support regulatory compliance.

c. **Conclusions**

The licensee was in compliance with the TS requirements for review and audit oversight. Changes to the facility were being done in accordance with the applicable regulations.

**3. Procedures**

a. **Inspection Scope (IP 69008)**

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

- Administrative Rules (AR)
- Operating Instructions (OI)
- Annunciator Procedures (AP)
- Emergency Instructions (EI)
- Health Physics Procedures (HP)
- TS Procedures

b. **Observations and Findings**

The inspector determined that the licensee's written procedures met the requirements of TS 7.4, Procedures. This TS required that procedures be provided and utilized in six topical areas. The licensee had developed a series of procedures meeting these requirements along with administrative requirements for the creation, maintenance, updating, and proper use of procedures. The inspector found that the system of procedures addressed those TS requirements.

c. **Conclusions**

The licensee had prepared and maintained procedures that met the TS requirements.



#### 4. Radiation Protection

##### a. Inspection Scope (IP 69012)

The inspector toured the facility and also reviewed the following to verify compliance with 10 CFR Part 20 and TS Sections 7.1, Organization, requirements:

- TLD Monitoring Records, January 1, 1998 to present
- Personnel Dosimetry Summary for 2007, First Quarter

##### b. Observations and Findings

The inspector focused his investigation in three areas. Primarily, the inspection consisted of observations of the facility, equipment, procedure implementation, as low as reasonably achievable (ALARA) practices, radiation postings, and radiological housekeeping. The effectiveness of these observed practices was then verified through records of radiation monitors mounted throughout the facility and personnel dosimetry.

The inspector made an extensive tour of the facility with a Health Physicist (HP) on his daily rounds, describing work practices and responding to the inspector's questions throughout the tour. Effective use of friskers and hand and foot monitors was observed. The inspector randomly checked calibration stickers on devices and found them all current. Contaminated areas were maintained at a minimum but where appropriate, protective clothing was worn. Experimenters and reactor operators had ready access to radiation detectors for their own use and to HPs for consultation, resulting in good ALARA practices throughout the facility and in particular at experimenter's stations. Posting of radiation areas, radioactive materials, and other signage was found to be appropriate. The inspector concluded that good radiation protection practices were in effect.

The licensee maintained thermoluminescent dosimeters (TLDs) throughout the reactor and guide hall. Readings from those dosimeters, prior to subtracting background, were below 300 millirem per quarter in all cases; areas with frequent occupancy were below 100. Personnel dosimetry readings were likewise very low. Results for the first quarter of 2007 for all monitored personnel and for reactor personnel only, after subtracting background, were as follows:

<u>Range (millirem )</u>	<u>All Personnel</u>	<u>Reactor Personnel</u>
0	351	1
1 to 49	200	15
50 to 99	7	6
>99	0	0

##### c. Conclusions

Radiation protection practices were found to be in compliance with regulatory requirements and in accordance with ALARA practices as verified by low radiation readings on both area surveillance monitors and personnel dosimetry.

## 5. Effluent and Environmental Monitoring

### a. Inspection Scope (IP 69004)

The inspector witnessed effluent processing operations and reviewed the following to verify compliance with the requirements of 10 CFR Part 20 and TS Section 5.9, Environmental Monitoring:

- Gamma Tracer Data Files, Locations 1-16, January 1, 2005 to present
- TLD Results for Environmental Stations, Quarterly Reports 1997 to present
- Sanitary Sewerage Releases, 2006 and 2007
- Gaseous Effluent Analysis File
- Stack Charcoal Filter Analysis Data Files, 2006 and 2007
- Report on Compliance with the Clean Air Act for Radionuclide Emissions from the COMPLY Code – VI.6, by D. Brown, January 13, 2006
- Report on Compliance with the Clean Air Act for Radionuclide Emissions from the COMPLY Code – VI.6, by D. Brown, January 29, 2007
- Environmental Analysis Files for 2006 and 2007

### b. Observation and Findings

The licensee monitored both quarterly doses and continuous dose rates at the facility fence line for each of the 16 nominal sectors. The inspector viewed some of the monitoring devices. Doses were recorded on TLDs; dose rates were recorded continuously and down-loaded as monthly plots of daily average readings. The data indicated doses of 20 to 25 millirem per quarter, approximately equal to the natural background dose for that area. Ten additional TLDs monitored other NIST buildings and public areas, giving similar indications. The licensee also collected and analyzed water and vegetation samples from the environment surrounding the facility in compliance with TS 5.9. There were no indications of radioactivity from the licensee's operation adversely impacting the environment.

Liquid waste from reactor drains, primarily humidity removed from environmental air supplied for ventilation, was collected in tanks for batch release after sampling and analysis. The inspector observed the isolation of a tank and initiation of agitation in preparation for drawing a uniform sample. Release concentrations were below 10 CFR Part 20 limits, measured prior to dilution by a factor of 120 with other site effluents. The most limiting liquid effluent was tritium with a year-to-date release of 0.55 Curie relative to a Part 20 annual limit of 5.0 Curies.

The licensee reported two predominant gaseous releases, Argon-41 and Tritium H-3. The Ar-41 was monitored continuously at the exhaust stack while H-3 was collected in a cold trap and measured in an alpha/beta counter. A charcoal filter through which an exhaust gas sample passed was routinely analyzed for other effluents but nothing else of significance was identified. The COMPLY computer

code was used at level four to determine the maximum dose to the public. For 2006, effluents of 547 Curies of H-3 and 1220 Curies of Ar-41 were calculated to result in a dose of 0.8 millirem to the hypothetical maximally exposed member of the public relative to an annual limit of 100 millirem.

The inspector observed two forms of solid waste being processed. Some very slightly contaminated soil and concrete rubble was being trucked to a licensed disposal site and drums of routine low level waste were being characterized and packaged. In addition, records of solid waste shipments to licensed disposal facilities were reviewed. Discussion of the transportation of solid waste can be found in the next section of this report.

c. **Conclusions**

Effluent monitoring verified that releases were in compliance with license and regulatory requirements. Environmental monitoring was performed in accordance with TS requirements; no adverse environmental impact was observed.

## **6. Transportation**

a. **Inspection Scope (IP 86740)**

The inspector reviewed the following to verify compliance with regulatory and procedural requirements for transferring licensed material:

- Waste Characterization and Shipment Files for 2006 and 2007

b. **Observations and Findings**

Through records reviews and the discussions with licensee personnel, the inspector determined that the licensee shipped three forms of solid radioactive waste for offsite disposal. In late 2006 eight shipments of shield pieces from retired experimental configurations were disposed as Low Specific Activity group I (LSA-I) waste. In mid-2007 a single shipment of drums containing resins and filters was disposed as LSA-II waste. The inspector observed a campaign of concrete rubble shipments in progress. Records of all shipments were in order.

c. **Conclusions**

Radioactive material was shipped for offsite disposal in licensed disposal facilities pursuant to procedures and regulatory requirements.

## **7. Exit Interview**

The inspection scope and results were summarized on September 28, 2007, with members of licensee management. The inspector described the areas inspected and discussed in detail the inspection findings. The licensee did not state any dissenting opinions nor identify any information considered proprietary.

## **PARTIAL LIST OF PERSONS CONTACTED**

Licensee:

P. Brand, Chief of Reactor Engineering  
D. Brown, Senior Health Physicist and Irradiation Subcommittee Chairman  
J. Clark, Health Physicist  
K. Consani, Health Physicist  
P. Gallagher, Director, Center for Neutron Research  
D. Gilliam, Chairman of the Safety Evaluation Committee  
T. Myers, Chief, Reactor Operations  
W. Richards, Chief of Operations and Engineering  
M. Rowe, Consultant (Retired Director)  
F. Scarano, Health Physics Technician  
J. Tracy, Health Physicist  
S. Weiss, Consultant (Retired Chief of Operations and Engineering)

## **INSPECTION PROCEDURES USED**

IP 69004 Class 1 Research and Test Reactor Effluent and Environmental Monitoring  
IP 69006 Class 1 Research and Test Reactors Organization, Operations, and Maintenance Activities  
IP 69007 Class 1 Research and Test Reactors Review and Audit and Design Change Functions  
IP 69008 Class 1 Research and Test Reactor Procedures  
IP 69012 Class 1 Research and Test Reactor Radiation Protection  
IP 86740 Inspection of Transportation Activities

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

Opened

None

Closed

None

Discussed

None

## **LIST OF ACRONYMS USED**

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ALARA	As low as reasonably achievable
AP	Annunciator Procedure
AR	Administrative Rules

CFR	<i>Code of Federal Regulations</i>
ECR	Engineering Change Request
HP	Health Physics/Physicist
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
OI	Operating Instruction
Rev.	Revision
SAC	Safety Audit Committee
SEC	Safety Evaluation Committee
TLD	Thermoluminescent Dosimeter
TS	Technical Specification