

May 5, 2011

Colonel Mark A. Melanson, Director
Armed Forces Radiobiology
Research Institute
National Naval Medical Center
8901 Wisconsin Avenue
Bethesda, MD 20889-5603

SUBJECT: ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE - NRC ROUTINE,
ANNOUNCED INSPECTION REPORT NO. 50-170/2011-201

Dear Colonel Melanson:

On April 11-14, 2011, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted an inspection at the Armed Forces Radiobiology Research Institute. The inspection included a review of activities authorized for your facility. The enclosed report documents the inspection results, which were discussed on April 14, 2011, with members of your staff.

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.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 2.390 "Public inspections, Exemptions, Request for withholding" a copy of this letter and its enclosure will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Document Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>.

Should you have any questions concerning this inspection, please contact Gregory M. Schoenebeck at 301-415-6345.

Sincerely,
/RA/

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

Docket No. 50-170
License No. R-84

Enclosure: NRC Inspection Report No. 50-170/2011-201
cc w/encl: See next page

Armed Forces Radiobiology Research

Docket No. 50-170

cc:

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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

Docket No: 50-170

License No: R-84

Report No: 50-170/2011-201

Licensee: Armed Forces Radiobiology Research Institute

Facility: AFRRRI Reactor Facility

Location: Bethesda, MD

Dates: April 11-14, 2011

Inspectors: Greg Schoenebeck
Patrick J. Isaac

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

EXECUTIVE SUMMARY

Armed Forces Radiobiology Research Institute
AFRRI Research Reactor Facility
NRC Inspection Report No. 50-170/2011-201

The primary focus of this routine, announced inspection included the onsite review of selected aspects of the Armed Forces Radiobiology Research Institute (AFRRI, the licensee's) Class II research reactor facility safety programs including organization and staffing; operations logs and records; requalification training; surveillance and limiting conditions for operation; emergency planning; maintenance logs and records; fuel handling logs and records. The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

Organization and Staffing

- The licensee's organization and staffing was in compliance with the requirements specified in the Technical Specifications (TS) Section 6.0.

Operations Logs and Records

- Operational activities were consistent with applicable TS and procedural requirements.

Requalification Training

- Operator requalification was up-to-date and was being performed as required by the AFRRI Reactor Operator Requalification Program.

Surveillance and Limiting Conditions for Operation

- The program for Surveillance and limiting condition for operation confirmation was implemented in accordance with TS Sections 3.0 and 4.0 requirements.

Emergency Planning

- The emergency preparedness program was conducted in accordance with the Emergency Plan.

Maintenance Logs and Records

- Maintenance activities ensured that equipment remained consistent with the Safety Analysis Report and TS requirements.

Fuel Handling Logs and Records

- Fuel handling and inspection activities were completed and documented as required by TS and facility procedures.

REPORT DETAILS

Summary of Facility Status

The Armed Forces Radiobiology Research Institute (AFRRI, the licensee's) one megawatt Training Research Isotope Production General Atomics (TRIGA) Mark II research reactor located on the campus of the National Naval Medical Center (NNMC) operated in support of the Institute's mission of research, experiments, education, reactor operator training and periodic equipment surveillance immediately prior to the inspection. During the inspection the reactor was maintained in a shutdown status for transient rod inspection and repair activity.

1. Organization and Staffing

a. Inspection Scope (IP 69001)

To verify that the licensee's organization and staffing were as stated in Section 6.1 of the AFRRI Technical Specifications (TS), Amendment No. 24 to License No. R-84 dated September 18, 2001, the inspectors reviewed:

- Organizational structure
- Management responsibilities
- Staffing requirements for safe operation of the research reactor facility
- Reactor Logbook Number 133, February 24, 2010 to November 30, 2010
- Reactor Logbook Number 134, November 30, 2010 to present

b. Observations and Findings

The structure and functions of the licensee's organization at the AFRRI facility had not functionally changed since the last U. S. Nuclear Regulatory Commission (NRC) inspection. The licensee's current organizational structure and assignment responsibilities were consistent with those specified in the TS Section 6.1. All positions reviewed were filled with qualified personnel. Review of records verified that management responsibilities were generally administered as required by TS Section 6.1.2 and applicable procedures. The inspectors determined from the reactor console logbook that minimum staffing and on-call requirements were in compliance with TS Section 6.1.3.2, Operations.

c. Conclusion

The licensee's organization and staffing was in compliance with the requirements specified in the TS Section 6.0.

2. Operations Logs and Records

a. Inspection Scope (IP 69001)

The inspectors reviewed selected aspects of the following to verify compliance with TS Sections 2, 3, and 6 and applicable procedure requirements for operation:

- AFRRRI Reactor Monthly Usage Summary, January 2011 to present
- Reactor Logbook Number 133, February 24, 2010 to November 30, 2010
- Reactor Logbook Number 134, November 30, 2010 to present
- AFRRRI Operational Procedure 8, Reactor Operations, Rev. dated May 1, 1998
- AFRRRI Operational Procedure 8, TAB A, Logbook Entry Checklist, Rev. dated February 26, 2001
- AFRRRI Operational Procedure 8, TAB B, Daily Operational Startup Checklist, Rev. dated September 11, 2009
- AFRRRI Operational Procedure 8, TAB G1, Pulse Operation (Critical), Rev. dated March 16, 1998
- Weekly Operational Instrument Checklist, January 14, 2011 to April 7, 2011
- Minutes of the Reactor and Radiation Facilities Safety Subcommittee Meeting, dated August 5, 2010
- AFRRRI 2010 Annual Report, dated March 30, 2011

b. Observations and Findings

The operating logs and records were well maintained and provided a clear indication of operational activities, changes in reactivity, and maintenance actions or malfunctions that had occurred. The logs and records indicated that shift staffing, including on-call personnel, was as required by TS 6.1.3.2. Logs and records also showed that operational conditions and parameters were consistent with license and TS requirements. Information on the operational status of the facility was recorded in log books and on checklists as required by procedure. Operational problems and events noted in the logs were reported, reviewed, and resolved as required. Operations logs and records also documented that shift staffing met the minimum requirements.

c. Conclusion

Operational activities were consistent with applicable TS and procedural requirements.

3. **Requalification Training**

a. Inspection Scope (IP 69001)

To verify that the licensee was complying with the requirements of the operator requalification program, the inspectors reviewed selected aspects of:

- Reactor Operator Requalification Program for the Armed Forces Radiobiology Research Institute TRIGA Reactor Facility, revised June 27, 2001
- Effective dates of current operator licenses
- Operator training records maintained on "Requalification Program Checklist" forms in individual folders for each operator
- Medical examination records for the past two years
- Operator Requalification Training Classes for 2010
- Operator Requalification Training Classes for 2011
- 2010 Facility Practical Exam, administered January 2011

b. Observations and Findings

There were five NRC licensed Senior Reactor Operators (SROs) on staff at the facility. As of the date of the inspection, all the operators' licenses were current. All operators were enrolled in the licensee's NRC-approved requalification and training program and had completed a minimum of four hours of shift functions per quarter. The inspectors noted that operators were receiving the required biennial medical examinations.

A review of the logs and records showed that training was being conducted in accordance with the program. Requalification program data such as attendance at training sessions and completion of written examinations and operation tests was documented as required. As of the date of this inspection, the required biennial written examination for this training cycle was not yet administered. The inspectors noted that the last written examination was administered in December 2009. Records of quarterly reactor operations, reactivity manipulations, and other operations activities were being maintained.

c. Conclusion

Operator requalification was up-to-date and was being performed as required by the AFRRRI Reactor Operator Requalification Program.

4. Surveillance and Limiting Conditions for Operation

a. Inspection Scope (IP 69001)

To determine that surveillances and Limiting Conditions for Operations (LCOs) verifications were being completed as required by TS Sections 3.0 and 4.0, the inspectors reviewed:

- TS for the AFRRRI Reactor Facility, dated June 27, 2001
- 2010 Annual Operating Report for the AFRRRI
- The AFRRRI Malfunction Log from April 22, 2008 to present
- Reactor Logbook Number 133, February 24, 2010 to November 30, 2010
- Reactor Logbook Number 134, November 30, 2010 to present
- Daily Operational Startup/Shutdown Checklist, various 2011
- Calibration Procedures for the AFRRRI Reactor Facility
- Maintenance Procedures for the AFRRRI Reactor Facility
- TRIGA Tracker Report

b. Observations and Findings

Daily, weekly, monthly, quarterly, semi-annual, and other periodic checks, tests, and verifications for TS required LCOs were being completed as required. The inspectors performed a random sampling of the AFRRRI surveillance and verified that the annual reactor audit was performed in accordance with TS 6.2.5; Examination of Control Rods was performed in accordance with TS 4.1c and TS 4.2.5; Facility Interlock Checklist was performed in accordance with TS 4.2.4 and TS 3.2.3; Control Rod Drop Times were performed in accordance with TS 4.2.1 and 3.1.4; Inspection of Control Rod Connecting Pins was performed in accordance with internal requirements; Transient Rod Drive inspection was performed as required per TS 4.1d, and the Channel Test of RAM was performed in accordance with TS 4.5.

The inspectors reviewed operational logs and records and determined that the random sampling of said logs and records met the required LCOs.

The AFRRRI uses a computer database, the TRIGA Tracker Report, to track completion of the various required surveillance and LCO verifications. The database's spreadsheets denote the Task ID No. (e.g., surveillance, calibration, etc.), the task description, the requirement (e.g., TS, internal, etc.), the frequency (e.g., annual, quarterly, etc.), the due date, the date the task was last completed, and the date the task was completed. The inspectors performed a random sampling of the data base to ensure that there were no overdue requirements and cross-referenced the applicable TS to ensure all required surveillances were accounted for in the TRIGA Tracker Report; there were no issues noted.

c. Conclusion

The program for Surveillance and LCO confirmation was implemented in accordance with TS Sections 3.0 and 4.0 requirements.

5. Emergency Preparedness

a. Inspection Scope (IP 69001)

The inspectors reviewed the implementation of selected portions of the emergency preparedness program including:

- AFRRRI Emergency Plan, dated December 2003
- Emergency Response Guidebook, April 1996
- Emergency Response Team Files for 2010 and 2011
- AFRRRI Emergency Drill conducted on December 10, 2010
- AFRRRI Emergency Supplies

b. Observations and Findings

The inspectors reviewed the current Emergency Plan and the AFRRRI Reactor Emergency Response Guidebook which contains the specific implementing procedures for contending with emergency conditions at the facility. The AFRRRI Reactor Emergency Response Guidebook generally correlated the same guidance as the Emergency Plan. The inspectors noted that the telephone contact list in the Control Room is up to date and reviewed periodically in accordance with procedures.

The inspectors toured the Emergency Response Center (ERC) and the facility to inventory the emergency caches and ensure they have been inventoried as specified by the AFRRRI Reactor Emergency Guidebook. The ERC and emergency caches are adequately maintained and inventoried as required. The inspectors noted that the telephone contact lists in the ERC are consistent with the Control Room's copy.

The inspectors reviewed initial and the periodic retraining program for maintaining emergency preparedness. An initial emergency response training and periodic retraining program is conducted to maintain the ability of emergency response personnel to perform their assigned functions. AFRRRI reactor operators, Emergency Command Post and Emergency Response Team personnel, security detail, and off-site responders (e.g., fire department) have received and completed their periodic training as stipulated by the emergency plan.

The inspectors verified that inventories of emergency supplies were maintained per procedure and that radiation monitoring devices designated for emergency

use were available, functional, and within their calibration period. The inspectors interviewed the Health Physics Coordinator and he was knowledgeable of the emergency supply application during an event which necessitates Emergency Response Team activation.

The inspectors verified the completion of an annual drill. The drill was successfully completed without remedial actions as noted by the drill evaluator. The inspectors reviewed the Action List from previous Drills and noted that they were being tracked and closed out if able.

c. Conclusion

The emergency preparedness program was conducted in accordance with the Emergency Plan.

6. Maintenance Logs and Records

a. Inspection Scope (IP 69001)

To determine that maintenance was being completed as required by the TS and applicable procedures, the inspectors reviewed:

- AFRRRI Malfunction Log from April 22, 2008 to present
- Minutes of the Reactor and Radiation Facilities Safety Subcommittee Meeting, Dated December 14, 2010
- Reactor Logbook Number 133, February 24, 2010 to November 30, 2010
- Reactor Logbook Number 134, November 30, 2010 to present
- Daily Operational Startup Checklist, various
- Maintenance Procedures for the AFRRRI Reactor Facility
- TRIGA Tracker Report
- Annual Maintenance Report for Year 2008, dated January 9, 2009
- Annual Maintenance Report for Year 2009, dated January 6, 2010

b. Observations and Findings

The inspectors verified through records that annual, semi-annual, quarterly, and monthly requirements were performed on their respective frequency. Routine and preventive maintenance were well controlled and documented in the TRIGA Tracking system. Use of maintenance and malfunction logs satisfied procedural requirements. Much of the annual surveillances and supporting reactor component maintenance is performed during an annual outage; the last occurred on October 18th through November 5th 2010. The data collected from the maintenance is correlated into the Annual Shutdown Maintenance Checklist; any issues resulting from the outage is recorded in the Malfunction Log.

1. *Non-linearity of the Regulating Rod position indicator potentiometer*

On November 2, 2010, during the annual calibration of the regulating rod, it was determined that the incremental rod position indicator was non-linear from approximately 400-600 units of rod withdrawal; however the cumulative rod indicator for the regulating rod was correct. The reactor staff determined that regulating rod position was correct (i.e., had linearity) from 0-400 and from 600-995. Because the total rod worth could be measured, the shutdown margin and excess reactivity of the core were known, the staff determined that the core excess reactivity could not have exceeded the TS allowed limit, \$5.00. The inspectors verified that excess reactivity measurements had typically occurred within the 600-995 range. The regulating rod is not used in pulsing operations. The Reactor Facility Director was notified and all rod calibrations and other annual maintenance shutdown activities were suspended until repairs were completed. This issue was recorded in the Malfunction Log.

Solution:

The rod position indicator potentiometer was determined to be non-linear for two rotations of travel. The part was replaced, and the drive placed back in service. The rod curves were then completed and the reactor annual shutdown maintenance completed.

2. *Transient Rod Failure*

On April 6, 2011, the SRO on console attempted to withdrawal control rods to bring the reactor critical as part of ongoing maintenance activities. While attempting to withdraw the control rods, the operator observed the indicated power level was not increasing as expected; however the console display indicated that the rods were withdrawn. Reactor period and power did not correlate to the rod positions displayed on the console. Furthermore, fuel temperature indication and power indications showed power to be less than 1 Kilowatt (kW). The operator immediately scrammed the reactor and notified the Reactor Facility Director. When the reactor was scrammed, the compressed air to the transient rod was released, but the rod drive anvil did not drive down. This gave the operator a visual indication that the transient rod was not full reinserted in the core, even though all nuclear instrumentation indicated a shutdown reactor. Indicated power at that time was less than 10 milliwatt (mW).

Inspection of the top of the core revealed that the bottom of the connecting rod on the transient rod drive was wedged against the top of the transient rod guide tube, bowing the connecting rod. The top fitting of the transient rod itself was attached to the connecting rod, but the full transient rod was not visible. The facility suspects that the transient control rod remained in the core in the fail safe position (as designed), as supported by the highest attained reactor power level (i.e., 1 kW) during the evolution.

Solution:

The facility removed the transient rod from the guide tube and was placed in a sealed container in the reactor pool until radiation levels decay to a threshold which allows a detailed inspection (on the pool deck) which maintains As Low As Reasonably Achievable (ALARA) principles. Prior to transient rod removal, sufficient fuel was removed from the core to allow removal and inspection (via binoculars) of the transient rod while maintaining the minimum 50% required shutdown margin as denoted in TS. The facility intends to remain shutdown to support its investigation of the transient rod. The inspectors have opened an Inspector Follow-up Item (IFI) 50-170/2011-201-01 to track the maintenance activities regarding the transient rod issue.

c. Conclusion

Maintenance activities ensured that equipment remained consistent with the Safety Analysis Report and TS requirements.

7. Fuel Handling Logs and Records

a. Inspection Scope (IP 69001)

The inspectors reviewed the following to verify compliance with TS Section 6.3.f, [Procedures] Reactor core loading and unloading:

- AFRRRI Current Stainless Steel Clad Fuel Element Records
- Fuel Inventory Sheet
- AFRRRI Operational Procedure 7, Reactor Core Loading and Unloading, May 15, 1991
- Control Room Reactor Fuel Inventory Map
- Reactor Logbook Number 133, February 24, 2010 to November 30, 2010
- Reactor Logbook Number 134, November 30, 2010 to present

b. Observations and Findings

The AFRRRI maintains a fuel element record of all their elements. Information such as serial number, core position, and power history are maintained and tracked. The inspectors reviewed selected records for fuel movements conducted for the periodic surveillance measurements and inspection of the reactor fuel. For a random sample of elements, the inspectors verified that fuel moves and measurements were accurately recorded in each of the various records referenced above and that fuel locations were consistent with records. A written and properly approved procedure was used in the conduct of the fuel moves.

c. Conclusion

Fuel handling and inspection activities were completed and documented as required by TS and facility procedures.

8. Exit Interview

The inspectors presented the inspection results to licensee management at the conclusion of the inspection on April 14, 2011. The inspectors described the areas inspected and discussed in detail the inspection observations. No dissenting comments were received from the licensee. The licensee acknowledged the findings presented and did not identify as proprietary any of the material provided to or reviewed by the inspectors during the inspection.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Melanson, Colonel	Director, AFRRRI
S. Miller	Reactor Facility Director
H. Spence	Reactor Operations Supervisor
W. D. Tomlinson	Senior Reactor Operator

INSPECTION PROCEDURES USED

IP 69001	Class II Research and Test Reactors
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ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-170/2011-201-01	IFI- Track maintenance activities regarding the transient rod mechanical failure.
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Closed

None

Discussed

None

PARTIAL LIST OF ACRONYMS USED

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ADAMS	Agencywide Document Access and Management System
AFRRRI	Armed Forces Radiobiology Research Institute
ERC	Emergency Response Center
IFI	Inspector Follow-up Item
IP	Inspection Procedure
LCO	Limiting Condition for Operation
NRC	U. S. Nuclear Regulatory Commission
SRO	Senior Reactor Operator
TS	Technical Specifications
TRIGA	Training Research Isotope Production General Atomics