

March 10, 2011

Dr. Ayman I. Hawari, Director  
Nuclear Reactor Program  
Department of Nuclear Engineering  
North Carolina State University  
P. O. Box 7909  
Raleigh, NC 27695-7909

SUBJECT: NORTH CAROLINA STATE UNIVERSITY – NRC ANNOUNCED ROUTINE  
INSPECTION REPORT NO. 50-297/2011-201

Dear Dr. Hawari:

The U.S. Nuclear Regulatory Commission (NRC) conducted an inspection on February 7-10, 2011, at your North Carolina State University (Inspection Report No. 50-297/2011-201). 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 enclosed 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 requirements was identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390 "Public inspections, exemptions, and requests for withholding" 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 component of NRC's document system (Agencywide Document Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

Should you have any questions concerning this inspection, please contact Jack Donohue at 301-452-1950 or electronic mail at [Jack.Donohue@nrc.gov](mailto:Jack.Donohue@nrc.gov).

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. 50-297  
License No. R-120

Enclosure: As stated  
cc w/encl: See next page

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North Carolina State University

Docket No.: 50-297

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

Docket No: 50-297

License No: R-120

Report No: 50-297/2011-201

Licensee: North Carolina State University

Facility: PULSTAR Nuclear Reactor Facility

Location: Raleigh, NC

Dates: February 7 to 10, 2011

Inspector: Jack Donohue

Accompanied by: Johnny H. Eads, Jr., Chief

Foreign Assignee: Samina Kanwal

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

North Carolina State University  
PULSTAR Reactor Facility  
NRC Inspection Report No. 50-297/2011-201

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the North Carolina State University Class II research reactor facility safety programs including procedures; requalification training; surveillance and limited conditions for operation (LCO); design changes; committees, audits and reviews; emergency planning; maintenance logs and records; fuel handling logs and records; and follow up on previously identified items. The licensee's programs were acceptably directed toward the protection of public health and safety, and were in compliance with U. S. Nuclear Regulatory Commission (NRC) requirements

### Procedures

- Facility procedural review, revision, and implementation satisfied Technical Specification requirements.

### Requalification Training

- Operator requalification was conducted as required by the Requalification Program and Title 10 of the *Code of Federal Regulations* (10 CFR) Part 55.

### Surveillance and LCO

- LCO and surveillances required by Technical Specification were being properly implemented.

### Design Changes

- Changes at the facility were acceptably reviewed in accordance with 10 CFR 50.59 and applicable licensee administrative controls.

### Committees, Audits, and Reviews

- The Radiation Safety Committee and Reactor Safety and Audit Committee provided the oversight required by the Technical Specifications.

### Emergency Planning

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

Maintenance Logs and Records

- Maintenance was performed and logs and records maintained consistent with Technical Specification and licensee procedure requirements.

Fuel Handling Logs and Records

- Fuel handling logs or activities satisfied the Technical Specification requirements and facility procedural requirements.

Follow-up of Previously Identified Items

- Action items from the previous inspection and “14 Day Report” related to radiation control in HRA and unmonitored exposure was satisfactorily reviewed with the licensee.

## REPORT DETAILS

### Summary of Facility Status

The North Carolina State University (NCSU, the licensee) Nuclear Reactor Program (NRP) PULSTAR research reactor continued to be operated in support of graduate and undergraduate research and laboratory instruction, service irradiations, reactor operator training, and periodic surveillance. During the inspection, the reactor was operated in support of ongoing work and research

### 1. Procedures

#### a. Inspection Scope (IP 69001-02.03)

The inspector reviewed the following to ensure that the requirements of technical specification (TS) Section 6.4, Operating Procedures, were being met:

- PULSTAR Operations Manual, specifically procedures:
  - NRP-OP-101, Reactor Startup and Shutdown, Rev. 7, October 18, 2010
  - NRP-OP-103, Reactor Operations, Rev. 2, April 15, 2009, Appendix A Pulsar Operating parameters, April 15, 2009
  - NRP-OP-104, Reactor Experiments, Rev. 3, January 10, 2010
  - NRP-OP-105, Response to SCRAMS, Alarms and Abnormal Conditions, Rev. 4, January 7, 2011
  - NRP-OP-201, Primary Demineralizer, Rev 0, September 13, 2004
  - NRP-OP-202, Service Water, Rev 1, January 1, 2009
  - NRP-OP-301, Reactor Fuel Handling, Rev. 0, September 13, 2004
  - NRP-XP-102, Neutron Imaging Facility, Rev. 0, January 10, 2011
- Special Procedure Manual, specifically procedures:
  - SP 2.1, Review and Approval of Documents, Rev. 8, September 15, 2008
  - SP 2.6, Operator Requalification Program, Rev. 6, January 19, 1995
- PULSTAR Emergency Procedures, specifically procedures:
  - EP-1, Emergency Plan Activation, Response, and Actions, October 13, 2008
  - EP-4, Emergency Classification, October 13, 2004
- PULSTAR Nuclear Reactor Emergency Plan, September 19, 2008

b. Observations and Findings

The inspector observed that the licensee maintained written procedures covering the areas specified in TS Section 6.4. A systematic approach was being used to update and reissue procedures. New procedures and major changes were reviewed and approved by the Reactor Safety Audit Committee (RSAC) and the Radiation Safety Committee (RSC) in accordance with a written procedure on document control. Minor changes did not require committee approval but were reviewed by the committees; the reviews and approvals were documented in the minutes of the respective committee meetings.

c. Conclusions

The licensee was maintaining and implementing written procedures in accordance with TS requirements.

**2. Requalification Training**

a. Inspection Scope (Inspection Procedure (IP) 69001-02.04)

The inspector reviewed the following to verify that the requirements of 10 CFR Part 55, Operators' Licenses, and the licensee's Operator Requalification Program were being met:

- Requalification Written Examination administered October 28, 2010
- Special Procedure 2.6, PULSTAR Operator Requalification Program, January 19, 1995
- On-The-Job Training Log File, 2009 - 2010

b. Observations and Findings

The licensee's reactor operator staff consisted of five NRC licensed Senior Reactor Operators (SRO), all held by full time staff members, and six Reactor Operators (RO).

The licensee's requalification program included the regulatory requirement for an annual operating test and a biennial written examination. The inspectors verified that both examinations were administered at the specified frequency and that the level of difficulty was comparable to that of NRC-administered examinations.

The inspector reviewed the content of the written and oral examinations used for the 2009 - 2010 requalification cycle and found them adequate. The inspector selected two licensed SROs and two licensed ROs and reviewed their training and medical records in detail. The inspector reviewed documentation indicating that all operators had performed the required number of reactor manipulations at the frequency specified in the requalification program.



c. Conclusions

Operator requalification was conducted as required by the Requalification Program and NRC regulations.

**3. Surveillance and Limiting Conditions for Operation**

a. Inspection Scope (IP 69001-02.05)

The inspector reviewed the following to determine if limiting conditions for operation specified in TS Section 3.0 were being effectively implemented and if the periodic surveillance tests on safety systems were being performed in accordance with TS Section 4.0:

- Procedure NRP-OP-101, Reactor Startup and Shutdown, Appendix A, Startup Checklist, Rev. 7, October 18, 2010
- Procedure SP-2.5, PULSTAR Reactor Surveillance, Rev. 1, February 1, 1989
- NRP-SP-101, Appendix A, Controlled Access Area Lock-up Checklist, February 23, 2006
- PULSTAR Surveillance and Maintenance File
- PULSTAR 2010 and 2011 Surveillance Master Schedule
- NCSU PULSTAR Reactor Logbook, #5 dated April 8, 2009, thru March 29, 2010, and # 6 dated March 30, 2010, to present

b. Observations and Findings

Surveillances were completed on schedule and in accordance with licensee procedures. The protocols and techniques were effective in verifying the performance of the safety equipment. All the recorded results were within the TS and procedurally prescribed parameters. The records and logs were complete and were being maintained as required. Checks and calibrations were completed as required by TS.

c. Conclusions

The limiting conditions for operation and surveillances required by TS were being properly implemented.

**4. Design Changes**

a. Inspection Scope (IP 69001-02.08)

In order to verify that any modifications to the facility were consistent with 10 CFR 50.59, the inspector reviewed selected aspects of:

- SP 2.1, Review and Approval of Documents, September 15, 2008

- Neutron Imaging Facility Hydrogen and Oxygen Gas System, Memo dated September 19, 2008
- PULSTAR Reactor Annual Report For Period January 1, 2009, to December 31, 2009

b. Observations and Findings

Through review of applicable records and interviews with licensee personnel, the inspector determined that no changes requiring prior NRC approval had been initiated and/or completed at the facility since the last NRC operations inspection.

The following three changes were made during this period. A licensee review determined that a 10 CFR 50.59 evaluation was not required. A primary pump was replaced, a stack sample flow switch and a thermal column modification was made for the Ultra-Cold Neutron Facility.

c. Conclusions

Records indicated that changes at the facility were acceptably reviewed in accordance with 10 CFR 50.59 and applicable licensee administrative controls.

**5. Committees, Audits, and Reviews**

a. Inspection Scope (IP 69001-02.09)

The inspector reviewed the following to ensure that the audits and reviews stipulated in TS Section 6.2 were being completed:

- Reactor Safety and Audit Committee (RSAC) Membership, December 7, 2010
- RSAC Minutes of meeting held October 28, 2010 and January 10, 2011
- RSC Minutes of meeting held March 10, 2010 and October 6, 2010
- 2009 – 2010 RSC Annual Report

b. Observations and Findings

The composition of the RSC and RSAC were as specified in the TS. A review of records indicated that both committees met at the prescribed frequency and provided the oversight and reviews of the reactor programs as required by the TS.

c. Conclusions

The Radiation Safety Committee and Reactor Safety and Audit Committee provided the oversight required by the TS.

## 6. Emergency Planning

### a. Inspection Scope (IP 69001-02.10)

The inspector reviewed the emergency preparedness program and its implementation through the following:

- PULSTAR Nuclear Reactor Emergency Plan, Rev. 9, September 19, 2008
- Emergency Procedures 1, Emergency Plan Activation, Response and Actions, October 13, 2008
- Emergency Procedures 2, Off-Site Notification, January 1, 2009
- Emergency Procedures 4, Emergency Classification, October 13, 2008
- Emergency Procedures 6, Training, July 19, 2006
- Emergency Procedures 7, Drills, April 2, 2001
- Emergency Procedures 9, Emergency Locker Inventory, February 20, 2009
- Training Records of Emergency Support Groups
- PULSTAR Nuclear Reactor, Emergency Drill Scenario, January 28, 2010
- PULSTAR Nuclear Reactor Drill Summary and Critique, February 10, 2010
- Letter of Agreement with City of Raleigh Fire Department, February 2, 2011
- Letter of Agreement with State of North Carolina Division of Emergency Management , February 2, 2011
- Letter of Agreement with Wake County Emergency Management, October 25, 2010
- Letter of Agreement with Rex Healthcare Hospital, October 18, 2010

### b. Observations and Findings

The inspector reviewed the licensee's emergency preparedness program as defined in the above-referenced emergency plan and implementing procedures. The inspectors also reviewed documentation related to an annual drill conducted January 28, 2010, the critique of the drill, lessons learned, action items identified in the critique, and disposition of action items.

The inspector found that letters of agreement with support agencies were available and current. The inspector toured the decontamination facility and conducted interviews with the Emergency Room Team Leader at the Rex Healthcare Hospital Emergency Department, and the NCSU Police Department. The inspector verified a test alarm was initiated from the NRP Pulsar reactor and acknowledged by the campus police

Emergency Procedure 6, Training, specifies that training for support agency personnel be offered every two years. Training records indicated that it was offered annually on multiple days to accommodate shift workers' schedules.

Emergency Procedure 9, Emergency Locker Inventory, specified the inventory for emergency supply cabinets at various locations, calling for a quarterly inventory of each locker and also an inventory after each use. The inspector checked the inventory of two lockers in the Burlington Laboratory and verified that the inventory was performed on the designated frequency, that the specified items were in the cabinets, and that the radiation detectors were operable and in the specified calibration interval.

c. Conclusions

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

**7. Maintenance Logs and Records**

a. Inspection Scope (IP 69001-02.11)

The inspector reviewed the following selected maintenance and reactor operations records to ensure that the requirements of TS Sections 6.8 "Retention of Records" were being met:

- PULSTAR Maintenance Log and History Report
- PULSTAR Unscheduled Scram and Shutdown Log
- PULSTAR Reactor Logbook, April 8, 2009, to present

b. Observations and Findings

The inspector reviewed the maintenance records related to scheduled and unscheduled preventive and corrective maintenance activities that had occurred during the inspection period. Routine and preventive maintenance was controlled and documented in the appropriate logs. These documents indicated that all maintenance activities were in accordance with the requirements in 10 CFR 50.59. The inspector verified that all maintenance was conducted in accordance with the requirements of TS Section 4.0, and system operational checks were performed before returning them to service.

c. Conclusions

Maintenance was performed and logs and records maintained consistent with TS and licensee procedure requirements.

**8. Fuel Handling Logs and Records**

a. Inspection Scope (IP 69001-02.12)

The inspectors reviewed the following records to verify implementation of the requirements of TS Section 4.1:

- Procedure NRP-OP-301, Reactor Fuel Handling, Rev. 0, September 13, 2004, Appendix A, Confirmations of fuel movement and Appendix B, Fuel Movements Schedule on October 4, 2010, June 2, 2010, and March 2, 2010
- Core Map Records of Fuel Element Locations
- PULSTAR Reactor Console Logbook entries October 4, 2010, June 2, 2010, March 2, 2010, and January 19, 2010

b. Observations and Findings

The inspector found the procedures used for fuel handling provide for the safe handling of fuel elements. The data sheets and the Core Map Records adequately documented the location of fuel elements at all times.

c. Conclusions

Fuel movements were performed safely in accordance with TS requirements and licensee procedural requirements.

**9. Follow-up of Previously identified items**

a. Inspection Scope (IP 92701)

The inspector reviewed the following to verify compliance with TS Sections 3.7, Limitations on Experiments, 3.8, Operation with Fueled Experiments, and 6.5, Review of Experiments:

- Experiment Logbook
- NC State University, Ayman I. Hawari, Ph.D., Reportable Event 46484; Radiography Incident, dated December 23, 2010
- Procedure NRP-OP-104, Reactor Experiments, Rev. 3, January 10, 2010

b. Observations and Findings

The inspector reviewed action items from the Radiography Incident "14 Day Report" identified in the Reportable Event 46484. The inspector noted five open items remain of the remaining 18 items identified.

c. Conclusions

The inspector issued an inspector followup item, (50-297-2011-201-01) to review the open items during the next following inspection.

**10. Exit Interview**

The inspector presented the inspection results to licensee management at the conclusion of the inspection on February 10, 2010. The inspector 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 and of the material provided to or reviewed by the inspector during the inspection.

## **PARTIAL LIST OF PERSONS CONTACTED**

### Licensee

Y. Azmy	Professor, and Head of Nuclear Engineering
J. Barnwell	NCSU Campus Police
L. Broussard	Chief Reactor Operator
A. Cook	Manager, Nuclear Reactor Program and Reactor Operations Manager
A. Hawari	Director, Nuclear Reactor Program
K. Kincaid	Chief of Reactor Maintenance
L. West	Rex Emergency Department Team Leader
G. Wicks	Reactor Health Physicist

## **INSPECTION PROCEDURES USED**

IP 69001	Class II Research and Test Reactors
IP 92701	Follow-up

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

### Opened

50-297/2011-201-01	IFI	Reportable Event 46484, Radiography Incident items 4, 9, 11, 12 and 13 remain open.
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### Closed

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
ALARA	As Low As Reasonably Achievable
EHS	Department of Environmental Health and Safety
HP	Health Physics
IP	Inspection Procedure
NCSU	North Carolina State University
NCV	Non-Cited Violation
NRC	U. S. Nuclear Regulatory Commission
NRF	Nuclear Reactor Facility
NRP	Nuclear Reactor Program
PARS	Publicly Available Records
Rev.	Revision
RHP	Reactor Health Physicist
RO	Reactor Operator
ROM	Reactor Operations Manager
RPP	Radiation Protection Program
RSAC	Reactor Safety and Auditing Committee
RSC	Radiation Safety Committee
SRO	Senior Reactor Operator
TLD	Thermoluminescent dosimeters
TS	Technical Specifications