

July 24, 2012

Dr. Henry C. "Hank" Foley
Vice President for Research &
Dean of the Graduate School
The Pennsylvania State University
304 Old Main
University Park, PA 16802-1504

SUBJECT: PENNSYLVANIA STATE UNIVERSITY - NRC ROUTINE INSPECTION
REPORT NO. 50-5/2012-201

Dear Dr. Foley:

From June 26 to 29, 2012, the U.S. Nuclear Regulatory Commission (NRC) conducted a routine operations inspection at your Pennsylvania State University Breazeale Research Reactor facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of that inspection.

The inspection examined activities conducted under your license as they relate to the conduct of operations and compliance with the Commission's rules, regulations, and with the conditions of your license. The inspector reviewed selected procedures and records, observed activities, and interviewed personnel. Based on the results of this inspection, no safety concerns were identified. There were two minor instances of non-compliance with NRC requirements identified; however, no response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 2.390, "Public inspections, exemptions, requests for withholding," a copy of this letter 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. The Agencywide Documents and Management System (ADAMS) is accessible from the NRC Website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

H. Foley

- 2 -

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

Sincerely,

/RA/

Gregory T. Bowman, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-5
License No. R-2

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

Pennsylvania State University

Docket No. 50-5

cc:

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

H. Foley

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

Docket No: 50-5

License No: R-2

Report No: 50-5/2012-201

Licensee: The Pennsylvania State University

Facility: Penn State Breazeale Reactor

Location: University Park, Pennsylvania

Dates: June 26-29, 2012

Inspectors: Gregory M. Schoenebeck
Craig Bassett

Approved by: Gregory T. Bowman, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

EXECUTIVE SUMMARY

The Pennsylvania State University
Penn State Breazeale Reactor Facility
NRC Inspection Report No. 50-5/2012-201

The primary focus of this routine, announced operations inspection was the onsite review of selected aspects of the Pennsylvania State University's (the licensee's) Class II research reactor facility safety programs, including organization and staffing, operations logs and records, procedures, requalification training, surveillance and limiting conditions for operation, emergency planning, maintenance logs and records, and fuel handling logs and records since the last U.S. Nuclear Regulatory Commission (NRC) inspection of these areas. 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 was generally in compliance with organizational and staffing requirements for operation of the reactor facility.

Operations Logs and Records

- The licensee's operations record keeping program conformed to Technical Specification requirements.

Procedures

- Reactor personnel observed administrative controls and Technical Specification requirements and demonstrated satisfactory procedural compliance during operations.

Requalification Training

- Operator requalification was conducted as required by the Requalification Program.

Surveillance and Limiting Conditions for Operation

- Operations were found to be generally in compliance with the limiting conditions for operation and surveillances requirements as stated in the Technical Specifications.

Emergency Planning

- The records reviewed by the inspectors indicated that the Pennsylvania State Breazeale Reactor Emergency Preparedness Plan, oversight, and training were generally being implemented as required.

Maintenance Logs and Records

- The licensee maintained records documenting principal maintenance activities in compliance with Technical Specification requirements.

Fuel Handling Logs and Records

- The licensee documented the fuel manipulations, performed inspections of the fuel and control rods, and verified reactor safety in accordance with Technical Specification requirements.

REPORT DETAILS

Summary of Facility Status

The Pennsylvania State University (PSU or the licensee) operates the one megawatt Penn State Breazeale Reactor (PSBR) as a major facility in its Radiation Science and Engineering Center (RSEC). The PSBR continued to be operated in support of graduate and undergraduate research, laboratory instruction, and a variety of radiation services.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure (IP) 69001-02.01)

The inspector used the procedural guidance of IP 69001-02.01 to verify the licensee's compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 55 and Section 6.1.3, "Administrative Controls," of the Technical Specifications (TS) were being met:

- Administrative Procedure (AP)-4 2011-03, dated August 31, 2011
- Reactor Control Logbook # 88, June 29, 2010 to Present
- Reactor Control Logbook # 87, January 14, 2010 to June 28, 2010
- Letter dated December 11, 2009, to NRC, "Penn State Breazeale Reactor (PSBR) Technical Specification (TS 6.6.2.b.1) Special Report, Permanent changes in the facility organization-Level I Change"

b. Observations and Findings

Since the last inspection, there were no significant change to PSBR's reporting hierarchy with the exception of staff turnover at the reactor operator and senior reactor operator (SRO) level. One inspector noted that the facility self-identified a non-compliance with TS 6.1.3 a (i.e., minimum staffing requirements) during work on a coupled control rod drive mechanism; there was no operator present in the control room for the conditions of the evolution as required by TS for the maintenance evolution. Because of: 1) the minimal safety significance of the violation (i.e., the reactor was shut down), 2) the fact that the non-compliance was identified by the licensee, and 3) the implemented corrective actions in AP-4 2011-03, the inspector determined that this is a minor violation¹ and no further NRC action was taken or warranted with the exception of discussion with the licensee at the formal exit meeting.

¹ **Minor Violation:** A violation that is less significant than a Severity Level IV violation and not the subject of formal enforcement action.

c. Conclusion

The licensee was generally in compliance with organizational and staffing requirements for operation of the reactor facility.

2. Operations Logs and Records

a. Inspection Scope (IP 69001-02.02)

The inspector used the procedural guidance of IP 69001-02.02 to verify the licensee's compliance with TS Section 6.7, "Records:"

- Reactor Control Logbook # 91, January 19, 2012 to Present
- Standard Operating Procedure (SOP)-1, "Reactor Operating Procedure," Revision (Rev.) 17, September 17, 2010
- SOP-2, "Daily Checkout Procedure"

b. Observations and Findings

The inspector found entries to be consistent with the procedural requirements; specifically, such matters as pre-start checks, reactor startups, personnel on duty, experiments being performed, maintenance, surveillance, and core configurations. Required logs and records were maintained as required by TS and APs. In the event that an equipment issue manifests during reactor operations, the operator typically generates a change review form, which is used for tracking and resolution of the deficiency.

c. Conclusion

The licensee's operations record keeping program conformed to TS requirements.

3. Procedures

a. Inspection Scope (IP-69001-02.03)

The inspector used the procedural guidance of IP 69001-02.03 to verify the licensee's compliance with TS Section 6.3 Procedures:

- SOP-1, "Reactor Operating Procedure," Rev. 20, March 8, 2012
- SOP-2, "Daily Checkout Procedure," Rev. 23, June 19, 2012
- SOP-4A, "Radiation Evacuation and Alarm Checks," Rev. 1, dated June 17, 2011
- AP-4 2011-01, dated May 11, 2011
- AP-4 2011-02, dated May 24, 2011
- AP-4 2012-04, dated June 15, 2012
- AP-12, "Change," Rev. 6, dated June 17, 2011

- AP-12 2012-02, dated June 19, 2012

b. Observation and Findings

The facility had discovered that TS 3.5.a had been historically violated during the testing of the facilities' emergency evacuation alarm system. The duration of non-compliance appears to likely coincide with a TS amendment in the 1990s which conformed to the historic American National Standards Institute (ANSI) 15.1, "The Development of Technical Specifications for Research Reactors." When making the administrative change to align with the historical ANSI standard guidance, the licensee created a condition which would perpetually violate TS 3.5.a in the facilities' as built condition, as described below.

Non-Compliance

The current, approved TS 3.5.a requires that at least one facility exhaust fan be operating if the reactor is not secured. When an evacuation signal is initiated, the fans are secured as described in the basis section of TS 3.5. In order to terminate an evacuation alarm test and return the fans to service, the reactor key must be inserted in order to reset the console; thereby placing the reactor in a non-secure condition, as per TS 1.1.29.

SOP-2 and SOP-4A are procedures that are used to test the functionality of the exhaust system. SOP-2 is performed daily before the reactor is operated and SOP-4 is performed monthly. Each time the procedure had been used, the limiting conditions for operation (LCO) (i.e., TS 3.5.a) had been violated.

Licensee Identification and Corrective Actions

The historical non-compliance was not a reportable occurrence as described in TS 1.1.34; however, the facility provided a courtesy notification to the NRC staff. Because of: 1) the minimal safety significance of the violation (i.e., the reactor is always shut down at the time of the test and the duration of the test is minimal), 2) the fact that the non-compliance was identified by the licensee, 3) the implemented corrective actions in AP-4 2012-04, and 4) the implementation of a reviewed and approved revision to SOP-2 (i.e., Step G "Console Evacuation Alarm Channel Check") for the daily emergency evacuation testing, the inspector determined that this is a minor violation and no further NRC action was taken or warranted with the exception of discussion with the licensee at the formal exit meeting.

c. Conclusion

Reactor personnel generally observed administrative controls and TS requirements and generally demonstrated satisfactory procedural compliance during operations.

4. Requalification Training

a. Inspection Scope (IP 69001-02.04)

The inspector used the procedural guidance of IP 69001-02.04 to verify the licensee's compliance with 10 CFR 50.55, "Operators' Licenses:"

- Qualified operators' licenses
- Recent NRC Form 396s for the licensed operators
- AP-3, "Operator and Senior Operator Requalification," Rev. 2, dated October 17, 2005
- Operations exam final results for 2011
- Tracking spreadsheet for operators performing license activities, 2008-2011
- Written exam results for 2010
- List of training topics

b. Observations and Findings

The inspector found the licensee's requalification plan to include the regulatory requirements, such as: 1) the two-year program cycle; 2) written, oral, and operating examinations; 3) lectures; and 4) procedure review. The written examination was determined to be of equivalent difficulty to those administered by the NRC. The duty of writing the written exam is rotated and is typically assigned to a qualified reactor operator who would be graduating from the University and have their operating license subsequently terminated. The operating exam included topics and areas of operating deficiency noted from various AP-4 reports (e.g., beam port operation resulting in a reactor step back, etc.)

Record reviews indicated adequate attendance at all training lectures. Those who could not attend due to conflict had reviewed the lecture notes and topics. Through record reviews it was noted that there were review/training sessions with regards to procedure changes.

The inspector noted that the licensee maintained all operators in an active duty status in accordance with 10 CFR 55.53(e).

c. Conclusion

Operator requalification was conducted as required by the Requalification Program.

5. Surveillance and Limiting Conditions for Operation

a. Inspection Scope (IP 69001-02.08)

The inspector used the procedural guidance of IP 69001-02.08 to verify the licensee's compliance with TS Section 3.0, "Limiting Conditions for Operation," and to determine if the periodic surveillance tests on safety systems were performed as stipulated in TS Section 4.0, "Surveillance Requirements."

- Penn State Reactor Safeguards Committee (RSC) Meeting Minutes, dated April 29, 2011
- Reactor Control Logbook # 91, January 19, 2012 to Present
- Check and Calibration Procedure (CCP)-1, Rev. 8, dated March 19, 2010
- CCP-11, "Core Reactivity Evaluation," dated May 22, 2012
- CCP-16, "Inspection of Fuel Elements," dated May 14, 2012
- CCP-21, "Emergency Support Center Supplies Check," dated April 17, 2012
- CCP-28, "Review of Emergency Preparedness Plan 2011"
- CCP status matrix

b. Observations and Findings

The inspector selected a sample of the TS surveillances and LCOs to verify implementation. The inspector determined that the selected surveillances met TS requirements and were acceptably conducted for the as-built condition of the facility. The LCOs were maintained in accordance with the licensee's procedural requirements. The inspector became aware that the facility desires to request an expedited TS amendment to address the issues of the emergency exhaust surveillance (i.e., TS 3.5.a) as described in Section 3 of this inspection report.

c. Conclusion

Operations were found to be in compliance with the LCO and surveillance requirements as stated in the TS.

6. Emergency Planning

a. Inspection Scope (IP 69001-02.10)

The inspector used the procedural guidance of IP 69001-02.10 to verify the licensee's compliance with 10 CFR 50.34, Appendix E, and TS Section 6.3.u:

- PSBR Emergency Preparedness Plan (EPP), Rev. 4, September 21, 2000
- Emergency Procedure (EP)-1, "EPP Implementation," Rev. 15, dated April 8, 2010

b. Observation and Findings

One inspector reviewed the current EPP, which had not changed since the previous inspection; revisions typically are reviewed and approved through the individual implementing procedures. The EPP and implementing procedures were current and readily available in several locations for use as required. An annual emergency drill is performed in accordance with TS.

The inspector made one observation with regards to command and control during an emergency event at the PSBR. On October 26, 2011, with the reactor operating at 800 kilowatt, there was a South Bay radiation detector failure at the deuterium tank. The facility was evacuated per EP-1 and the off-site security force quickly responded to the gate. Through record reviews it was noted that one security force member disregarded the authority of the PSBR emergency support staff and did not follow protocol and re-entered the facility without authorization. This observation deviates from the guidance provided by Section 3.4 of the EPP and the guidance EP-1 as it relates to command and control during response to an event at the PSBR. The facility has provided training on this matter and no further NRC action is warranted.

c. Conclusion

The records reviewed by the inspectors indicated that the PSBR EPP, oversight, and training were generally being implemented as required.

7. Maintenance Logs and Records

a. Inspection Scope (IP 69001-02.11)

The inspector used the procedural guidance of IP 69001-02.11 to verify the licensee's compliance with TS Sections 6.7.1.c and 6.7.1.g:

- AP-13 "Maintenance/Repair," Revision 4, dated September 6, 2004
- AP-13 2011-03 "Wide Range indication abnormal," dated April 11, 2011
- AP-13 2011-04 "Pulse Calibration reading abnormal," dated April 20, 2011
- AP-13 2011-07 "Power Range erratic reading during testing," dated July 29, 2011
- Reactor Control Logbook # 88, June 29, 2010 to Present

b. Observations and Findings

One inspector reviewed a selection of maintenance and troubleshooting records and determined that preventative and corrective maintenance logs for electronic and associated reactor equipment (i.e., TS 6.7.1.c and 6.7.1.g) had been retained for at least 5 years. The inspector determined that the selected maintenance items which were reviewed had not been facility modifications of

systems as described in the Safety Analysis Report.

c. Conclusion

The licensee maintained records documenting principal maintenance activities in compliance with Technical Specification requirements.

8. Fuel Handling Logs and Records

a. Inspection Scope (IP 69001-02.12)

The inspector used the procedural guidance of IP 69001-02.12 to verify the licensee's compliance with TS and Administrative Procedures:

- SOP-3, "Core Loading and Fuel Handling"
- Reactor control logbook # 91, January 19, 2012 to Present
- Current core configuration Map
- Current fuel element storage location map
- RSC meeting minutes for the past 2 years
- Fuel handling equipment and reactor instrumentation
- Various records and data sheets related to fuel movement and storage
- Fuel movement and examination records including video of fuel inspection
- Listing of the stuck fuel elements and graphite elements, including a description of each
- E-mail from licensee to the NRC, dated May 9, 2012
- AP-12, "Change," Rev. 6, effective date June 17, 2011

b. Observations and Find

By e-mail on May 9, 2012, the licensee informed the NRC that, during their periodic surveillance of fuel removal and inspection, they had noted swelling in one fuel element and one graphite element. The amount of swelling in each of these elements precluded the licensee from removing them from the upper core grid plate. The licensee then developed a plan and procedure for removing the stuck elements.

One inspector reviewed the licensee's actions regarding the swollen elements. It was noted that the licensee had followed their procedure, AP-12, "Change." As required by AP-12, a plan had been developed to ensure safe removal of the stuck elements. In conjunction with the work package, a safety analysis had been performed. The safety analysis included a description of the fuel, a description of the problem (i.e., the elements would not pass through the upper grid plate), Emergency Plan screening, Physical Security Plan screening, radiation protection screening, 10 CFR 50.59 screening, and a 10 CFR 50.59 review. After the screenings and planning, the work package was reviewed and approved as required.

As a result of the planning and screening, on May 11, 2012, the licensee completed removal of all the fuel that could be removed from the core

Subsequently, lines were attached to the elements that were still stuck so that they would not fall over and the upper grid plate was lifted so that the elements could be removed. Once the elements were removed, they were thoroughly examined using an underwater camera and then placed in storage. No obvious problems were noted with the elements other than the slight swelling that had stopped them from being removed through the grid plate. Following removal of the problem elements, the licensee proceeded with reloading the core, which included some fuel shuffling. The licensee then resumed normal reactor operations using a new core configuration designated as Core Number 54. No problems have been noted.

The inspector noted that the licensee had followed their procedure and had developed a plan to allow removal of the stuck elements. Special tools had also been designed and fabricated to assist in the safe handling of the elements. The inspector determined that the stuck element problem had been addressed and resolved in a safe and timely manner. The facility intends to perform a shipment of these and other spent fuel elements in the pool to the Department of Energy at a time to be determined in 2013.

On May 17, 2012, the facility performed the Core Number 54 initial loading, which included the full inspection of the reactor's fuel elements, and performed maintenance on the control rod drives. The facility logs indicated who was acting as the SRO, as required by TS 6.1.3.c. During fuel handling operations, the facility ensured that criticality could not be achieved and met the requirements of TS 1.1.2.9.a. The fuel movements from the core to the storage racks (and vice versa) were tracked by use of an Excel spreadsheet and incorporated into the logs.

c. Conclusion

The licensee documented the fuel manipulations, performed inspections of the fuel and control rods, and verified reactor safety in accordance with TS requirements.

9. Exit Interview

The inspection scope and results were summarized on June 28, 2012, with members of licensee management. The inspector described the areas inspected and discussed in detail the inspection findings. No dissenting comments were received from the licensee.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Trump, Associate Director for Operations

M. Bryan, Research Engineer

C. Davison, Research and Education Specialist

INSPECTION PROCEDURES USED

IP 69001 Class II Research and Test Reactors

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened None

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 Management System
AP	Administrative Procedure
CCP	Checks and Calibrations Procedures
EP	Emergency Procedure
EPP	Emergency Preparedness Plan
IP	Inspection Procedure
LCO	Limiting Conditions for Operation
NRC	U. S. Nuclear Regulatory Commission
PARS	Publicly Available Records
PSBR	Penn State Breazeale Reactor
PSU	Penn State University
Rev.	Revision
RSC	Reactor Safeguards Committee
RSEC	Radiation Science and Engineering Center
RSO	Radiation Safety Office
SOP	Standard Operating Procedure
SRO	Senior Reactor Operator
TS	Technical Specifications