November 17, 2014

Dr. Kenan Unlu, Director
Breazeale Nuclear Reactor
Radiation Science and
Engineering Center
The Pennsylvania State University
University Park, PA 16802-2301

SUBJECT: PENNSYLVANIA STATE UNIVERSITY - NRC ROUTINE INSPECTION REPORT NO. 50-5/2014-201

Dear Dr. Unlu:

From October 14-17, 2014, the U.S. Nuclear Regulatory Commission (NRC) conducted a routine 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 findings of significance were identified and 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).

Should you have any questions concerning this inspection, please contact Mr. Ossy Font at (301) 415-2490.

Sincerely,

/RA Elizabeth Reed for/

Kevin Hsueh, 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:
Inspection Report

cc w/ encl: See next page

Pennsylvania State University Docket No. 50-5

cc:

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DATE	11/14/2014	11/17/2014

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

Docket No:	50-5
License No:	R-2
Report No:	50-5/2014-201
Licensee:	The Pennsylvania State University
Facility:	Penn State Breazeale Reactor
Location:	University Park, Pennsylvania
Dates:	October 14-17, 2014
Inspector:	Ossy Font
Accompanied by:	Eben Allen, Rotational Assignee
Approved by:	Kevin Hsueh, Chief Research and Test Reactors Oversight Branch Division of Policy and Rulemaking Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

The Pennsylvania State University
Penn State Breazeale Reactor Facility
NRC Inspection Report No. 50-5/2014-201

The primary focus of this routine, announced operations inspection was the onsite review of selected aspects of the Pennsylvania State University's (PSU, the licensee's) Class II research reactor facility safety programs, including organization and staffing, operations logs and records, procedures, requalification and 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

- Organizational structure and responsibilities were consistent with Technical Specification (TS) requirements.
- Shift staffing met or exceeded requirements of the Pennsylvania State Breazeale Reactor (PSBR) TS for current operations.

Operation Logs and Records

- Logs and records were being conducted in a manner consistent with technical specifications and approved procedures.
- Retention of logs and records met or exceeded the requirement of the technical specifications.

Procedures

- PSBR staff was observed following approved procedures during normal operations.

Requalification and Training

- The requalification and training program is being conducted in accordance with TS.
- Operational personnel not fulfilling the conditions of their licenses were administratively removed from manipulating the controls of the reactor.

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 inspector indicated that the (PSBR) 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 Specifications 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 Specifications requirements.

REPORT DETAILS

Summary of Facility Status

The Pennsylvania State University's (the licensee's) 1,000 kilowatt research reactor was operated in support of routine experiments, reactor operator training, and periodic equipment surveillances. During the performance based portion of this inspection, NRC staff observed the reactor being operated to support experiments in the Fast Neutron Irradiator (FNI), Fast Flux Tube (FFT), and Deuterium Tank (D_20) positions. Observations were made of day-to-day operations of staff in the control room.

a. **Organization and Staffing**

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

The inspector reviewed the following to verify compliance with the organizational and staffing requirements in Technical Specifications (TS) 6.1.3:

- Penn State Breazeale Reactor (PSBR) organizational structure and staffing
- Annual Operating Report for the PSBR, FY 2012-2013, dated December 8, 2013
- PSBR logbook entries from June 2013, to present
- SOP-1"Reactor Operator Procedure"
- Letter dated August 8, 2013, to NRC, "Personnel Change License Number R-2; Docket Number 50-005"

b. Observations and Findings

Since the previous U.S. Nuclear Regulatory Commission (NRC) inspection (Inspection Report 50-5/2013-201), there have been no notable changes in the staffing at the PSBR.

A list of facility personnel is posted in the control room in accordance with TS 6.1.3(b). NRC staff found the list to contain the names and contact information for management, operations, radiation safety, and other support personnel. The list was found to have current management and operational personnel listed in the PSBR logbook.

The PSBR staff satisfied TS 6.1.3 with console logbook entries.

c. Conclusion

The PSBR organization and staffing was consistent with TS requirements.

2. Operation Logs and Records

a. Inspection Scope (IP 69001-02.02)

The inspector reviewed the following to verify that the requirements of TS Sections 6.7, "Records".

- PSBR logbook entries from July, 2013 to present
- SOP-1, "Reactor Operating Procedure," Rev. 23
- AP-3, "Operator and Senior Operator Requalification"

b. Observations and Findings

Routine logbook entries were to be made with the direction of standard operating procedure 1 section IV.

Log book entries were maintained in accordance with approved procedures and uniformity. The Senior Reactor Operator (SRO) would enter their name into the log book signifying their position as the SRO present in the facility. The console position would be staffed by either a licensed reactor operator (RO) or SRO. A formal turnover was completed when the operator at the console was relieved. An operator in training completed a formal turn over and logged name and time, this trainee manipulated the controls of the reactor under the instruction of the RO at the console. Trainees are allowed to manipulate the controls of the PSBR under the instruction of a SRO or RO by procedure.

By PSBR procedures, certain items were to be entered in the console log book, these include: on the job training, operation exams, and upon notification of successful licensing exam, additional staff would be entered into the console logbook as required. Completed compliance checks, maintenance items, core position were recorded in the console logbook.

Compliance checks were observed to be stamped with retention compliant IAW with TS 6.7. The records for operator requalification included lecture series, operations exams, on the job training, and written exam. The retention of these records were in excess of the requirements of TS 6.7.2

c. Conclusion

No deficiencies were noted with logbook records, retention met or exceeded the retention requirements of the PSBR TS.

3. Procedures

a. Inspection Scope (IP 69001-02.03)

The following items were reviewed to verify compliance with PSBR TS Sections 6.3 and 6.2.3.

- PSBR logbook entries from July, 2013 to present
- SOP-1, "Reactor Operating Procedure," Rev. 23
- SOP-2 "Daily Check Sheet"
- SOP-4 "Radiation Evacuation and Alarm Checks"
- SOP-10 "Reactor Operations at the Fast Neutron Irradiator (FNI) and the Fast Flux Tube".
- SOP-11 "Reactor Operations at the Beam Ports".
- Annual Operating Report for the PSBR, FY 2011-2012, dated December 5, 2012

b. Observations and Findings

Procedures were approved and signed and dated at the bottom of the first page. Revisions were done to the procedures as needed. A program at PSBR continuously reviewed the procedures. All procedures observed were approved and dated.

Random check of standard operator procedures found in different locations showed that each procedure checkered was on the same revision. This showed that a method to control procedures was in use and up to date.

Observation of repositioning of the reactor to the R1 position, FNI, FFT and D_2O tank was observed. Prior to the evolution PSBR staff reviewed SOP-10 and SOP-11. The evolution was recorded in the console logbook.

Compliance checks done to satisfy the surveillance requirements of the PSBR TS were captured in Check and Calibration Procedure series proceeds. With the exception of TS 4.5 which was accomplished with SOP-4.

License amendment request "AP-12: 2012-01" was submitted to the NRC in 2012 and not yet approved. The modification has been completed to the facility and routine surveillance is being done to provide a record of operational experience prior to being put officially in service.

c. Conclusion

Procedures at PSBR were up to date and available to operation staff. Staff reviewed the procedures and carried operations IAW the appropriate procedure.

4. Requalification and Training

a. Inspection Scope (IP 69001-02.04)

To ensure that staff at the facility were completing requalification and training as required by TS Section 6.7.2 and 10 CFR 55.53(e):

- AP-3 "PSBR Operator and Senior Operator Requalification"
- PSBR logbook entries from June, 2013 to present

- AP-4 Identification Evaluation and Documentation of Safety System Failures, Abnormal Events and Operation Events."

b. Observations and Findings

The requalification plan is captured in AP-3 and contains annual on the job training, oral test, and operational test. Continuous lectures were done throughout the year and a biennial medical and written exam are completed.

Procedural exams, operation exams, and the written exams were written by PSBR staff. The same staff member will be excluded from that exam which they have written for that cycle but may not write more than one exam cycle. A matrix provided showed tracking was accomplished on the exam writes.

For various reasons including: written exam failures, lack of periodic on the job training, exceeding the medical exam, and not taking exams, operations staff were unable to maintain activates at the PSBR. These staff members were tracked and a logbook check showed they had not been logged in once their issue was discovered.

Lecture series and emergency procedures (operational exams) were satisfactorily completed continuously throughout the training cycle and records retained. Proficiency (on the job training) was followed on a matrix and recorded in the console logbook.

To prevent reoccurrence of events documented in AP-4 discussion and training were completed. Specific lecture series were not found but questioning licensed operators showed an awareness of the event and satisfactory level of knowledge of the corrective action.

c. Conclusion

The requalification program was being conducted consistently with the TS and AP-3. Staff not meeting conditions of the license were not allowed to assume control of the reactor until they satisfied the requirements of their license.

5. Surveillance and Limiting Conditions for Operation

a. Inspection Scope (IP 69001-02.08)

To verify the licensee's compliance with TS Section 3.0, "Limiting Conditions for Operation," (LCO) and to determine if the periodic surveillance tests on safety systems were performed as stipulated in TS Section 4.0, "Surveillance Requirements:"

- Reactor Control Logbook # 93 and 94
- Check and Calibration Procedure (CCP):
  - Annual- CCP-1, 2, 3, 5, 7, 8, 10, 11, 14, 15
  - Semi-annual- CCP-4;

  - Daily- SOP-2
- 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 LCO to verify implementation and determined that they frequency and outcome met TS requirements. The LCOs were maintained in accordance with the licensee's procedural requirements.

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)

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. 16, dated September 25, 2012
- Audit Report dated December 2012

b. Observation and Findings

The inspector reviewed the current EPP, which had not changed since the previous inspection; revisions typically were 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.

The TS requires a biennial audit be performed by a person not directly involved with the function being audited. The last audit was completed by Corey Hines from Washington State University's Nuclear Radiation Center with no significant issues.

The inspector visually inspected the emergency supply cabinets and reviewed the equipment check semi-annual surveillance. The inspector notes that the Emergency Support Center moved to a better location within the same building.

This location has more room and will allow for better coordination in the case of an emergency.

The facility is required to perform an annual emergency drill in accordance with TS. In 2013, the drill involved an experimenter tripping, dropping a sample, and injuring self. The sample set-off the radiation monitor. The ambulance services participated. A full scale drill for 2014 is still being planned.

Sometimes the licensee has completed the evacuation drill via actual events that required an evacuation. Events in 2013 included a failure of the N-16 pump tripping the set point, as discussed in the Maintenance section below. Events in 2014 included a fire alarm due to smoke from a failed condensate pump. Another took place during the day's fifth tour, during the pulse demonstration. A high radiation alarm was set-off. It was found to have failed high and replaced, as discussed in the Maintenance section below. All evacuation and responder actions were performed as expected.

Additionally, in 2012, the licensee and the Centre Region Council of Governments conducted an exercise of the combined Emergency Operations Center. PSU tested and used the PSUTXT emergency messaging system to alert the campus.

The inspector notes that during all actual events used to fulfill the emergency drill requirements, all staff evacuated the facility and external emergency organizations responded as expected. The licensee has a Memorandum of Understanding (MOU) with these external organizations. The inspector reviewed the MOUs with off-site police support, dated January 15, 2014 and Mount Nittany Medical Center, dated December 16, 2013.

Lastly, the inspector met with the Alpha Fire Company. Their MOU was also up to date (12-2-2013). The inspector discussed training, response, and that all volunteers were Haz-Mat operations certified.

c. Conclusion

The records reviewed by the inspector 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-4 "Event Evaluation", 2013-03, 2013-05, 2014-005
- Reactor Control Logbooks # 93, 94, and 95

b. Observations and Findings

The 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.

Examples:

- 2013-03 “Boron Nitride (BN) Sample Holder Failure”
    - When the sample holder fractured it exposed more boron to the neutron flux, therefore increasing the total thermal neutron capture, and resulting in a -80kW spike on the wide range and power range monitors.
    - A special procedure was used to measure the reactivity associated with the contents that were not able to be removed from Dry Tube 2 (BN pieces and dust).
    - During the 2014 outage, the facility completed retrieving the remaining contents.
- 2013-05 “N-16 Pump Failure”
    - During operation the operator noticed that the pump read zero. The reactor was shut down to prevent buildup.
    - During the investigation it was discovered that a fuse was blown due to long term degradation. The fuse was replaced with an identical fuse.
- 2014-005 “Radiation Monitor Failure”
    - The facility was hosting tours and demonstrating the reactor’s pulse capability. During that day’s fifth tour (fifth pulse), a high radiation alarm was set-off, resulting in an evacuation.
    - During the investigation it was discovered that the detector was reading full scale, even when tested with a low dose source. The monitor was bypassed, tested, and replaced. The failed detector was taken to be calibrated.

The inspector determined that the selected maintenance items 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 Specifications requirements.

8. Fuel Handling Logs and Records

a. Inspection Scope (IP 69001-02.12)

To verify the licensee’s compliance with TS sections 3.1.6 and 4.1.3 and Administrative Procedures:

- CCP-16 “Inspection of Fuel Elements”
- CCP-17 “Inspection of Control Rods and Rod Drives”
- SOP-3, “Core Loading and Fuel Handling”
- Reactor control logbook # 93 and 95
- Current core configuration Map
- Current fuel element storage location map
- RSC meeting minutes for the past 2 years

b. Observations and Findings

The inspector reviewed the fuel movement and inspection records for the previous two years and verified that the manipulations followed established procedures. Core reconfiguration was a result of request from experimenters needing more or different flux.

No problems or anomalies were noted.

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 October 17, 2014, with members of licensee management. The inspector described the areas inspected and discussed in detail the inspection findings. The licensee acknowledged the inspection findings.

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 *Code of Federal Regulations*
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
RO	Reactor Operator
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