

July 20, 2017

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

SUBJECT: PENNSYLVANIA STATE UNIVERSITY – U.S. NUCLEAR REGULATORY  
COMMISSION SAFETY INSPECTION REPORT NO. 50-005/2017-201

Dear Dr. Unlu:

From May 8-11, 2017, the U.S. Nuclear Regulatory Commission (NRC, the Commission) conducted an inspection at the Pennsylvania State University Breazeale Nuclear Reactor facility. The enclosed report documents the inspection results which were discussed on May 11, 2017, with you and members of your staff.

This inspection was an examination of activities conducted under your license as they relate to safety and compliance with the Commission's rules and 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 non-compliance were 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, requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

K. Unlu

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Should you have any questions concerning this inspection, please contact Mr. Ossy Font at (301) 415-2490 or by electronic mail at [Ossy.Font@nrc.gov](mailto:Ossy.Font@nrc.gov).

Sincerely,

*/RA/*

Anthony J. Mendiola, Chief  
Research and Test Reactors Oversight Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

Docket No. 50-005  
License No. R-2

Enclosure:  
As stated

cc: See next page

SUBJECT: PENNSYLVANIA STATE UNIVERSITY – U.S. NUCLEAR REGULATORY  
COMMISSION SAFETY INSPECTION REPORT NO. 50-005/2017-201  
DATED: JULY 20, 2017

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Pennsylvania State University

Docket No. 50-005

cc:

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

Docket No. 50-005

License No. R-2

Report No. 50-005/2017-201

Licensee: Pennsylvania State University

Facility: Pennsylvania State Breazeale Nuclear Reactor

Location: State College, PA

Dates: May 8-11, 2017

Inspector: Ossy Font

Approved by: Anthony J. Mendiola, Chief  
Research and Test Reactors Oversight Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

## EXECUTIVE SUMMARY

The Pennsylvania State University  
Pennsylvania State Breazeale Nuclear Reactor Facility  
NRC Inspection Report No. 50-005/2017-201

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the Pennsylvania State University's (the licensee's) Class II research reactor facility safety program including: (1) procedures; (2) experiments; (3) health physics; (4) design changes; (5) committees, audits, and reviews; and (6) transportation since the last U.S. Nuclear Regulatory Commission (NRC) inspection of these areas. The licensee's program was acceptably directed toward the protection of public health and safety and in compliance with NRC requirements.

### Procedures

- Procedures at Pennsylvania State Breazeale Reactor were up to date and followed by the staff as required.

### Experiments

- The licensee's program for the control of experiments satisfied technical specifications (TSs) and procedural requirements.

### Health Physics

- The radiation safety program was commensurate with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection against Radiation," requirements, TS, and procedures.

### Design Changes

- The review and evaluation of changes to facilities and procedures satisfied NRC requirements specified in 10 CFR 50.59, Changes, tests, and experiments."

### Committees, Audits, and Reviews

- Review, audit, and oversight functions required by the TS were acceptably completed by the Reactor Safeguards Committee; the annually required audit was thorough and complete.

### Transportation

- Radioactive material shipments by the licensee were conducted in accordance with applicable procedures and regulatory 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.

#### 1. Procedures

##### a. Inspection Scope (Inspection Procedure [IP] 69001-02.03)

To ensure that the requirements of technical specification (TS) Sections 6.3, "Operating Procedures," and 6.2.3, "Review Function," were being met, the inspector reviewed:

- Pennsylvania State Breazeale Reactor (PSBR) Logbook 98 (2015-2) to present
- Annual Operating Report for the PSBR, fiscal year (FY) 2015-2016
- Administrative Procedure (AP) 8, "Radiation and Visitor Orientation Requirements," Revision (Rev.) 8; dated May 10, 2017
- AP-6, "Pennsylvania State Reactor Safeguards Charter Committee Charter and Operating Procedures," Rev. 4; dated April 20, 2006
- AP-18, "Radiation Protection Program," Rev. 4; dated September 1, 2008
- AP-12, "Change," Rev. 6; dated June 17, 2011

##### b. Observations and Findings

Procedures are typically reviewed biennially, and on an as-needed basis. Numerous minor changes and updates were made to maintain procedures during the year and are not reported under 10 CFR 50.59, "Changes, tests and experiments." All procedures observed were approved and dated.

The inspector observed staff referencing procedures as needed and found their use and content adequate.

##### c. Conclusion

Procedures at PSBR were up to date and followed by the staff as required.

#### 2. Experiments

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

To ensure that the requirements of TS Sections 3.7, "Limitations of Experiments," and 6.4, "Review and Approval of Experiments," were being met, the inspector reviewed:

- Various active experiments for 2015 to present
- PSBR Logbook 98 (2015-2) to present

- Standard Operating Procedure (SOP)-5, "Experiment Evaluation and Authorization," Rev. 4; dated November 16, 2004
- Annual Operating Report for the PSBR, FY 2015-2016
- "PSBR Fuel Element Fission Product Inventory Characterization," from September 2015 – February 2016
- AP-12 2017-07, "Irradiation Testing of the Nuclear-Driven Thermo-acoustic Engine," from September 24 – 30, 2015

b. Observations and Findings

The inspector reviewed a random sampling of forms for experiments performed since the previous inspection, and found that experiments were generally being reviewed, updated, and performed in accordance with TS requirements and the licensee's written procedures.

c. Conclusion

The licensee's program for the control of experiments satisfied TS and procedural requirements.

### 3. Health Physics

a. Inspection Scope (IP 69001)

To ensure that the requirements of 10 CFR Part 20, "Standards for Protection against Radiation," and TS Sections 3.6, "Radiation Monitoring System," and 4.6, "Radiation Monitoring System and Effluents," were being met, the inspector reviewed:

- "Rules and Procedures for Users of Radioactive Material at the Pennsylvania State University," revised 2010
- Radiation Training Records for the past two years
- Radiation Safety Refresher Training Newsletter
- PSBR Logbook 98 (2015-2) to present
- Annual Operating Report for the PSBR, FY 2015-2016
- PSBR Radiation Dosimetry Records for the past two years
- Supplemental Dosimetry Log for Visitors for the past two years
- Environmental Dosimeter Data for the past two years
- Various Weekly and Quarterly Radiation and Contamination Surveys for the past two years
- Portable Monitor Calibration Records for the past two years
- AP-18, "Radiation Protection Program [RPP]," Rev. 4; dated September 1, 2008
- AP-18 A-1, "RPP Audit," Rev. 4
- Auxiliary Operating Procedure (AOP) 4, "Daily Contamination Check and Response Procedure," Rev. 10; dated September 29, 2016
- AOP-5, "Water Collection and Analysis," Rev. 7; dated March 7, 2017
- Checks and Calibrations Procedure (CCP) 8, "Calibration of Air Monitors," Rev. 7; dated March 14, 2016
- SOP-4A, "Radiation, Evacuation, and Alarm Checks," Rev. 4



- CCP-10, "Calibration of Area Radiation Monitors," Rev. 4; dated February 10, 2014
- SOP-4, "Partial," May 17, 2016
- CCP-12, "Calibration of Portable Survey Instruments and Pocket Dosimeters," Rev. 4; dated September 26, 2016
- Tag Out Logbook

b. Observations and Findings

The inspector interviewed and observed licensee personnel implementing practices regarding the use of dosimetry, radiation monitoring equipment, and placement of radiological postings and barriers and determined that they were appropriate.

The licensee used a National Voluntary Laboratory Accreditation Program-accredited vendor to process personnel dosimetry. The inspector reviewed dosimetry reports from 2015 to the present and noted that doses were well within the regulatory limits and consistent with the operations of the PSBR. Copies of current notices to workers were posted in the facility.

The calibration of portable survey meters and friskers was completed by radiation protection personnel at the Environmental Health and Safety (EHS) office while fixed radiation detectors and air monitoring instruments were calibrated by PSBR personnel at the facility. The calibration records were reviewed and calibration frequency was being maintained as required.

The EHS health physics group also performs routine surveys. The group also performs special surveys for different reactor equipment configurations which could identify high dose rates (i.e., tube locations, different power levels, and plug in or out). They also provided training. Initial training was completed online, then hands on survey meter use, and contamination and spill cleanup. Annual refresher training was performed via a newsletter where the staff signed as having read. Additional training was provided by the operations group.

The EHS also performs quarterly radioactive material safety audits. The only identified issue was contamination from an experiment where the customer did not fully know all the materials being irradiated. Unknowingly, the material had deteriorated, and flakes fell off. That was not identified during the daily survey sweep and spread in the reactor bay and work areas.

As a result of the contamination event, the licensee's corrective actions included an update to their daily contamination survey procedures. Their new procedure segments areas, so that each swept section is surveyed before moving on to the next in order to avoid spreading contamination. The staff's approach is to assume the entire area is contaminated until proven otherwise. The sweeper mop is surveyed using a pancake probe.

Current emission records, environmental monitoring (including dosimetry and tritium release records), and the most recent annual operating report were reviewed with no liquid radioactive effluent releases during those periods. Liquid

radioactive waste is under the broad scope license and is transferred for disposal with waste from other campus laboratories. Argon-41 releases were well below permissible concentrations.

c. Conclusion

The radiation safety program was commensurate with 10 CFR Part 20 requirements, TS, and procedures.

**4. Design Changes**

a. Inspection Scope (IP 69001)

To ensure that the requirements of TS Section 6.2, and 10 CFR 50.59, were being met, the inspector reviewed:

- AP-12, "Change," Rev. 6; dated June 17, 2011
- AP-12 Work Package #2015-06, "Relocation and upgrade of Reactor Uninterruptible Power Supply"
- AP-12 Work Package #2015-07, "New In-core Experimental Apparatus"
- AP-12 Work Package #2016-01, "Transient Rod Drive Motor Replacement and Torque Setting Testing," and associated appendixes
- AP-12 Work Package #2017-01, "Tuning Block Update for South Bay Area Radiation Monitor"
- Annual Operating Report for the PSBR, FY 2015-2016
- Pennsylvania State Reactor Safeguards Committee (RSC) Meeting Minutes for the past two years

b. Observations and Findings

The inspector reviewed several changes to the facility during the past two years that were reviewed and approved under the 10 CFR 50.59 screening process. The procedure in use was noted as being comprehensive and all of the changes to the facility were well documented with a thorough evaluation. The modifications had no safety implications for the public or the facility. It was noted that the RSC reviewed the series of documents listed above as required in the facility TS.

c. Conclusion

The review and evaluation of changes to facilities and procedures satisfied NRC requirements specified in 10 CFR 50.59.

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

a. Inspection Scope (IP 69001)

To ensure that the requirements of TS Section 6.2 were being met, the inspector reviewed:

- Pennsylvania State RSC Meeting Minutes from May 2015 to the present
- External Audit Report for the PSBR for the past two years
- AP-6, "Pennsylvania State Reactor Safeguards Committee Charter and Operating Procedure," Rev. 4; dated April 20, 2006

b. Observations and Findings

The inspector verified that the RSC was composed of at least five members and met at least once per calendar year as required by Section 6.2 of the facility TS, but typically met quarterly. The inspector reviewed the RSC meeting minutes for the past two years and found that the RSC provided appropriate guidance and direction for reactor operations, and ensured acceptable use and oversight of the reactor. Additionally, comprehensive audits were being performed annually by non-reactor staff.

c. Conclusion

Review, audit, and oversight functions required by the TS were acceptably completed by the RSC; the annually required audit was thorough and complete.

**6. Transportation**

a. Inspection Scope (IP 86740)

To ensure that the requirements of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," and 49 CFR Parts 100–185 for the transportation of hazardous materials, and procedural compliance for transporting or shipping licensed radioactive material were being met, the inspector reviewed:

- Selected records of various types of radioactive material shipments
- Environmental Health and Safety Training Records for Limited Quantity Shipments
- RPP-Shipping-10, "Radioactive Receipt and Shipping Procedure," (February 2013)
- Training records and certificates for authorized shippers

b. Observations and Findings

Through records review and discussions with licensee personnel, the inspector noted that low level (Limited Quantity of Radioactive Material Shipping) was done by the reactor facility staff whereas the high radioactive material (Type A shipments) were completed by EHS staff. The inspector determined that the licensee had shipped various packages of radioactive material since the previous inspection. The records indicated that the radioisotope types and quantities were calculated and dose rates measured as required and that copies of the recipients' licenses to possess radioactive material were available and verified prior to shipment. The radioactive material records reviewed by the inspector had been completed in accordance with the Department of Transportation (DOT) and NRC regulations.

The inspector observed the preparation of a shipping package and found that procedural requirements were being followed. An inventory identification number tracks all incoming and outgoing isotopes. An annual inventory verification report tracks what's on hand.

The training of staff members responsible for shipping material was also reviewed and noted to be completed every two years (more frequent than the three year requirement) and up-to-date. The shippers' training met NRC and DOT requirements.

c. Conclusion

Radioactive material shipments by the licensee were conducted in accordance with applicable procedures and regulatory requirements.

7. **Exit Interview**

The inspection scope and results were summarized on May 11, 2017, with members of licensee management. The inspector described the areas inspected and discussed in detail the inspection findings. The licensee acknowledged the results of the inspection.

## **PARTIAL LIST OF PERSONS CONTACTED**

### Licensee

K. Ünlü                      Director, Radiation Science & Engineering Center  
C. Davison                 Interim Associate Director for Operations

### Other Personnel

M. Lindsley                Radiation Safety Officer  
D. Bertocchi               Health Physics Technician  
T. Daubenspeck            Low Level Shipper

## **INSPECTION PROCEDURES USED**

IP 69001                  Class II Research and Test Reactors  
IP 86740                  Inspection of Transportation Activities

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

### Opened

None

### Closed

None

## **PARTIAL LIST OF ACRONYMS USED**

10 CFR                    Title 10 of the *Code of Federal Regulations*  
AOP                        Auxiliary Operating Procedure  
AP                         Administrative Procedure  
CCP                        Checks and Calibrations Procedure  
EHS                        Environmental Health and Safety  
FY                         Fiscal Year  
DOT                        Department of Transportation  
IP                         Inspection Procedure  
NRC                        U.S. Nuclear Regulatory Commission  
PSBR                      Pennsylvania State Breazeale Reactor  
Rev.                        Revision  
RSC                        Reactor Safeguards Committee  
SOP                        Standard Operating Procedure  
TS                         Technical Specification