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*The John A. Edwardson Dean of Engineering*  
*Ransburg Distinguished Professor*  
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May 22, 2014

Mr. Duane A. Hardesty  
Attn: Document Control Desk  
U.S. Nuclear Regulatory Commission  
One White Flint North  
11555 Rockville Pike  
Rockville, MD 20852-2738

RE: Submission of 2013 Annual Report for PUR-1, Docket Number 50-182

Dear Mr. Hardesty,

Enclosed please find one copy of the 2013 Annual Report for the Purdue University Research Reactor, PUR-1, Docket Number 50-182.

Should you have any questions, please contact Robert Bean ([bean@purdue.edu](mailto:bean@purdue.edu)).

Sincerely,



The John A. Edwardson Dean of Engineering  
Ransburg Distinguished Professor of  
Electrical and Computer Engineering

cc: James F. Schweitzer, Chair CORO, Radiation Safety Officer, Purdue University  
Robert Bean, Director Radiation Laboratories, Purdue University  
File

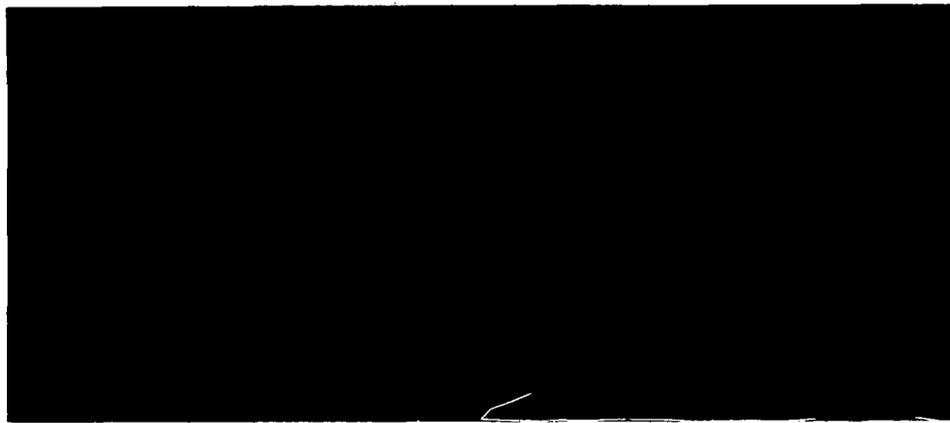


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**Purdue University**

**West Lafayette, Indiana 47907**



**REPORT ON REACTOR OPERATIONS**

**For the Period  
January 1, 2013 to December 31, 2013**

**PURDUE UNIVERSITY REACTOR-1 (PUR-1)  
Facility Docket No. 50-182  
PURDUE UNIVERSITY  
West Lafayette, Indiana 47907**

**May 2014**

**Prepared by  
Robert S. Bean, Facility Director  
and Nader Satvat, Reactor Supervisor**

## **1. INTRODUCTION**

This report is submitted to meet the requirements set forth in the technical specifications of the Purdue University Reactor (PUR-1) and 10 CFR 50.59 for the period January 1, 2013 to December 31, 2013.

## **2. PLANT DESIGN AND OPERATIONAL CHANGES**

### **2.1 Facility Design Changes**

There were no design changes to the facility in 2013.

### **2.2 Performance Characteristics**

The overall operation of the PUR-1 facility continued satisfactorily during the reporting period. However, due to unplanned maintenance and failure of channel 1, PUR-1 only achieved criticality twice.

During the visual inspection of the fuel on July 19<sup>th</sup> 2013 no changes were identified. This inspection included any defects that might compromise the integrity of the cladding including any evidence of corrosion. Monthly surveillances of process water showed no fission product contamination, verifying fuel integrity. Satisfactory performance of the fuel continued throughout the year.

### **2.3 Changes in Operating Procedures Concerning Safety of Facility Operations**

There were no changes to the operating procedures of the facility during 2013.

### **2.4 Results of Surveillance Tests and Inspections**

#### **2.4.1 Reactivity Limits**

The reactivity worths of the control rods were not determined due to failure of channel 1 and other outages due to series of unplanned maintenance. The latest measured values are the ones for 2011 and are as follows:

**Shim-safety #1: 3.96%**  
**Shim-safety #2: 2.19%**  
**Regulating Rod: 0.229%**

These values are consistent with previous reported values. The worth curves of the control rods were checked after the loading and the

excess reactivity was determined to be 0.42%, and the shutdown margin was determined to be 1.77% based on these values.

#### 2.4.2 Reactor Safety Systems

Each pre-startup check included a channel test for each safety system, provided the shutdown exceeded 8 hours or if the system was repaired or de-energized.

Each reactor safety system had a channel check performed at time intervals of 4 hours or less during operation.

On December 14, 2012, the electronic calibration of all safety channels was completed. This was not performed during 2013 due to extended maintenance down-time.

Power calibration using gold foils was not performed in 2013 due to extended maintenance down-time.

During the pre-startup, which precedes each run, the radiation area monitors and the continuous air monitor were checked for normal operation.

Area monitors and the CAM were calibrated on Jan 30, 2013 and July 24, 2013.

The rod drop times were measured on February 15, 2013. The rod drop times fell between 554.47 and 608.51 milliseconds. These values are consistent with past measurements and are well within the specification limit of one second.

The control rods were visually inspected on January 25, 2013. No evidence of deterioration or damage was observed.

#### 2.4.3 Primary Coolant System

The weekly measurements of the pH of the primary coolant consistently gave readings between 4.2 and 5.2 during 2013. In only two incidents, the value was as low as 4.2 which is outside the specification limits of  $5.5 \pm 1.0$ . The issue appears to be the current pH meter so a new pH meter was purchased. We are in the process of checking the new meter for consistent performance.

During the weekly checks and the pre-startup check, which precedes each run, the conductivity of the primary coolant was measured and

the values never exceeded 2.29 micromhos-cm. This represents a resistivity of more than 436,681.2 ohm/cm, which exceeds the lower limit of 330,000 ohm/cm as given in the specifications.

The specification of 13 feet of water was always either met or exceeded, according to the pre-startup checklist that was completed prior to each reactor run.

Monthly samples of the primary coolant were collected and analyzed by personnel from Radiological and Environmental Management for gross alpha and beta activity. No activity which would indicate failure of the fuel plates was identified in the samples.

#### 2.4.4 Containment

Readings between 0.04 and 0.17 inches of water were recorded weekly for the negative pressure in the reactor room. The reading of 0.04 inches of water is below the minimum required for operation. Upon investigation, we determined that the pressure gauge should be replaced, and we purchased a new pressure gauge.

The confinement negative pressure was greater than 0.05 inches of water before any operation, according to the pre-start checklists.

A visual inspection of fuel plates was performed on July 19, 2013. The surface condition of the fuel plates indicated no change from the last inspection, and the cladding of the other inspected plates identified no changes.

#### 2.4.5 Experiments

The mass of the singly encapsulated samples and the flux of the reactor are such that the complete release of all gaseous, particulate, and volatile components of the samples would not result in doses in excess of 10% of the equivalent annual doses as stated in 10 CFR 20.

No samples of unknown composition were irradiated in 2013.

### 2.5 Changes, Tests and Experiments Requiring Commission Authorization

During 2013 no changes, or experiments, which required authorization from the Commission pursuant to 10 CFR 50.59 (a), were performed.

## 2.6 Changes in Facility Staff

As of Aug 12, 2013 Professor Robert S. Bean is the new facility director.

## 3. POWER GENERATION

Operation of the PUR-1 during 2013 consisted of 11 runs, which only had two criticalities and the rest of the runs were scrapped. The total run time was 4.3 hours and total energy generated was 300 Joules.

## 4. UNSCHEDULED SHUTDOWNS

There were no unscheduled shutdowns during 2013.

## 5. MAINTENANCE

The HEPA filter for the room exhaust air was replaced September 24, 2013. The confinement pressure monitor was replaced on September 18, 2013.

## 6. CHANGES, TESTS AND EXPERIMENTS

No changes, tests or experiments were carried out without prior Commission approval pursuant to the requirements of 10 CFR 50.59 (b).

## 7. RADIOACTIVE EFFLUENT RELEASES

No measurable amount of radioactive effluent was released to the environs beyond our effective control, as measured at or prior to the point of such release.

## 8. OCCUPATIONAL PERSONNEL RADIATION EXPOSURE

No radiation exposures greater than 25% of the appropriate limits of 10 CFR 20 were received during the reporting period.