

**Purdue University**  
*School of Nuclear Engineering*

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March 28, 2007

U.S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, DC 20555-0001

Docket No. 50-182

Enclosed please find two copies of the 2006 Annual Report for the Purdue University Reactor (PUR-1).

Sincerely,

E. C. Merritt  
Reactor Supervisor

A020

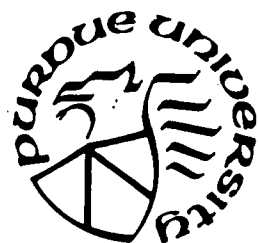
**SCHOOL  
OF  
NUCLEAR ENGINEERING**

**REPORT ON REACTOR OPERATIONS**

**For the Period  
January 1, 2006 to December 31, 2006**

**Purdue University**

**West Lafayette, Indiana 47907**



**REPORT ON REACTOR OPERATIONS**

**For the Period  
January 1, 2006 to December 31, 2006**

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

**March 2007**

**Prepared by  
E. C. Merritt  
Reactor Supervisor**

## **1. INTRODUCTION**

This report is submitted to meet the requirements set forth in 10 CFR 50.59 and the technical specifications of the Purdue University Reactor (PUR-1) for the period January 1, 2006 to December 31, 2006.

During the reporting period of 2006 a total of 1048 people visited the reactor facility. Those people included 132 different groups, of which 78 groups were for the purpose of maintenance or surveillance testing, 19 groups were for class purposes, 110 groups were tours, and 5 groups were participants in our reactor sharing program.

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

### **2.1 Facility Design Changes**

There were no design changes to the facility in 2006.

### **2.2 Performance Characteristics**

The operation of the PUR-1 facility continued satisfactorily during the reporting period. During the visual inspection of the surfaces of two representative fuel plates, no changes were identified. This inspection included any defects that might compromise the integrity of the cladding including any evidence of corrosion. Satisfactory performance of the fuel continued during the year.

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

There were no new procedures approved during the reporting period.

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

#### **2.4.1 Reactivity Limits**

The reactivity worths of the control rods were determined to be as follows:

Shim-safety #1 - 4.11%

Shim-safety #2 - 2.31%

Regulating Rod - 0.265%

These values are consistent with previous reported values. The worth curves of the control rods were checked after the inspection and the excess was determined to be 0.43%. The shutdown margin was determined to be 1.88% based on these values.

The inspection of the control rods was completed on October 23, 2006 with no evidence of change or deterioration observed.

Two experiments were placed in the reactor pool during the year that required the determination of its reactivity during the initial criticality following its installation. The result was at most one one-thousandth of the allowable reactivity worth in the Tech. Specs.

#### 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 during operation with one exception dated April 27, 2006.

On February 13, 2007, the required 2006 electronic calibration of all safety channels was completed.

The required 2006 irradiation of gold foils for a power calibration was done on March 23, 2007. The calibration indicated that the actual power was below (i.e., conservative) the indicated power level (i.e. the actual power being 788 watts when the indicated power level was at 810 watts).

During the pre-startup, which precedes each run, the radiation area monitors and the continuous air monitor were checked for normal operation. During 2006, the calibration of the radiation area monitors was completed on March 20 and August 3 and the continuous air monitor was completed on January 20 and July 31.

Following the control rod inspections, the rod drop times were measured on October 23, 2006. The rod drop times fell between 524 and 591 milliseconds. These values are consistent with past measurements and are well within the specification limit of one second.

#### 2.4.3 Primary Coolant System

The weekly measurements of the pH of the primary coolant consistently gave readings between 5.0 and 5.3 during 2006. These values are within the specification limits of  $5.5 \pm 1.0$ . 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 2.18 micromhos-cm. This represents a resistivity of more than 459,000 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 was identified in the samples, which would indicate failure of the fuel plates.

#### 2.4.4 Containment

Readings between 0.11 and 0.21 inches of water were recorded weekly for the negative pressure in the reactor room.

The semi-annual checks for the proper operation of the inlet and outlet dampers and the air conditioner were completed on June 21, 2006 and December 18, 2006. All worked satisfactorily.

Selected fuel plates were visually inspected on October 23, 2006. The surface condition of fuel plate #4-3-73 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 2006. Two experiments that required reactivity evaluation were carried out during the reporting period. The resulting reactivity worth change was negligible for all samples.

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

During 2006 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

There were no changes in the Facility Staff during the year. During 2006 there were two licensed operators, at the facility.

### **3. POWER GENERATION**

Operation of the PUR-1 during 2006 consisted of 54 runs, which generated 153,859 watt-minutes of energy and covered an integrated running time of 141.2 hours.

### **4. UNSCHEDULED SHUTDOWNS**

Five unscheduled shutdowns occurred during 2006. April 13 a rod dropped leaving no indication as to the cause, November 29, Channel 3 was rotated the wrong direction twice. Operators will need to be more observant during student operations. Nov. 30 scrambled due to drive motor/gearbox dragging. Dec. 5 the reactor was shut down by gang-lower because the Channel-3 chart recorder was not responding correctly causing the operator much trouble in finding exact level. Gummy chart recorder ink on sliding parts was found to be the cause.

### **5. MAINTENANCE**

There were twelve instances of non-routine maintenance during the reporting period. Five had to do with standard parts replacement, or substitution (4-tubes, fuse, resistor, and capacitor). A spare area monitor was placed in service Jan. 20<sup>th</sup> retiring the old one. In July a campus chilled water outage reduced HVAC to the reactor room, and the excessive heat caused a capacitor failure, requiring the replacement of the channel 3 micro-micro ammeter. Also the source drive cable was replaced, a clog in the inlet line was removed, a check valve in the make-up water system was replaced, and the lower limit micro switch on reg. rod was replaced. On 30 November, the shim-safety #1 drive did not drive down during a routine student experiment. There was no 'jam' indication, and the rod scrambled correctly. After disassembly and investigation of the motor/gearbox no broken parts and only the usual wear was found. The box was cleaned, lubricated and reassembled resulting in no further trouble to date. All could be expected with our instrumentation.

### **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.