



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

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March 28, 2008

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

Docket No. 50-182

Enclosed please find two copies of the 2007 Annual Report for the Purdue University Reactor (PUR-1).

Sincerely,

A handwritten signature in black ink, appearing to read 'E. C. Merritt'.

E. C. Merritt  
Reactor Supervisor

A020  
NRR

**REPORT ON REACTOR OPERATIONS**

**For the Period  
January 1, 2007 to December 31, 2007**

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

**March 2008**

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

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## **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, 2007 to December 31, 2007.

During the reporting period a total of 803 people visited the reactor facility. Those people included 273 different groups, of which 191 groups were for the purpose of maintenance, fuel loading or surveillance testing, 28 groups were for class purposes, 53 groups were tours, and 2 groups participated in our reactor sharing program.

The fuel of the reactor was converted from highly enriched uranium (HEU) to low enriched uranium (LEU) during the reporting year, and the last core loading change was made on November 12, 2007.

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

### **2.1 Facility Design Changes**

The lower enrichment did not change the reactor function, control or the intended function of the reactor. With the exception of required changes for the LEU; cans, safety limit, fuel materials, etc.; there were no design changes to the facility in 2007.

### **2.2 Performance Characteristics**

The operation of the PUR-1 facility continued satisfactorily during the reporting period. During the visual inspection as the HEU fuel was removed, 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 until removal.

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

The new safety related procedures approved during the reporting period were required for the fuel conversion. These included:

- 07-01: Core Unloading, Procedure
- 07-04: Initial Fuel Assembly Loading Procedure
- 07-05: Fuel Assembly Re-loading Procedure

Two other indirect safety related procedures were also approved:

- 07-02: Inspection of Control Rods (replaces 96-5)
- 07-03: New fuel receipt and inspection,

All of these procedures were evaluated for safety, adherence to technical specifications, and were approved by the CORO prior to their use.

## 2.4 Results of Surveillance Tests and Inspections

### 2.4.1 Reactivity Limits

The reactivity worths of the control rods were determined after the LEU was installed and were found to be as follows:

|                 |        |
|-----------------|--------|
| Shim-safety #1: | 3.93%  |
| Shim-safety #2: | 2.22%  |
| Regulating Rod: | 0.272% |

These values are consistent with previous reported values. The worth curves of the control rods were checked after the loading and the excess was determined to be 0.42%, and the shutdown margin was determined to be 1.80% based on these values.

The inspection of the control rods was completed on September 12, 2007 with no evidence of change or deterioration observed.

No experiments were performed during 2007 that required a determination of the reactivity worth of the experiment per Technical Specification 4.1.c.

### 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 three exceptions.

On February 15, 2008, the required 2007 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 2007, the calibration of the radiation area monitors was completed on January 9 and July 26 and the continuous air monitor was completed on January 8 and July 27.

During installation of the LEU core, the control rods were inspected, and the rod drop times were measured on September 11 and September 28, 2007. The rod drop times fell between 513 and 665 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 4.9 and 5.2 during 2007. 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 1.32 micromhos-cm. This represents a resistivity of more than 759,000 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 0.08 and 0.23 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 July 16 and December 14, 2007. All worked satisfactorily.

Many HEU fuel plates and entire bundles of LEU were visually inspected on September 7, 2007. The surface condition of HEU fuel plates indicated no change from the last inspection, and the cladding of the other inspected plates identified no changes. The LEU fuel was X-rayed, photographed, measured and each plate has a visual inspection record.

#### 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 2007.

## 2.5 Changes, Tests and Experiments Requiring Commission Authorization

Pursuant to 10 CFR 50.64, the conversion of PUR-1 from HEU to LEU was completed in 2007. Two license amendments were issued by the NRC for this activity. The first was Amendment 11 (ML071550409, EA-07-160), which increased the possession limits of PUR-1 to allow for receipt of the new LEU fuel prior to the order being issued. A request for the limit increase was submitted 25 May 2007 (ML071500054), with an appropriate safety analysis. The order modifying the license included a safety evaluation report.

The second amendment, Amendment 12, to the PUR-1 license was the order to convert PUR-1 from HEU to LEU fuel (ML071920168, EA-07-197). This order was issued based on the Conversion Proposal (ML070920272) Safety Analysis Report, and subsequent Response to RAI (ML071410299). The order modifying the license included a safety evaluation report.

## 2.6 Changes in Facility Staff

There were no changes in the Facility Staff during the year. During 2007 there were three licensed operators, at the facility.

## 3. POWER GENERATION

Operation of the PUR-1 during 2007 consisted of 70 runs, which generated 33,134 watt-minutes of energy and covered an integrated running time of 38.0 hours with the HEU; and 47,780 watt-minutes in 157.4 hours with the new LEU. This gives a total run time of 195.4 hours with 80,914 watt-minutes.

## 4. UNSCHEDULED SHUTDOWNS

Three unscheduled shutdowns occurred during 2007. On February 16 there was excessive noise on channel 3 (our linear channel), on March 23 a rod dropped leaving no indication as to the cause, and on November 30, Channel 3 was rotated the wrong direction. Operators will need to be more observant during student operations. We have experienced no further dragging of the drive motor/gearbox.

## 5. MAINTENANCE

There were seven instances of non-routine and one of routine maintenance during the reporting period. Six had to do with standard parts replacement, or substitution (3-tubes, transistor, resistor, inductor, transformer and pump seal). In August the transformer vault was remodeled and up graded thus requiring the power to be turned off to the reactor. This resulted directly in some of our instrumentation problems and possibly some of the other

outages. Our water circulation pump was leaking and the seal was replaced with a new one in August. All problems of this type can be expected in our equipment.

#### **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). Note the HEU to LEU conversion information in 2.5 above.

#### **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.