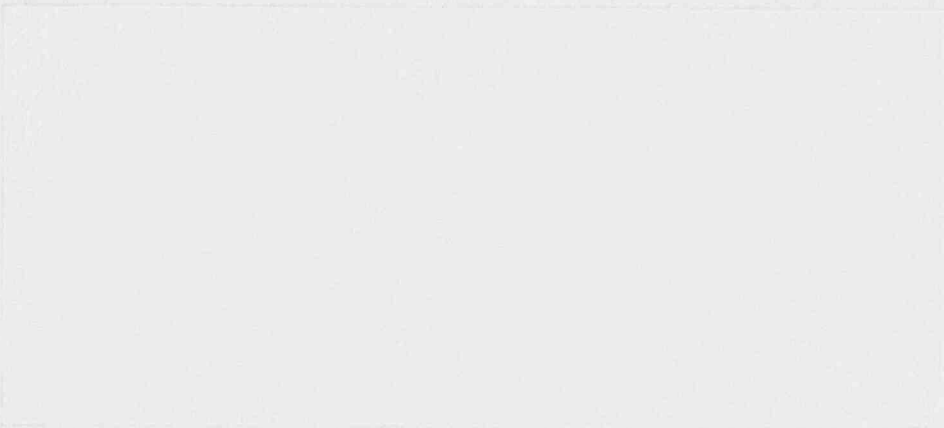


**SCHOOL  
OF  
NUCLEAR ENGINEERING**



**Purdue University**

**West Lafayette, Indiana 47907**



**REPORT ON REACTOR OPERATIONS**

For The period

January 1, 1987 to December 31, 1987

**PURDUE UNIVERSITY REACTOR-1**

**PURDUE UNIVERSITY**

**West Lafayette, Indiana 47907**

March 1988

Prepared by

**Eldon R. Stansberry**

**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, 1987 to December 31, 1987.

During the reporting period of 1987 a total of 604 persons visited the reactor facility. Those persons included 179 different groups, of which 102 groups were for the purpose of maintenance or surveillance testing, 13 groups were for class purposes, 9 groups were pre-scheduled tours and 7 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 1987.

### 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

No changes in the operating procedures of the facility were made during 1987.

### 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 - 4.98%

Shim-safety #2 - 2.63%

Regulating Rod - 0.25%

The worth curves of the control rods were checked after the inspection and the excess was calculated to be 0.41%. The shutdown margin was determined to be 7.46% based on these values.

The control rod inspection was done on July 13, 1987 with no evidence of change or deterioration observed.

No experiment was placed in the reactor pool during the year that would require the determination of its reactivity during the initial criticality following its installation.

#### 2.4.2 Reactor Safety Systems

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

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

The electronic calibration of all safety channels was completed on September 10, 1987.

On September 30, 1987 the irradiation of gold foils for a power calibration was made. No significant change was identified from this irradiation.

During the prestartup which precedes each run, the radiation area monitors and the continuous air monitor were checked for normal operation. During 1987 the calibration of the radiation area monitors was completed by March 13 and September 13 and the calibration of the continuous air monitor was completed by March 13 and September 28.

Following the control rod inspections, the rod drop times were measured on July 13, 1987. The rod drop times fell between 535 and 538 milliseconds. These values are consistent with past measurements and are well within the specification limits of 1 second.

#### 2.4.3 Primary Coolant System

The weekly measurements of the pH of the primary coolant fell between 4.8 and 6.3 during 1987. These value are within the specification limits of  $5.5 \pm 1.0$ .

During the prestartup check, which proceeds each run, the conductivity of the primary coolant was measured and the values never exceeded 1.38

micromhos-cm during the year. This represents a resistivity of more than 720,000 ohm/cm which exceeds the lower limit of 330,000 ohm/cm as given in the specifications.

According to the prestartup checklist the height of water above the core was 13 feet or greater for each reactor run. The specification of 13 feet of water was always either met or exceeded.

Monthly samples of the primary coolant was collected and analyzed by personnel from Radiological Control 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 0.06 and 0.145 inches of water were recorded weekly for the negative pressure in the reactor room and exceeded the minimum of 0.05 inches required by the specifications.

The semi-annual checks for the proper operation of the inlet and outlet dampers and the air conditioner were completed on May 1 and October 30, 1987. All worked satisfactorily.

On July 13, 1987 selected fuel plates were visually inspected. 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 or that required double encapsulation were submitted for irradiation.

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

No changes, or experiments which required authorization from the Commission pursuant to 10 CFR 50.59 (a) were performed during 1987.

## 2.6 Changes in Facility Staff

No changes in the facility staff occurred in 1987.

## 3. POWER GENERATION

Operation of the PUR-1 during 1987 consisted of 35 runs which generated 481,447 watt-minutes of energy and covered an integrated running time of 76.2 hours.

## 4. UNSCHEDULED SHUTDOWNS

Two unscheduled shutdowns occurred in 1987, both on the same run. Both instances were attributed to instrument instability. The annunciator indicated short periods on the log N channels at times when the periods were relatively quiet. No meters were observed to indicate a short period but that is often the case for period indications of this time. The electronic technician could identify no cause for the shutdowns.

## 5. MAINTENANCE

Only routine maintenance was required during the reporting period.

## 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 effluents were released to the environs beyond our effective control, as measured at or prior to the point of such release.

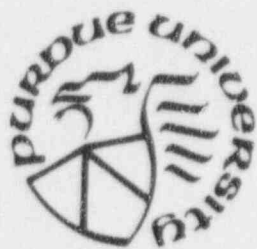
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**Reactor Supervisor**



## 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, 1988 to December 31, 1988.

During the reporting period of 1988 a total of 555 persons visited the reactor facility. Those persons included 162 different groups, of which 85 groups were for the purpose of maintenance or surveillance testing, 14 groups were for class purposes, 13 groups were pre-scheduled tours, 8 groups were participants in our reactor sharing program and 37 were miscellaneous groups.

## 2. PLANT DESIGN AND OPERATIONAL CHANGES

### 2.1 Facility Design Changes

There were no design changes to the facility in 1988.

### 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

No changes in the operating procedures of the facility were made during 1988.

### 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 - 4.95%  
Shim-safety #2 - 2.60%  
Regulating Rod - 0.25%

The worth curves of the control rods were checked after the inspection and the excess was calculated to be 0.40%. The shutdown margin was determined to be 7.40% based on these values.

The control rod inspection was done on July 12, 1988 with no evidence of change or deterioration observed.

No experiment was placed in the reactor pool during 1988 that would require the determination of its reactivity during the initial criticality following its installation.

#### 2.4.2 Reactor Safety Systems

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

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

The electronic calibration of all safety channels was completed on August 23, 1988.

On August 31, 1988 the irradiation of gold foils for a power calibration was made. No significant change was identified from this irradiation.

During the prestartup which precedes each run, the radiation area monitors and the continuous air monitor were checked for normal operation. During 1988 the calibration of the radiation area monitors was completed by March 30 and August 30 and the calibration of the continuous air monitor was completed by March 30 and September 26.

Following the control rod inspections, the rod drop times were measured on July 12, 1988. The rod drop times fell between 532 and 541 milliseconds. These values are consistent with past measurements and are well within the specification limits of 1 second.

#### 2.4.3 Primary Coolant System

The weekly measurements of the pH of the primary coolant fell between 4.7 and 6.0 during 1988. These value are within the specification limits of  $5.5 \pm 1.0$ .

During the prestartup check, which proceeds each run, the conductivity of the primary coolant was measured and the values never exceeded 1.34

micromhos-cm during the year. This represents a resistivity of more than 740,000 ohm/cm which exceeds the lower limit of 330,000 ohm/cm as given in the specifications.

According to the prestartup checklist the height of water above the core was 13 feet or greater for each reactor run. The specification of 13 feet of water was always either met or exceeded.

Monthly samples of the primary coolant was collected and analyzed by personnel from Radiological Control 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 0.07 and 0.145 inches of water were recorded weekly for the negative pressure in the reactor room and exceeded the minimum of 0.05 inches required by the specifications.

The semi-annual checks for the proper operation of the inlet and outlet dampers and the air conditioner were completed on May 3 and October 17, 1988. All worked satisfactorily.

On July 15, 1988 selected fuel plates were visually inspected. 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 or that required double encapsulation were submitted for irradiation.

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

No changes, or experiments which required authorization from the Commission pursuant to 10 CFR 50.59 (a) were performed during 1988.

## 2.6 Changes in Facility Staff

No changes in the facility staff occurred in 1988.

## 3. POWER GENERATION

Operation of the PUR-1 during 1988 consisted of 37 runs which generated 187,969 watt-minutes of energy and covered an integrated running time of 107.0 hours.

## 4. UNSCHEDULED SHUTDOWNS

Seven unscheduled shutdowns occurred in 1988. Six of these shutdowns were associated with instrument noise on the Log N channel. Voltage checks did not reveal the cause of the intermittent noise. Subsequent use of a digital storage oscilloscope finally determined the cause to be a defective tube in the Log N power supply. Replacement of the tube eliminated the troublesome noise.

A shim safety rod drop accounted for the other shutdown. Since the magnet current is operated for a 120% trip point instead of the designed trip point of 150%, the magnet current is starting to drop when we operate close to our full-licensed power. A piece of dust between the magnet and the armature or a noise pulse can easily cause a shutdown. The armatures and magnets were cleaned to minimize this possible cause.

## 5. MAINTENANCE

Only routine maintenance was required during the reporting period.

## 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 effluents were released to the environs beyond our effective control, as measured at or prior to the point of such release.