SCHOOL

OF

NUCLEAR ENGINEERING

Purdue University

West Lafayette, Indiana 47907

REPORT ON REACTOR OPERATIONS

For the Period

January 1, 1979 to December 31, 1979

PURDUE UNIVERSITY REACTOR-1

PURDUE UNIVERSITY

West Lafayette, Indiana 47907

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1. INTRODUCTION

This report describes the operation of the Purdue University Reactor (PUR-1) for the period from January 1 to December 31, 1979. The report is to meet the requirements set forth in 10CFR50.59 and in the PUR-1 Technical Specifications.

During 1979 the reactor continued to be available to all Schools and Departments of Purdue University as well as industrial organizations and other educational institutions for irradiations or educational purposes. Laboratory classes perform reactor experiments and irradiations as well as gain experience in reactor operation. All of these uses assist the University in its mission of education to the community.

In an effort to fulfill its role to educate students and the general public many tours and demonstrations were provided. Although the number of groups visiting the reactor declined to 33 during 1979, the total number of visitors increased to 800, indicating an increased desire for information about the field.

2. PLANT DESIGN AND OPERATIONAL CHANGES

Reactor operations during the year consisted of sample irradiations, instruction in reactor operation, laboratory experiments and surveillance checks.

2.1 Facility Design Changes

No changes in the facility design were made during the year.

2.2 Performance Characteristics

Instrumentation problems continue to cause shutdowns and delays. Preventive maintenance minimizes this problem, but a shortage of personnel to adapt state-of-the-art instrumentation to the existing system has prevented a more permanent solution to the instrumentation problem. In all cases the instrumentation problems have been such as to fail in a safe manner, causing inconvenience, but no safety problems.

Fuel performance continued satisfactory as indicated by an inspection completed June 29, 1979. Neither visual inspection nor measurements taken with a micrometer indicated any significant change in the fuel plates.

2.3 Changes in Operating Procedures Concerning Safety of Facility Operations

No change in operating procedures concerning the safety of facility operations was made during the year.

2.4 Results of Surveillance Tests and Inspections

2.4.1 Reactivity Limits. The reactivity worths of the control rods remained as follows:

Shim-safety #1 - 5.2% $\frac{\Delta k}{k}$

Shim-safety #2 - 2.6% $\frac{\Delta k}{k}$

Regulating Rod - .28% $\frac{\Delta k}{k}$

With an excess of .47% $\frac{\Delta k}{k}$ the shutdown margin was calculated to be 7.6% $\frac{\Delta k}{k}$.

The annual inspection of the control rods was completed on June 21, 1979 with no noticeable change observed.

No new experiment was placed in the PUR-1 that required a determination of its reactivity worth.

2.4.2 Reactor Safety System. A channel test was performed on each safety system channel during the prestartup check. This was done for each reactor run that follows a shutdown of 8 hours or more.

A channel check of each reactor safety channel was performed at least once every four hours when the reactor was critical.

An electronic calibration was completed on all the safety channels on March 23, 1979. The results are in close agreement with previous checks.

Verification that the radiation monitoring equipment is operational was completed during the prestartup procedure that preceeded each reactor run.

Shim-safety rod drop times were measured on June 21,1979 following the annual inspection of the rods. All drop times fell between 574 and 586 milliseconds which is below the 600 millisecond maximum. These drop times are consistant with past drop times.

2.4.3 Primary Coolant System. In an attempt to minimize any variables the pH of the primary coolant was measured each Monday before the skimmer was put into operation. Values between 5.6 and 5.9 were measured during 1979.

Conductivity of the pool water was recorded each Monday and never exceeded 1.14 micromho-cm during the year. This value corresponds to a resistivity greater than 877,000 ohm/cm.

The level of the primary coolant was recorded as part of the prestartup check list which preceeded each reactor run. It was maintained at or above the 13 foot level during operation the entire year.

2.4.4 Containment. The weekly posting of the negative pressure in the reactor room indicated 0.08 to 0.135 inches of water.

The operation of the inlet and outlet dampers of the exhaust system and the air conditioner are checked at the same time since they are controlled from the same toggle switch. Both systems were checked in April and October, and demonstrated correct operation.

Three representative fuel plates were inspected on June 29, 1979. No evidence of deterioration of the fuel cladding was revealed by the visual inspection or the micrometer measurements that were taken. Fuel plate number 4-3-73, incorporated as the ninth fuel plate in fuel assembly F-4, showed no visible change in the surface defect that has been inspected annually since its discovery in 1967.

2.4.5 Experiments. The singly encapsulated samples were of such small quantity and both the reactor flux and irradiation time so small that the complete release of all gaseous, particulate, or volatile components of the sample are below 10% of the equivalent annual doses stated in 10CFR20.

No samples requiring double encapsulation were irradiated.

2.5 Changes, Tests, and Experiments Requiring Commission Authorization

No changes, tests, or experiments which required authorization from the Commission pursuant to 10CFR50.59(a) were performed.

2.6 Changes in Facility Staff

There were no changes in the facility staff during the year.

3. POWER GENERATION

Operation of the PUR-1 during 1979 consisted of 53 runs which generated 641,374 watt-minutes of energy covering an integrated running time of 140.8 hours.

4. UNSCHEDULED SHUTDOWNS

During the year a total of 21 unscheduled shutdowns occurred. They were distributed as follows:

17 composite safety amplifier trouble

4 instrument noise

4.1 Composite Safety Amplifier Trouble

It is still felt that operation of the composite safety amplifiers so close to the trip points accounts for most of the unscheduled shutdowns. It takes very little drift in the magnet amplifiers to reach these trip points. A relay that would drop out if tapped was replaced, but no great improvement was noted after this maintenance.

A continuing program of preventive maintenance is an effort to reduce the unscheduled shutdowns due to instrument noise, but a permanent solution will depend upon replacement of the vacuum tube components.

4.2 Instrument Noise

Maintenance of existing instruments is still the immediate solution to noise induced shutdowns. Replacement of obsolete vacuum tube instrumentation with solid state instrumentation should provide a more permanent solution to the instrument noise problem.

5. MAINTENANCE

The motor on the exhaust fan was replaced with a motor that had been rebuilt. It failed in a little over 2 months and was replaced by a new motor.

A worn gear was replaced on the period chart recorder.

The replacement of components such as relays, vacuum tubes or resistors accounted for the major portion of the maintenance.

6. CHANGES, TESTS AND EXPERIMENTS

No changes, tests or experiments were carried out without prior Commission approval, pursuant to the requirements of 10CFRPart50.59(b).

7. RADIOACTIVE EFFLUENT RELEASES

No measurable amounts of radioactive effluents were released or discharged to the environs beyond the effective control of the Licensee

as measured at or prior to the point of such release or discharge.

8. OCCUPATIONAL PERSONNEL RADIATION EXPOSURES

No personnel received radiation exposures greater than 500 mRem (50 mRem for persons under 18 years of age) during the reporting period.