THE UNIVERSITY OF MARYLAND
COLLEGE PARK CAMPUS
Department of Chemical and Nuclear Engineering
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Nuclear Engineering Program

50-166

July 19, 1988

Section 50.4 Distribution
Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir/Madam:

This annual report is submitted in accordance with requirements set forth in our Technical Specifications for the Maryland University Training Reactor (MUTR). This report covers the time period from July 1, 1987 to June 30, 1988.

A. Summary of Operation Experience

During the reporting period the reactor was operated 208 times, an increase of 3% over the previous reporting period, producing a total of 27099 kilowatt- hours of energy. This represents a consumption of approximately 1.4 grams of U - 235.

Several minor problems were encountered with the reactor during this reporting period. Corrections and minor adjustments were made to the reactor as needed to respond to each of these issues.

The general reactor operations can be broken down into the following categories:

a. Operator Training (30%)
b. Nuclear Engineering Courses (16%)
c. Activation Analysis (9%)
d. Calibration, Surveillance and Maintenance (10%)
e. Tours, Demonstrations, and Teaching Laboratories for Outside Organizations (18%)
f. Radioisotope Production (7%)
g. Material Irradiations (10%)

We continued to provide reactor service to the Nuclear Engineering courses; primarily, ENNU 320 - Nuclear Reactor Operations. This service utilized the reactor for four (4) two hour sessions per week during the Spring semester. A rather extensive reactor operator training program was undertaken during the summer months. Because of this effort, four students obtained Senior Reactor Operator Licenses and two obtained Reactor Operator Licenses. The Facility now has more current licensed operators than anytime in its 2. + year history.

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A number of undergraduate students have used the MUTR for student research projects. These projects resulted in six papers given at both the Eastern Regional ANS Student Conference and the the recent TRIGA Reactor Users Conference. Two papers won awards at the Student Conference. A third paper won an American Society of Women Engineers (ASWE) award and will be presented at an ASWE conference in July.

The DOE "Reactor Sharing Program" was renewed at about the same level of effort for this reporting period. This enabled us to use four (4) students on a part-time basis to support reactor operations. The number of students from regional institutions taking part in this program almost doubled from last year.

ASTM standard characterization of the neutron and gamma fluxes in the reactor facilities continued this period. In addition, we have obtained NBS-traceable 1-MeV equivalent silicon neutron fluence measurement capability in the MUTR experimental facilities.

The reactor facility was used to produce amounts of P-32 used as radioactive tracers in research work in the biochemistry department at the University. To obtain the amounts needed, the reactor was operated at near full power for 50 hours in two separate 5 day periods. All of the newly qualified Reactor Operators were used in shifts during these irradiations.

Irradiation effect studies on electronic components and systems has increased during this time period. Several electonics firms have used the facilities to measure the neutron exposure level which leads to failure of the system.

Activation analysis work for the Wye River Institute to determine the extent of migration of fertilizer from fields near the Chesapeake Bay has been completed.

Samples of ceramic material have been activated in the MUTR as part of a study being carried out at UM Baltimore Campus concerning high temperature superconducting properties.

Some research on a new type of neutron dosimeter, called a bubble detector, for the Navy is being conducted using the Reactor Facility. This study will be part of a Master's thesis when completed at the end of summer.

We have carried out some preliminary training for beginning power reactor operator trainees from a Nuclear Power Plant in the Atlantic Region. The MUTR facility is quite well suited for this type of training, and was designed and constructed with this objective in mind.

We have also used the facilities as part of a Health Physics training course undertaken by a local training firm. The students obtain practical experience of monitoring radiation levels around a nuclear reactor and handling radioactive material.

B. Maintenance Items

Regulating Rod:

We have been experiencing some problems with the Regulating Rod drive mechanism and controller. Sometimes the drive mechanism gears would bind and the rod would not drive out. This usually could be taken care of by dropping the rod and starting over. On one occasion the gears jammed and the drive mechanism (magnet, not the armature) would not drive down. These problems were resolved by modifying the worm wheel gear shaft bearing and replacing the worm wheel gear. In addition, the Reg Rod position indicator appears to drift about 4% maximum. The rod itself doesn't drift, but rather the position indicator. We are not sure what component causes the drift, but suspect it may be the potentiometer. We are carrying out tests in order to isolate the problem. It is not a safety concern at the present time because of the relatively small amount of drift.

At the beginning of last summer, the size of the dead band on the automatic flux controller was adjusted to be large enough that the drive mechanism would not continuously hunt and search for the correct rod position. Over the course of this reporting period, the dead band size has narrowed again, and adjustments will have to be made again.

Log % Power Amplifier:

We have experienced some unplanned period scrams which appear to have their origin in adrifting of the Campbelling Mode cross-over point in the log amplifier. These period scrams occur somewhat above 25 watts where the log amplifier usually changes operation from the pulse counting mode to the statistical variance (Campbelling) mode. This is not part of a Safety Channel and therefore does not involve a safety concern. The problem has usually been taken care of by spraying the test position contacts with Tuner Cleaner, causing better electrical connection.

On Sept. 9 1987, arcing was observed between two high voltage pins on the circuit board in the log % power drawer which resulted in excessive fluctuations in the log % power meter and chart recorder. This was corrected by changing the pin locations connected to the high voltage.

Compensated Ion Chamber (CIC):

It is never possible to adjust the compensating voltage on the CIC so that it is exactly gamma compensated over the full power. Over the years we have usually set the compensating voltage such that it was overcompensated, particularly at low power. This resulted in the chart recorder being pegged on zero at low power, particularly after a high power run when the gamma to neutron ratio was high. It was reasoned that it would be more conservative to have the CIC undercompensated so as to give a higher than actual reading, especially at the low power levels, so that the chart recorder would never be pegged at zero. Therefore the compensating voltage was reduced somewhat to allow for undercompensation.

Radiation Area Monitors (RAMS):

New RAMS have been installed, calibrated, and are part of the scram circuitry at the present time. The old RAMS are still functioning and are still part of the scram circuitry. This provides much more safety than necessary. The plan is to replace the present glove box GM detector with the old exhaust RAM, and the old ion exchange GM detector with the old bridge RAM.

Pool Tank Cleaning:

A swimming pool vacuum cleaner was used to clean the reactor pool last summer. The main effort was to sweep up the ion exchange resins that got into the pool due to a broken metal strainer in the ion exchange column which occured several years ago. We were able to sweep up all the visible resins and some collected dirt. None of the cleaned up material was very radioactive, only slightly above background. It was however disposed of as solid rad waste. Over the course of this reporting period, some more of the resins that were hiding under the core support structure have emerged into visible stagnant areas under the beam ports and through tube. These resins do not pose a saftey problem, and they probably don't have much induced radioactivity.

Also during this reporting period, the ion exchange resins and coarse filter were replaced. Both were placed in the rad waste because they had activities somewhat above background.

Hot Room Shadow Shield Repair and Upgrade:

Last summer a student who was using the lead brick shadow shield in the Hot Room grabbed hold of the wall for support and it broke loose and fell onto the floor. Fortunately no one was seriously hurt in the accident, but a number of the bricks were deformed. These bricks were repaired and the wall redesigned to have a structural restraint around the lead brick wall.

Reactor Building Intake and Exhaust Louvers:

The bi-annual external audit team commented that the building louvers did not close very quickly and did not close tightly enough. In response to these comments, the intake and exhaust louvers were repaired. They now close more quickly and tightly than before. It should be noted that we are allowed nominal leakage rates and closure times in the Technical Specifications and therefore were not in violation even before the improvements.

C. Equipment Surveillance and Tests

Area Radiation Monitors:

Area radiation monitors for the bridge and exhaust were calibrated in accordance with the Technical Specification surveillance schedule.

Pool Water Analysis:

Pool water was sampled and activation analysis made on a monthly basis in accordance with the Technical Specification surveillance schedule. No measured radioisotope concentration was found to be above MPC limits.

Control Rod Inspection:

A control rod inspection was performed Dec. 16, 1986. The appearance of the rods has not changed since the last inspection of Jan. 7, 1985. The next inspection will be performed before the end of this calendar year.

Control Rod Calibration:

Control rod worth calibrations were performed during the time period Sept. 8 - 13, 1986. The measured integral and differential worth is within experimental error of previous calibrations. Shutdown margins and excess reactivities were calculated and found to be within the Technical Specification requirements. The next calibration will be performed before the end of this calendar year.

Control Rod Drop Time:

Control rod drop times were last measured on Feb. 4, 1988 for the Shim Rods and April 28, 1988 for the Reg Rod. All drop times were less than .7 seconds which is less than the 1 second required by the Technical Specifications.

Power Calibration:

A power calibration was performed on Sept. 1, 1987. The measured thermal power output was 200 kW and the indicated power on Safety Channel I and II was also 200 kW, within a reading error of 1kW. Since the measured and indicated power levels were the same, no adjustments of either Safety Channel were made.

D. Radioactive Effluent Discharged to the Environment and Radioactive Waste Shipped Off-site for Disposal

No waste water with radioisotopic concentrations greater than MPC were discharged to the sewer system. Monthly air samples taken in the reactor building contained no activity greater than background. A small amount of low level radioactive waste in liquid and solid form has been shipped for off-site disposal through the University Radiation Safety Office.

E. Unplanned Shut-Downs, Scrams and Reportable Occurrences

There were no Reportable Occurrences during this reporting period while there were several unplanned shut-downs and scrams during this time period. Six unplanned scrams were due to drifting of the Campbelling mode transition as discussed above in the Maintenance section. These scrams indicated as period scrams, but were caused by the Campbelling mode transition drift.

One unexpected scram was caused by arcing of the high voltage pin in the log percent power circuit board as discuused in the Maintenance section. During one operation at high power, a visitor dropped a dosimeter into the pool and the operator scrammed the reactor. The dosimeter was quickly retrieved and the high power run continued. We also had another period scram due to operator error, and one due to unknown causes. Finally, there was a scram on high level due to noise in the circuitry.

F. Radiation Exposures

See the attached ALARA audits for this time period.

G. Changes to Facility Personnel, Procedures, and Special Experiments

No changes were made to the Facility Procedures and no special experiments were undertaken during this reporting period. Dr. Ralph Belcher retired from his position of Associate Reactor Director in September of 1987. Bernie White has assumed the position of Reactor Operations Manager, effective September 1, 1988

Sincerely yours,

Marvin L. Roush

Marvin L. Roush, Chairman
Chemical & Nuclear Engineering Dept.

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Nuclear Engineering Program

July 15, 1988

MEMO TO: Dr. Joe Silverman
Chairman
Reactor Safety Committee

MEMO FROM: David D. Ebert
Dr. David D. Ebert,
Reactor Director

Subject: ALARA Audit for 6/16/87 to 6/15/88

Item 1 - RADIATION AREA MONITOR CALIBRATION

All portable radiation monitors have been calibrated semi-annually. This service is performed by Radiation Safety with the exception of the RAMS. The RAMS were calibrated on 10/26/87 in accordance with the annual Technical Specification requirement.

Item 2 - CONTROL ROD INSPECTION

Control rods are inspected bi-annually. The last inspection was performed on 12/16/86. The next inspection is planned for December 1988.

Item 3 - FUEL ROD INSPECTION

This inspection is not required according to the MUTR Technical Specifications (8/7/84). This inspection has been replaced by the Pool Water Gamma Ray Analysis.

Item 4 - POWER CALIBRATION

A power calibration was performed on 9/1/87. The results of the calibration were as follows.

Indicated power level on:

Safety Channel I = 200 kW
Safety Channel II = 200 kW

Measrured thermal power = 200 kw

Since the measured and indicated power levels were within the experimental error bound, no adjustments of Safety Channels I or II were made.

Item 5 - POOL WATER GAMMA ACTIVITY ANALYSIS

Radioisotope gamma activity analysis of the reactor pool water has been performed on a monthly basis. No radioisotopes attributable to fission products were found. All radioisotopic concentrations were much less than the Maximum Permissible Concentration (MPC) for the general public. The same was true with the sump water which was dumped periodically to sewer.

Item 6 - FILM BADGE EXPOSURE RECORDS

All but 8 personnel film badge records showed exposures less than the minimum detectable dose equivalent of 10 mrem. These 8 people received exposures greater than 10 mrem were distributed as follows:

2 people received dose equivalent between 10 and 20 mrem
2 people received dose equivalent between 20 and 30 mrem
1 person received dose equivalent between 30 and 40 mrem
3 people received dose equivalent between 40 and 50 mrem

The following is a list of the 10 area monitor film badges.

Monitor #	Location	Exposure (mrem)
1	Control Room	<10
2	Bridge	1620
3	Hot Room	130
4	W. Balcony	330
5	S. Wall Upper Level	140
6	S. Wall Lower Level	200
7	E. Wall Lower Level	130
8	Water Room	860 *
9	N. Wall Lower Level	420
10	W. Wall Lower Level	<10

* - Pu/Be sources stored in water room

Item 7 - CONTAMINATION SURVEY REPORT

No contamination was found in the Reactor Area during the reporting period.

Item 8 - SELF-READING POCKET DOSIMETERS

a. Calibration

The calibrations were performed every 6 months by Radiation Safety.

b. Visitors Log of Personnel Exposure

No significant dose was recorded on the pocket dosimeters for any visitors during this audit period.