UNIVERSITY OF MASSACHUSETTS LOWELL

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RADIATION LABORATORY

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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: License No. R-125, Docket No. 50-223

Pursuant to the Technical Specifications for license referenced above, we are submitting the Annual Report for the University of Massachusetts Lowell Research Reactor.

Sincerely,

Leo M. Bobek,
Reactor Supervisor

cc: T. Dragoun, Region I
T. S. Michaels, Senior Project Manager

OPERATING REPORT

FOR THE

UNIVERSITY OF MASS. LOWELL REACTOR

FOR THE PERIOD

JULY 1, 1997 TO JUNE 30, 1998

Docket No. 50-223

License No. R-125

OP97-1

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A. INTRODUCTION

In the late 1950's the decision was made to build a Nuclear Center at what was then Lowell Technological Institute. Its stated aim was to train and educate nuclear scientists, engineers and technicians, to serve as a multi-disciplinary research center for LTI and all New England academic institutes, to serve the Massachusetts business community, and to lead the way in the economic revitalization of the Merrimack Valley. The decision was taken to supply a nuclear reactor and a Van-de-Graaff accelerator as the initial basic equipment.

Construction of the Center was started in the summer of 1966. Classrooms, offices, and the Van-de-Graaff accelerator were in use by 1970. Reactor license R-125 was issued by the Atomic Energy Commission on December 24, 1974, and initial criticality was achieved on January 1975.

The name of the Nuclear Center was officially changed to the "Pinanski Building" in the spring of 1980. The purpose was to reflect the change in emphasis of work at the center from strictly nuclear studies. At that time, the University of Lowell Reactor became part of a newly established Radiation Laboratory. The Laboratory occupies the first floor of the Pinanski Building and performs or coordinates research and educational studies in the fields of physics, radiological sciences, and nuclear engineering. The remaining two floors of the Pinanski Building are presently occupied by various other University departments.

On February 14, 1985, the University of Lowell submitted an application to the Nuclear Regulatory Commission for renewal of the facility operating license R-125 for a period of 30 years. On November 21, 1985, the license renewal was granted as Amendment No.9 of License R-125 in accordance with the Atomic Energy Act of 1954.

B. FUNCTION

The Radiation Laboratory is a major research focal point of the University. More than 200 graduate students have used or are using the Laboratory's services; the comparable number for the faculty is in excess of 25. The University departments utilizing the facility include Biology, Chemistry, Earth Sciences, Physics, Mechanical Engineering, Plastics Engineering, Radiological Science and Chemical/Nuclear Engineering. The University's Amherst campus and Medical Center have active research programs at the Radiation Laboratory. Much research is concerned with safety and efficiency in the nuclear and radiation industries, including pharmaceuticals, medical applications, health effects, public utilities, etc.; however, much research is also done by workers in other fields who use the unique facilities as analytical tools.

In addition, the Laboratory's facilities are used in the course work of various departments of the University. It also provides these services to other campuses of the Massachusetts system, other universities in the New England area, government agencies and, to a limited extent, industrial organizations in Massachusetts and the New England area, as well as numerous school science programs in the Merrimack Valley.

C. OPERATING EXPERIENCE

1. Experiments and Facility Use

The major uses of the reactor during this fiscal year were activation analysis, dosimetry studies, calibrations, specialized isotope production, neutron effects studies, teaching and personnel training.

Activation techniques were used to study geologic composition of rock samples and constituents of forest soils. The evaluation of the neutron to the gamma ratio and detailed neutron spectral mapping for in-core experiments is continuing.

Dosimetry studies and calibrations utilized N-16 production for high energy gamma fields and reactor facilities for mixed neutron and gamma dosimetry.

Isotopes were produced for calibration standards, medical research use, and lab practicums.

Reactor operating time used for teaching purposes included a reactor operations course emphasizing control rod calibrations, critical approaches, period measurement, prompt drops and calorimetric measurement of power and preparation of students and staff members for NRC licensing examinations. Freshman laboratories for reactor principles and activation analysis were conducted for chemical/nuclear engineering students.

Radiological science students utilized the facility for performance of radiation and contamination surveys. Senior students participated in a laboratory that required locating and identifying an unknown isotope of low activity in a mockup power plant environment. The isotope was provided for the students in an isolated area in the reactor pump room during non-operating hours. During the practicum, the students were supervised by faculty and staff. The reactor served as a source of neutron and gamma radiation for various radiological science and biology laboratories.

A number of activation and decay experiments were performed for both university and non-university students alike. For the seventh consecutive year, activation and decay experiments were provided for local school science classes involving more than 2,000 students who observed the experiment at the reactor or in their classrooms via interactive cable T.V.

The major outside uses for the reactor facility is neutron and gamma damage studies of electronic components, characterization of neutron detectors, and neutron effects upon materials.

2. Changes in Facility Design

Changes are pending to nuclear instrumentation and radiation monitoring systems under the provisions of 10CFR50.59.

3. Performance Characteristics

Overall, the performance of the reactor and associated systems has been normal over the past year.

4. Changes in Operating Procedures Related to Reactor Safety

The Department of Energy has revised the projected date for LEU fuel receipt to January 1999. Submittals to all NRC requests and answers to questions were completed in July, 1997 and an NRC order to effect the change to LEU fuel was issued on July 31, 1997. Changes to operating procedures will then be needed to implement the new fuel use.

Provisional changes to operating procedures have been made and approved for new nuclear instrumentation. They will be implemented as the equipment is installed. The same process will be used for new radiation monitoring equipment.

5. Results of Surveillance Test and Inspections

All Technical Specification Surveillances required during the fiscal year were performed in a timely manner. The results of each requirement have been reviewed by the Reactor Supervisor and Chief Reactor Operator. Almost all surveillance test results were found to be within specified limits and surveillance inspections revealed no abnormalities which would jeopardize the safe operation of the reactor. Each required calibration was also performed.

6. Staff Changes

Major changes to staff included the retirement of the Reactor Supervisor in January 1998. Subsequently, the Chief Reactor Operator became Acting Supervisor. A new Reactor Supervisor has been hired and will begin as July 1, 1998. The Health Physics Technician has transfered to another position within the university. Negotiations with the university administration are ongoing to authorize hiring a replacement. A part-time student senior reactor operator left in June. As of June 30, the reactor staff consists of two part-time student reactor operators and two full-time senior reactor operators, including the Acting Supervisor. An NRC license examination is scheduled for August 1998.

7. Operations Summary

During the course of the reporting period 1997-1998, the reactor was critical a total of 546.27 hours. The utilization is broken down as follows:

Operating Hours

Critical hours	627.29
Hours at full power	
Megawatt hours	517.43

Experimental Utilization

Sample hours	1038.49
(includes multiple samples)	
Number of irradiations	188
Number of training hours	417.81

D. ENERGY GENERATED

Total energy generated (MWD)	21.56
Number of hours reactor was critical	627.29
Total cumulative energy output (MWD)	249.71

E. INADVERTENT AND EMERGENCY SHUTDOWNS

There were 14 inadvertent scrams. Nine of these scrams were due to electronic noise on aging instrumentation which is being replaced. One scram occured due to loss of pressure on an access door seal. The four remaining scrams not related to instruments were operator errors in which three were upranging and downranging aged picoammeters, and the fourth due to a trip not being reset.

F. MAJOR MAINTENANCE

In order to maintain operations, two high enriched fuel elements were received and placed in core. Appropriate physics testing as required by the license Technical Specifications was performed to assure all operation requirements were met. The two HEU elements will permit continued operations until the LEU conversion takes place.

No other major maintenance, systems related or otherwise was undertaken.

G. FACILITY CHANGES RELATED TO 10 CFR 50.59

There have been no facility changes to date which pose an unreviewed safety question. A review of the changes for new nuclear instruments is ongoing in accordance with 10CFR50.59

H. ENVIRONMENTAL SURVEYS

Surveys of the environs external to the reactor building have continued to show no increase in levels or concentrations of radioactivity as a result of reactor operations. Air particulate samples collected at a continuously monitored site on the roof of the Pinanski building have shown no reactor produced radioactivity. Thermoluminescent dosimeters are used to monitor unrestricted areas outside of the Reactor. The results of these measurements show that doses in these areas were indistinguishable from background radiation levels during the period of July 1, 1997 to June 30, 1998.

Analysis of water samples collected from the Merrimack River upstream and downstream of the reactor location have continued to yield no radioactivity associated with reactor operations.

I. RADIATION EXPOSURES AND FACILITY SURVEYS

I. <u>Personnel Exposures</u>

Personnel exposures were maintained at the lowest reasonable levels. · Doses received by individuals concerned either directly or indirectly with operation of the reactor were within allowed limits. Twenty-four individuals were monitored by film badge during the year.

Twelve received measurable external deep dose equivalents ranging from 10 to 130 mrem.

2. Radiation Surveys

Radiation levels measured in the reactor building have been typically less than 0.1 mrem/hr in general areas. Experiments have been conducted in which transient levels at specific locations have been in excess of 100 mrem/hr. Doses in these instances have been controlled by use of shielding and/or personnel access control. The pump room remains designated as a high radiation area during reactor operation and access is controlled. Dose equivalent levels in the order of 10 mrem/hr are present adjacent to the closed beam ports during maximum power operation.

3. Contamination Surveys

General area contamination has not been a problem in the reactor building. Contamination has occurred at specific locations where samples are handled and particular experiments have been in progress. Contamination in these areas is controlled by the use of easily replaced plastic-backed absorbent paper on work surfaces, contamination protection for workers, and restricted access.

J. NATURE AND AMOUNT OF RADIOACTIVE WASTES

1. Liquid Wastes

Liquid wastes are stored for decay of the short lived isotopes and then released to the sanitary sewer in accordance with 20 CFR 2003. A total of 30.3 μCi were released over the 12 month period. The principle isotopes released were Na-24 and corrosion products, i.e. Mn-54, Co-60, Zn-65 and Sb-124.

2. Gaseous Wastes

Argon-41 continues to be the only significant reactor produced radioactivity identifiable in the gaseous effluent. Following are the monthly stack release data for Ar^{41} for the reporting period:

Month	Ar-41 Released (Curies)
July 1997	6.1
August 1997	3.7
September 1997	1.1
October 1997	1.2
November 1997	1.5
December 1997	3.3
January 1998	1.4
February 1998	0.5
March 1998	0.1
April 1998	8.8
May 1998	0.1
June 1998	0.0
Total	27.8

This release represents a 12 month dose of 0.6 mrem to the nearest member of the public using the EPA Comply code.

3. Solid Wastes

Solid wastes, primarily paper, disposable clothing, and gloves, along with other miscellaneous items have been disposed of in appropriate containers. Most of the activity from these wastes consisted of short lived induced radioactivity. These wastes were held for decay and then released if no activity remained. The remaining long lived waste (< 10 cubic feet) was collected and stored in a designated long lived waste storage area awaiting ultimate disposal at Barnwell.