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RADIATION LABORATORY

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Reactor Supervisor

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

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

Pursuant to Technical Specification NRC License No. R-125 we are submitting the Annual Report for the University of Massachusetts Lowell Research Reactor.

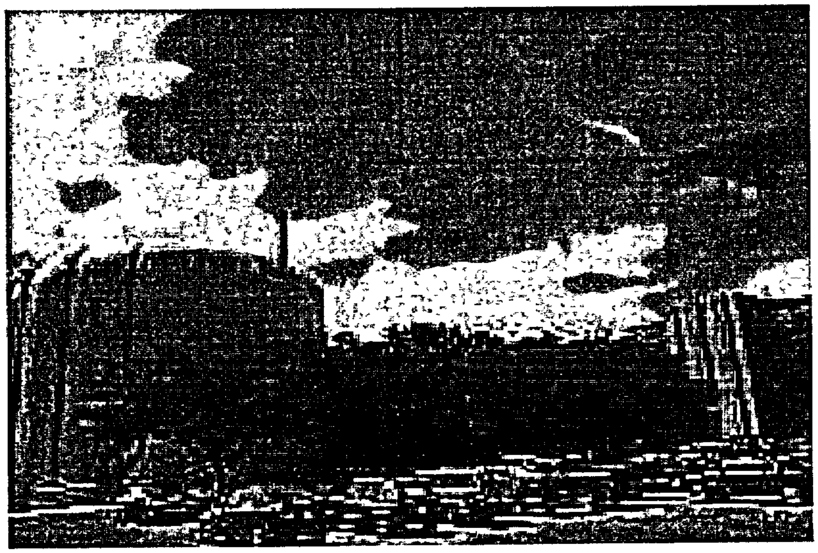
Sincerely,

Leo M. Bobek,
Reactor Supervisor

cc: M. Mendonca, NRC HQ
T. Dragoun, Region I

A020

University of Massachusetts Lowell
Research Reactor (UMLRR)



2001-2002 OPERATING REPORT

NRC Docket No. 50-223

NRC License No. R-125

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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.

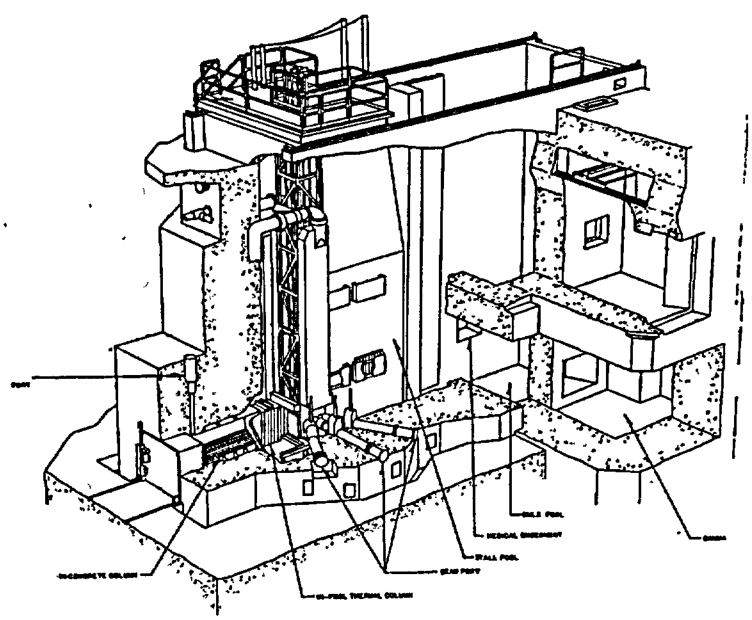
The name of the Nuclear Center was officially changed to the "Pinanski Building" in the spring of 1980. The purpose was to reflect the change in emphasis of work at the center from strictly nuclear studies. At that time, the University of Lowell Reactor became part of a newly established Radiation Laboratory. 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 one of 22 research centers at 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 Sciences, 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 affects, 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.



UMLRR Cutaway View

C. OPERATING EXPERIENCE

1. Experiments and Facility Use

The major uses of the reactor during this fiscal year were activation analysis, dosimetry calibrations, specialized isotope production, neutron effects studies, teaching, and personnel training. Due to upgrades to the control room and installation of a new experimental facility (described in the 2001 Annual Report), the reactor was shutdown during the first third of the reporting period, resulting in substantially reduced usage.

Research

Various radiation effects projects included: radiation induced materials enhancement for commercial and military applications, radiation resistant electronics testing for commercial and military aerospace applications.

Activation techniques were used to study geological composition of rock samples. Dosimetry studies and calibrations utilized N-16 production for high-energy gamma dosimetry.

Education

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 following UML courses use the reactor facilities as a major or partial component of the curriculum:

96.443 Radiochemistry Laboratory

96.393 Advanced Experimental Physics

96.306 Nuclear Instrumentation

96.201/96.301 Health Physics Internship

99.102 Radiation and Life Laboratory

98.666 Reactor Health Physics

10/24.431 Nuclear Reactor Systems and Operation

10/24.432 Nuclear Systems Design and Analysis

24.507 Reactor Engineering Analysis

87.111 Environmental Science

84.113 General Chemistry

19.518 Engineering Controls and PPE

19.517 Physical Agents

In addition, the summer Reactor Operations and Systems Experience (ROSE) program was provided again for undergraduate engineering students of all disciplines to participate in operator licensing training.

A number of activation and decay experiments were performed for both university and non-university students alike. A very successful program at the UMLRR is the Reactor Sharing Program sponsored by the Department of Energy. This program, which started at the University in 1985, has become extremely popular with area schools, grades 7 through 12. The goal of this program is two-fold: to motivate pre-college students into developing an interest in the sciences, and to promote an understanding of nuclear energy issues while expanding learning opportunities. The program is comprehensive in that it includes lectures, hands-on experiments and tours of the UMLRR. Students and teachers may also participate via interactive two-way cable and satellite television. The lectures cover topics on environmental radiation, the uses of radiation in medicine, and the potential of nuclear energy. Activation and decay experiments are often provided for local school science classes who observe the experiment at the reactor or in their classrooms via interactive cable T.V.

Service

The major outside uses for the reactor facility is neutron and gamma damage studies of electronic components.

2. Changes in Facility Design

One change to facility design has occurred during the reporting period. The water Makeup and Cleanup Systems as described in the UMLRR FSAR 4.2.4 and 4.2.5 have been replaced with a new industrial-grade mixed bed deionizer. The change was made under the provision of 10CFR 50.59 and is further described in Section G of this report.

3. Performance Characteristics

Performance of the reactor and related equipment has been normal during the reporting period.

4. Changes in Operating Procedures Related to Reactor Safety

The following procedures were revised with substantive changes that required the approval by the reactor safety committee: (1) RO-9 Reactor Checkout; revisions made to conform with control room upgrades, (2) RO-5 Routine Start-up, RO-6 Operations at Power and Adjustments in Power Level, RO-7 Reactor Shutdown; combined into one procedure (RO-6 Reactor Operations) with modifications to comply with control room upgrades.

5. Results of Surveillance Test and Inspections

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

As of June 30, the reactor staff consists of two full-time SROs, one full-time RO, and one part-time SRO. In addition, one full-time non-staff Asst.-Professor and teaching-assistant graduate student are maintaining SRO licenses. Remaining part-time staff consists of student assistants.

7. Operations Summary

Operations Summary data is presented for both the HEU and the LEU fueled reactor. The utilization is broken down as follows:

Reporting Period Hours

Critical hours	153.80
Full power hours	94.20
Megawatt hours	96.10

Reporting Period Utilization

Sample hours	30.81
Samples	39
Training hours	84.60

D. ENERGY GENERATED

Energy generated this period (MWD)	3.92
Cumulative energy to date (MWD)	7.55

E. INADVERTENT AND EMERGENCY SHUTDOWNS

There were 20 inadvertent shutdowns. While this number appears high, and is about twice the annual average, most of the inadvertent scrams were due to either electronic noise or overly conservative settings associated with new instrumentation installed in the control room. The scrams have no safety significance, and are more a nuisance to the educational and research uses of the facility. Descriptions of each scram are noted in operator logs. A brief summary of the number and type of scram follows:

Electronic Noise (10), Overly Conservative Trip Setting (4), Maintenance Activity (2), Jostled Sensor (2), Offsite Power Interruption (1), Inadvertent Use of Test Function (1).

F. MAJOR MAINTENANCE

No major maintenance was performed during the reporting period. Minor maintenance was performed by an outside sheet metal contractor to replace deteriorated duct-work for the main exhaust fan.

G. FACILITY CHANGES RELATED TO 10CFR50.59

The reactor primary cooling water is conditioned by two mixed-bed (single shell) regenerative demineralizers (Makeup and Cleanup Systems) as described in the UMLRR FSAR 4.2.4 and 4.2.5.

Regeneration of the demineralizer using strong acids and bases had taken its toll over 26 years. The rubber liner had degraded on one system, exposing the shell to the regeneration chemicals and resins. The shell, in addition to various regeneration related plumbing, had corroded and developed leaks. Regeneration of the systems was becoming increasingly difficult. Regenerate plumbing leaks produce puddles of corrosive and hazardous chemicals when regeneration is performed.

A new industrial-grade mixed bed deionizer was purchased and professionally installed to replace both the Cleanup and Makeup demineralizer systems. The Cleanup demineralizer was disconnected and abandoned in place. The Makeup demineralizer was dismantled and removed to make room for the new system. The change was reviewed under the provisions of 10CFR 50.59 to evaluate the effects and potential effects on the design bases of the reactor. The evaluation concluded the new deionizer system does not require a Technical Specifications revision and meets the criteria specified in 10 CFR 50.59. The new system is fully documented and has been thoroughly tested and all affected instrumentation has been calibrated using existing procedures, modified as necessary. Procedures requiring revisions (e.g., conductivity sensor calibration, and system regeneration) are currently being reviewed for revisions according to UMLRR administrative guidelines.

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, 2001 to June 30, 2002.

The Radiation Safety Office has performed an ALARA review for the 2001 calendar year. The table below is a summary of the environmental release pathways (sewer and stack) and the maximum environmental and occupational dosimetric exposures documented through the Landauer® film badge analysis service.

As expected, all environmental releases were below the goals set by the Radiation Safety Office (10 mrem per year). Sewer releases were minute quantities of Cs-137 and Co-60 and were well within release limits. The reactor stack release for 2001 was over ten times lower than in previous years. This was attributed to low reactor usage (1.2 MWD) and did not take into account the removal of three reactor beamports, which would result in further lowering the estimated Argon-41 production.

I. RADIATION EXPOSURES AND FACILITY SURVEYS

2001 ALARA Data

OCCUPATIONAL EXPOSURES

GROUP	NUMBER BADGED	MAXIMUM DOSE	GOAL
Reactor	19	678	*≤1000

*Goal increased to 1,000 mrem/year to allow for Fast Neutron Irradiator construction (see 2001 Annual Report).

ENVIRONMENTAL DOSIMETRY

SOURCE	DOSE EQUIVALENTS mrem	GOAL mrem
Reactor	46	≤50

1. <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.. The annual ALARA goal established by the Radiation Safety Committee is less than 500 mrem per employee.

The 2001, the installation of a fast neutron irradiator (Intersil Project) required the removal of three beam tubes. Over 80% of the annual person rems (0.1 of 1.3) was received during this project. ALARA goals for the project were met through careful planning and utilizing the pool water for shielding.

2. <u>Radiation Surveys</u>

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. <u>Contamination Surveys</u>

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.

K. NATURE AND AMOUNT OF RADIOACTIVE WASTES

2001 ALARA Data

ENVIRONMENTAL RELEASES

SOURCE	ACTIVITY	DOSE	GOAL
	mCi	mrem	mrem
Sewer Releases	<1.0	<1	≤10
Stack Releases	3.5 E3	<1	≤10

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 less than 1 mCi was released over the 12 month period consisting of small amounts of activation products.

2. Gaseous Wastes

Argon-41 continues to be the only significant reactor produced radioactivity identifiable in the gaseous effluent. This release represents a 12 month dose of 0.1 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 wasted (<10 cubic feet) is stored in a designated long lived waste storage area awaiting ultimate disposal at low-level radioactive waste disposal site.

End of Report