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RADIATION LABORATORY

Leo M. Bobek
Reactor Supervisor

August 30, 2007

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

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.

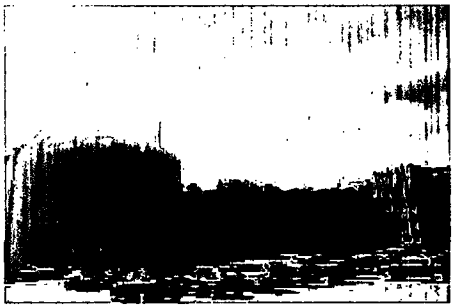
Sincerely,

Leo M. Bobek,
Reactor Supervisor

cc: M. Mendonca, NRC Project Manager

A020
NRR

University of Massachusetts Lowell
Research Reactor (UMLRR)



2006-2007 OPERATING REPORT

NRC Docket No. 50-223

NRC License No. R-125

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A. BRIEF HISTORY

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.

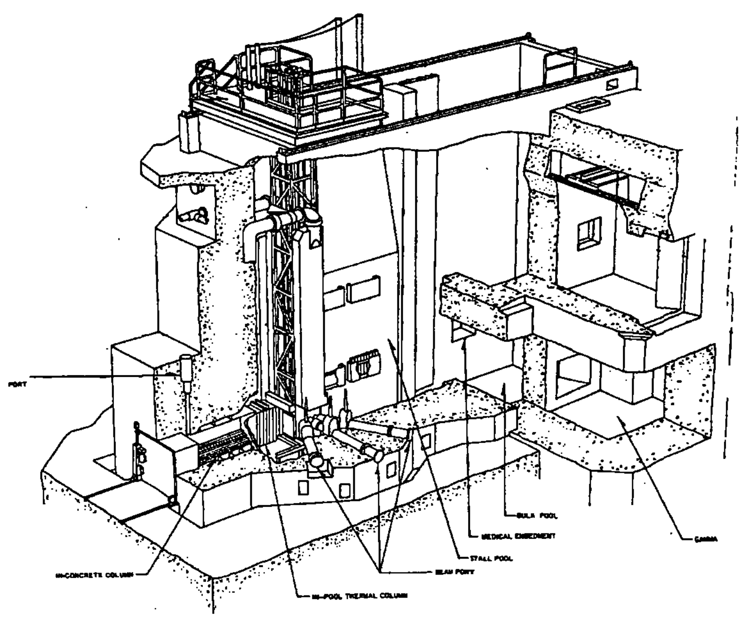
On February 14, 1985, the University of Lowell submitted an application to the Nuclear Regulatory Commission for renewal of the facility operating license R-125 for a period of 30 years. On November 21, 1985, the license renewal was granted as Amendment No. 9 of License R-125 in accordance with the Atomic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

In 1991, the University of Lowell name was changed to University of Massachusetts Lowell. On August 4, 2000, the reactor was converted from high enrichment uranium fuel to low enrichment uranium fuel.

B. FUNCTION

The University of Massachusetts Lowell Radiation Laboratory (UMLRL) is one of 22 research centers at the University. The University departments utilizing the laboratory 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 reactor and Cobalt-60 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, neutron radiography, neutron irradiation of electronics, teaching, and personnel training.

Research

MIT-UML-URI Consortium

Under the DOE INIE program, Asst. Prof. M. Tries (Physics) has been awarded the final phase of a multi-year contract totaling $275,000 to develop a digital imaging system using neutrons (neutron radiography). The present neutron imaging system at UMLRR provides users with industrial neutron radiographic service meeting ASTM standards using film technology. For the first two years of this program, Asst. Prof. Tries, Mr. Regan, and Mr. Bobek designed and built a digital neutron radiography system capable of imaging materials and components having a wide range of dimensions. The digital imaging shortens exposure times to provide almost immediate viewing of the radiographic image (near real-time), provides the flexibility to scan large areas with ease, provides accurate recording of a variety of radiographic details, and permits remote imaging via the internet.

Remote Education

As part of our DOE Reactor Sharing Program, Prof. White (Chem. Eng.) is developing a system for making real-time and archived research reactor data available to educational users via a standard web browser. Dr. White and Mr. Bobek are continuing to refine on-line material and establish additional content for use by UMass Lowell students and other distance education users.

Neutron Activation Analysis (NAA)

Prof. Nelson Eby (GeoSciences) continues to do research associated with instrumental neutron activation analysis (INAA) and fission track dating. Since 1990, this work has resulted in 28 publications. Fission-track geochronology, utilizing the minerals apatite and titanite, has been used to determine the both the age of igneous intrusion and the time of unroofing for a number of volcanic and plutonic provinces around the world. The most recent work has been the dating of alkaline igneous activity (420 Ma) in northern New Jersey and the time of unroofing (115 Ma) for this province. INAA has been used to determine the trace element compositions of rocks, minerals, soils, coal, atmospheric aerosols, human hair, film negative, and process sludge. During the past year this technique has been used to determine the trace element chemistry of tree rings (a collaborative project with Lehigh University, the data are used to monitor environmental changes), the trace element composition of volcanic rocks from Antarctica (a collaborative project with the University of Otago, NZ), and trace element compositions of volcanic rocks from central Europe (a collaborative project with the Geological Institute of Hungary).

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 are 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

In addition, a summer Reactor Operations and Systems Experience (ROSE) program is provided 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. Facility Changes

There were no facility changes for this reporting period.

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

As part of an ongoing effort to update and re-format all procedures associated with the reactor, several procedures had minor revisions or updates non-substantive in nature. Such changes are kept on file and summarized for the RSSC at each meeting.

5. Results of Surveillance Test and Inspections

All surveillance test results were found to be within specified limits and surveillance inspections revealed no abnormalities that could 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 three full-time SROs, and one part-time SRO, one part-time graduate student SRO and one part-time mechanical technician. Remaining part-time staff consists of student trainee assistants.

7. Operations Summary

Critical hours	145.63
Megawatt hours	90.04

D. ENERGY GENERATED

Energy generated this period (MWD)	3.75
Cumulative energy to date (MWD)	28.60

E. INADVERTENT AND EMERGENCY SHUTDOWNS

There were two inadvertent shutdowns, none of which were emergency related. One was due to the malfunction of fail-safe pressure switch on the first floor airlock door. One was due to a power over-range trip in Natural Convection (100kW) Mode during a cold water insertion demonstration. Neither of the scrams had any safety significance. Descriptions of each scram are noted in operator logs and are analyzed by an SRO for any safety significance.

F. MAJOR MAINTENANCE

No major maintenance was performed during the reporting period.

G. FACILITY CHANGES RELATED TO 10CFR50.59

There were no changes to the facility, procedures, or experiments related to 10CFR 50.59.

H. ENVIRONMENTAL SURVEYS

Members of the Radiation Safety Office performed an ALARA review for the 2006 calendar year with the results summarized below. Included is a summary of the environmental release pathways (sewer and stack) and the maximum environmental and occupational dosimetric exposures documented through the Global Dosimetry film badge service.

Thermoluminescent dosimeters, provided by Global Dosimetry, were used to monitor unrestricted areas outside of the Reactor and indicated that doses in these areas were statistically equivalent to background radiation levels for the 2006 calendar year. Surveys of the environs external to the reactor building also show no increase in levels or concentrations of radioactivity as a result of continued reactor operations.

All environmental releases were below the goals set by the Radiation Safety Office (10 mrem per year). All releases were well within federal, state, city, and university release limits. The reactor stack release during the 2006 was conservatively estimated to be less than 2.46 Ci and resulted in an estimated annual dose at the site boundary of 0.05 mrem in 2006. The dose estimate was obtained using the EPA Comply Code at a level 4 screening. This estimated did not take into account the removal of three reactor beamports, which would have further lowered the total estimated Argon-41 production and therefore the dose at the site boundary.

I. RADIATION EXPOSURES AND FACILITY SURVEYS

2006 ALARA Data

OCCUPATIONAL EXPOSURES

GROUP	NUMBER BADGED	MAXIMUM Wole Body DOSE (<500)	MAXIMUM Extremity DOSE (<5000)
Reactor	16	50*	30

* NOTE: This annual whole body exposure was to a film badge placed in test room 2 opposite a closed beam port. Presently, additional shielding is being added to the beam port. The highest annual *personnel* dose was 14 mrem for 2006.

1. Personnel Exposures

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 whole body and 5,000 mrem per employee Shallow Dose. Of the 16 badged individuals, the highest measured annual whole body dose was 14 mrem and the highest annual shallow dose was 30 mrem. All other total whole body doses for 2006 were below 10 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.

i. 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.

K. NATURE AND AMOUNT OF RADIOACTIVE WASTES

2006 ALARA Data

ENVIRONMENTAL RELEASES

SOURCE	ACTIVITY	DOSE	GOAL
	mCi	mrem	mrem
Sewer Releases	**0.006**	**M***	**≤10**
Stack Releases	**2.46 E3**	**0.05**	**≤10**

***NOTE: M indicates a level below detection limits of facility instrumentation**

1. Liquid Wastes

Liquid radioactive wastes are stored for decay of the short lived isotopes and then released to the sanitary sewer in accordance with 20 CFR 2003. Approximately six microCuries (6 μCi) were released over the 12 month period consisting of small amounts campus produced laboratory waste (H-3 and C-14) which was incorporated into the Reactor waste water tanks for purposes of better waste release control. Each sewer release was diluted to concentrations below the detection limits of the UML proportional counting system. The UML proportional counter detection limit is calculated to be approximately 4 pCi/L.

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 less than 0.1 mrem to the nearest member of the public using the EPA Comply code at the highest screening level (level 4).

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