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RADIATION LABORATORY

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U.S. Nuclear Regulatory Commission
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Re: License No. R-125, Docket No. 50-223

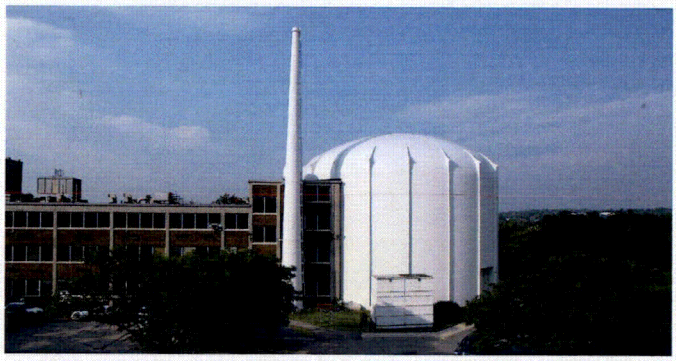
Pursuant to Technical Specification 6.6.4 of NRC License No. R-125 we are submitting the routine Annual Report for the University of Massachusetts Lowell Research Reactor.

Sincerely,

Leo M. Bobek,
Reactor Supervisor

A020
NRR

University of Massachusetts Lowell Research Reactor (UMLRR)



2014-2015 OPERATING REPORT

NRC Docket No. 50-223

NRC License No. R-125

University of Massachusetts Lowell

One University Avenue
Lowell, Massachusetts 01854

CONTENTS

This report is submitted as required by the Technical Specification 6.6.4 of reactor license R-125 and provides the information as outlined in the specification.

Facility History and Overview

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.

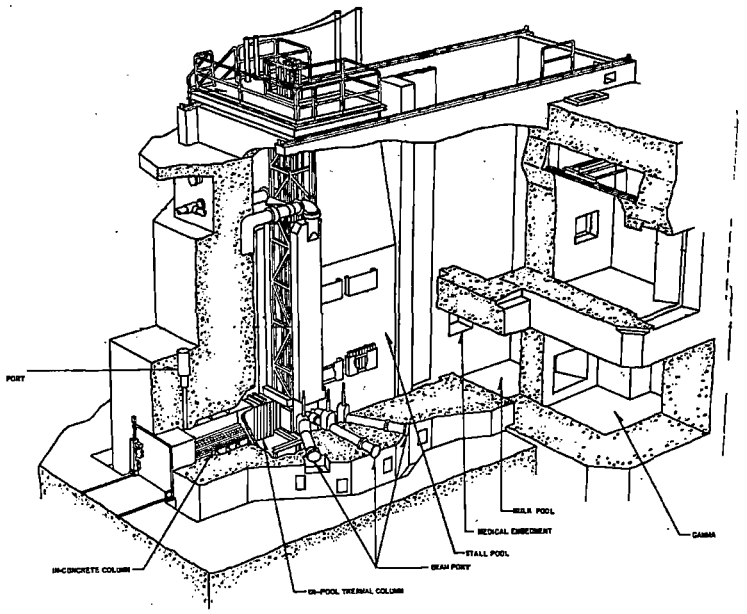
On February 14, 1985, the University of Lowell submitted an application to the Nuclear Regulatory Commission for renewal of the facility operating license R-125 for a period of 30 years. On November 21, 1985, the license renewal was granted as Amendment No. 9 of License R-125 in accordance with the Atomic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

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. Several of the UMass campuses,

including the university medical center, have or continue to have research programs at the Radiation Laboratory. Much of the research is concerned with safety and efficiency in the nuclear and radiation industries, including pharmaceuticals, medical applications, health affects, public utilities, etc. However, much of the research conducted in other scientific fields that make use the unique facilities as analytical tools.

Beyond the research activities, the Laboratory's reactor and Cobalt-60 facilities are used in the educational courses of various departments within 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

A. NARRATIVE SUMMARY

1. Operating Experience and Experiments

The UML research reactor is designed to produce thermal (low energy) neutrons for radioactivation and neutron radiography purposes, and fast (high energy) neutrons for radiation effects studies. Uses include neutron activation analysis research, materials atomic displacement damage studies, neutron absorption studies, short-lived radioisotope production, neutron detector studies, and neutron imaging (radiography). Education uses include a variety of lab courses in the nuclear engineering and radiological sciences programs. Tours and demonstrations are provided to several other UMass Lowell courses, as well as other universities, high schools, and various organizations.

Short lived isotopes (e.g., Al-28, Na-24) were produced for routine practicum and demonstration purposes. The reactor was used for several nuclear engineering and non-nuclear engineering laboratory exercises and demonstrations. In addition, the reactor was used for training of student operator license candidates. Student candidates are provided an opportunity to work at the reactor and gain practical experience while studying for a future licensing examination.

Organized tours were provided to UMass students, local college students, grade school students, and other groups and individual. As part of emergency responder training, tours and presentations also were provided to the UML Police Department.

2. Facility Design Changes

There were no facility design changes during the reporting period.

3. Performance Characteristics Changes

As noted in Section D, routine inspections of the reactor control blades have revealed instances of minor blisters in the aluminum cladding of the Boral material. As a result, control blade No. 3 has been replaced. Swelling of the center graphite flux trap was discovered during a core-offloading sequence. The flux trap has been removed from service and replaced with a solid graphite element until a replacement flux trap can be manufactured. Corrosion of some areas of piping on the secondary cooling system have been discovered and replaced.

Performance of all other reactor and related equipment has been normal during the reporting period. There were no other discernable changes that would indicate any degradation of other systems or components.

4. Changes in Operating Procedures Related to Reactor Safety

Minor edits were made to several Emergency Procedures due to numbering changes in the University telephone system. These changes have no effect on safety and were reviewed by the reactor safety committee.

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.

B. TABULATIONS

Energy generated this period (MWD)	7.097
Critical hours	395.72
Cumulative energy to date (MWD)	65.71

C. INADVERTENT AND EMERGENCY SHUTDOWNS

There were 12 inadvertent non-emergency automatic shutdowns during the reporting period. Most were due to electronic noise problems associated with the power monitoring channels. There was no safety significance associated with any of the 12 scrams. Descriptions of all automatic shutdowns are noted in operator logs and are analyzed by an SRO for safety significance and technical specification requirements.

D. MAJOR MAINTENANCE

There were two major maintenance activities was performed during the reporting period.

The UMLRR uses four control blades made of Boral – Boron Carbide in an aluminum matrix with aluminum cladding – for control for the reactor. An annual visual inspection of the reactor control blades is a requirement of license technical specifications. In a report to the RSSC in September 2011, a description of the previous inspection findings noted the formation of several small blisters ~1" in diameter on blade #3. An action plan was submitted for increased surveillance (drop times) and to evaluate the possibility of obtaining a replacement.

Boral has been known to have problems where water leakage between the aluminum cladding and the boron carbide aluminum composite can create hydrogen bubbles. The bubbles in turn create blistering of the aluminum cladding[1].

The NRC has recognized that there is no degradation of the Boral and therefore little to no reactivity effects from the blistering[2]. However, the concern for the UMLRR is that if the blistering becomes severe enough, there is a possibility of the control blade binding in or out of the reactor core. The decision was made to replace the Boral control blade with a blade of the same dimensions made from BORALCAN - Boron Carbide in an aluminum metal matrix composite manufactured by Ceradyne. BORALCAN is recognized to be a robust alternative to Boral[3].

1. Letter from Florida Power & Light Energy Seabrook, LLC to NRC, "Boral Spent Fuel Pool Test Coupons Report Pursuant to 10 CFR Part 21.21," October 6, 2003, ADAMS Accession No. ML032880525.

2. Draft NRC Generic Letter 201x-xx "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools," ADAMS Accession No. ML13100A086.

3. ACRS Comments on Generic Letter 201X-XX: Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools (OEDO-14-00640) ADAMS Accession No ML14252A299.

The second major activity involved the replacement of a steel elbow on the secondary cooling system piping due to corrosion.

E. FACILITY CHANGES RELATED TO 10CFR50.59

The maintenance activity described in Section D was screened under the UMLRR Procedure AP-6 *10CFR 50.59 Screenings and Evaluations*. It was determined via the screen this

activity would not require a complete evaluation. The screen has been documented and reviewed by the UMLRR reactor safety committee.

Panel meters for the primary coolant variables of flow and temperature have been added to a control panel in the control room. The change was made to add redundancy and diversity to the existing display in anticipation of re-licensing. The addition of the meters was screened under the UMLRR Procedure AP-6 10CFR 50.59 Screenings and Evaluations. It was determined via the screen this activity would not require a complete evaluation. The screen has been documented and reviewed by the UMLRR reactor safety committee.

F. ENVIRONMENTAL SURVEYS

Members of the Radiation Safety Office performed an ALARA review for the 2014 calendar year with the results summarized in Sections G and H. The following actions are performed in the indicated time period as part of the UMLRR radiation safety program:

1. Reactor Field Surveys – monthly (byproduct materials license)
2. Reactor Contamination Surveys – monthly (byproduct materials license)
3. Primary water analysis – weekly (SP-10)
4. 20 ml Secondary Water Analysis – each Rx operations day (SP-10)
5. 3 L Secondary Water Analysis - Biennially (SP-10)
6. liquid waste (sewer) – prior to disposal (SP-10)
7. Rad Monitor Check – each detector checked prior to each day's operations by Rx staff.
8. Personnel dosimetry – monthly; obtained using a NVLAP accredited dosimetry lab.
9. Environmental dosimetry – quarterly using NVLAP lab.

G. RADIATION EXPOSURES AND FACILITY SURVEYS

1. Personnel Exposures

An ALARA assessment of the UMass Lowell radiation safety program is performed annually. This review is reported to and reviewed by the Radiation Safety Committee. The 2014 ALARA goal for radiation workers at UMass Lowell was to limit the most exposed radiation worker at UML to less than 10% of the federal radiation exposure limits. In addition, the radiation safety manual requires a 100 mrem per week TEDE administrative level. No occupational exposure exceeded an ALARA limit in 2014. Personnel dosimetry was obtained by review of the 2014 Landauer dosimetry reports. These reports include, where appropriate, whole body OSL dosimetry and finger TLD dosimetry. Landauer is a NVLAP accredited dosimetry company.

OCCUPATIONAL EXPOSURES

GROUP	NUMBER BADGED	Average Whole Body Dose (<500mrem)	Average Extremity Dose (<5000 mrem)
Reactor	22	M	<1

**NOTE: 'M' indicates no detectable releases or exposure*

2. Radiation and Contamination Surveys

A review of all 2014 Research Reactor Radiation Survey and Contamination forms found no measurable removable contamination levels due to unexpected occurrences in the facility. The byproduct materials license specifies contamination as ≥500 dpm/100cm^2 (beta) or ≥50 dpm/100cm^2 (alpha). No appreciable stray radiation fields (>2mR/hr) were identified in a free area within the reactor. 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, visual and audial notifications, and/or personnel access

control. The pump room remains designated as a high radiation area during reactor operation and access is controlled.

H. NATURE AND AMOUNT OF RADIOACTIVE WASTES

1. Liquid Wastes and Gaseous Wastes

As part of UMass Lowell ALARA goals, the radiation safety office has set a campus goal of limiting exposures to members of the public to less than 10% of the federal regulatory limits. No radioactive material was released through the reactor sewer in 2014. Argon-41 continues to be the only significant reactor produced radioactivity identifiable in the gaseous effluent. The reactor stack released roughly 6.66 Ci in 2014 resulting in a (conservative) estimated upper limit to the TEDE of 0.2 mrem/year 100 m from the stack.

ENVIRONMENTAL RELEASES

SOURCE	ACTIVITY	DOSE	GOAL
	Ci	mrem	mrem
Sewer Releases	0	M*	≤10
Stack Releases	6.66	M*	≤10

NOTE: 'M' indicates no detectable releases or exposure

2. 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. Long lived waste (<40 cubic feet) is stored in a designated long lived waste storage area awaiting ultimate disposal at a low-level radioactive waste disposal site.

End of Report