University of Massachusetts Lowell
Research Reactor (UMLRR)

2015-2016 OPERATING REPORT

NRC Docket No. 50-223

NRC License No. R-125

One University Avenue
Lowell, Massachusetts 01854

CONTENTS

A. NARRATIVE SUMMARY

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.

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 individuals. 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

The occurrence and repair of a leak in the secondary cooling system piping was noted in the 2014-15 Annual Report. During the current reporting period, further corrosion and leaking had developed in an 8-inch line elbow joint. An inspection of the piping provided indication that much of the secondary system piping may have extensive corrosion. As a result, the entire secondary system piping was removed and replaced in April 2016 (See section D).

Also as noted in the 2014-15 Annual Report, one of the Boral control blades was replaced with a control blade made from a boron-aluminum metal-matrix composite (MMC). It was found after several weeks that the MMC material produced an aluminum oxide layer on the control blade. While unusual in appearance, the condition has not affected the functionality or the reactivity worth of the control blade. The condition of the control blade is inspected at annual intervals as required by the license Technical Specifications and reactivity measurements also are made annually.

4. Changes in Operating Procedures Related to Reactor Safety

A minor edit was made to the procedure for performing 10CFR 50.59 evaluations. The edit was made, as recommended during a formal NRC inspection, to include changes to procedures in the evaluation process. The edit was reviewed and approved 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)	4.62
Critical hours	242.95
Cumulative energy to date (MWD)	70.33

C. INADVERTENT AND EMERGENCY SHUTDOWNS

There were no emergency shutdowns for the reporting period. There were 8 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 inadvertent scrams. Descriptions of all manual and automatic scrams

are noted in operator logs and are analyzed by an SRO for safety significance and technical specification requirements.

D. MAJOR MAINTENANCE

There was one major maintenance activity during the reporting period. The secondary cooling system piping was removed and replaced. The secondary cooling system piping consists of 8-inch diameter steel piping for circulating cooling water from the heat exchanger to the cooling tower. Corrosion in the piping necessitated its replacement. The piping was removed and new piping was installed by a commercial HVAC contractor. During normal operations, the secondary system water is periodically sampled for indications of primary system to secondary system leakage. There has been no indication of leakage from the primary coolant into the secondary cooling system during the lifetime of the facility. As a normal health physics precaution, the old piping was checked for possible contamination prior to disposal. No contamination was detected. After installation of the new piping, the secondary system was pressure tested for leaks and then refilled with city water. The system is now functioning normally.

E. FACILITY CHANGES RELATED TO 10CFR50.59

The control room annunciator panel was replaced. The original alarm panel had 17 individual alarm indicators (2”x3”), each illuminated by two 120VAC miniature incandescent light bulbs. The new panel has 23 indicators (2.25”x2.75”), each illuminated by multiple LEDs. Six additional alarm indicators have been added to provide additional information for the operator. The original alarm was panel was designed to provide a visible and audible annunciation of an alarm condition to the operator. The new alarm panel performs the same function. The new indicators use more reliable LED technology rather than incandescent lights. The indicators are slightly larger and have the same physical location in the control room. The annunciator replacement 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 was reviewed by the UMLRR reactor safety committee.

F. ENVIRONMENTAL SURVEYS

Members of the Radiation Safety Office performed an ALARA review for the 2015 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 - Semi-annually (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 – quarterly; obtained using a NVLAP accredited dosimetry lab.
9. Environmental dosimetry – quarterly; using NVLAP lab accredited dosimetry 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 2015 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 2015. Personnel dosimetry was obtained by review of the 2015 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	19	1.6	23.7

2. Radiation and Contamination Surveys

A review of all 2015 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 and Beamport facility remain designated as a high and very high radiation area respectively 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. Less than 1.1 μCi of radioactive material were released through the reactor sewer (detection limits of approximately 3.3×10^{-8} μCi/ml). Argon-41 continues to be the only significant reactor produced radioactivity identifiable in the gaseous effluent. The reactor stack released roughly 6.27 Ci in 2015 resulting in a (conservative) estimated upper limit to the TEDE of 0.2 mrem/year 100 m from the stack.

ENVIRONMENTAL RELEASES

SOURCE	ACTIVITY Ci	DOSE mrem	GOAL mrem
Sewer Releases	$1.1x10^{-6}$	M*	≤10
Stack Releases	6.27	0.2	≤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