

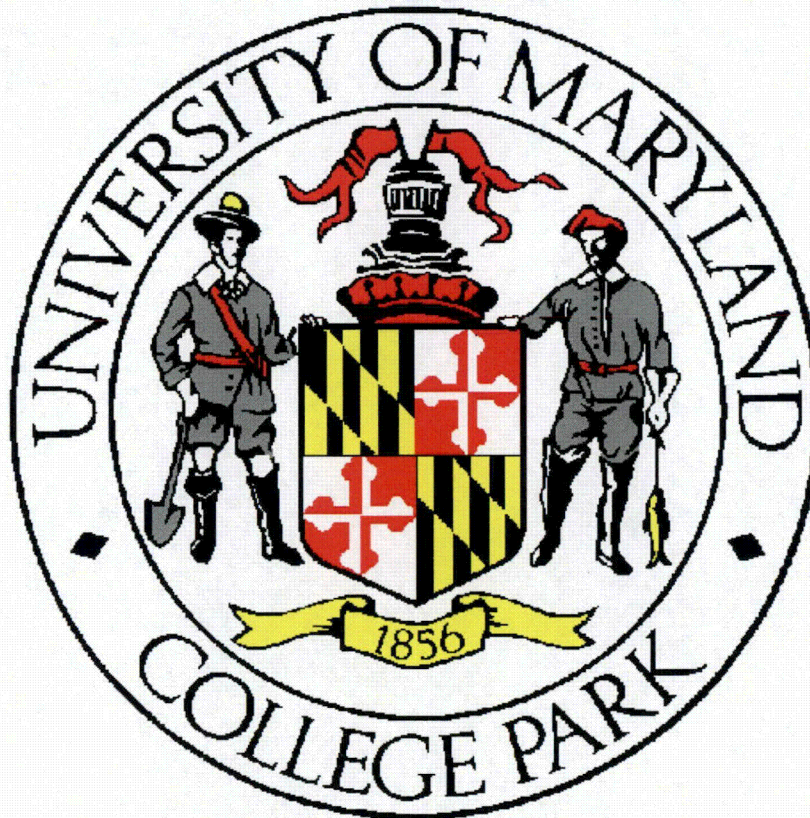
ANNUAL REPORT: July 1, 2014 – June 30, 2015

FOR THE

MARYLAND UNIVERSITY TRAINING REACTOR

License No. R-70

Docket No. 50-166



Department of Materials and Nuclear Engineering
A. James Clark School of Engineering
University of Maryland, College Park
College Park, MD 20742-2115

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I. INTRODUCTION

The University of Maryland Training Reactor (MUTR) is an open-pool type, TRIGA fueled reactor licensed for operation at 250 kW thermal power. The core is cooled by natural convection of the pool water with auxiliary cooling provided for protection of the filters and ion exchange equipment associated with reactor support piping.

The MUTR is used for academic instructions and operator training, performance of neutron and gamma irradiations, neutron activation analysis experiments, and tours and demonstrations for groups internal and external to the campus as well as for visiting scientist and researchers.

II. REACTOR USEAGE

During the past year the MUTR operated for a total of 67 runs (Run Numbers 4367 - 4433), which are categorized below:

Operator Training/Requalification*	37 runs
Tours, Labs & Demonstrations**	23 runs
Calibration, Maintenance, and Surveillance	19 runs
Irradiations and Activations	2 runs

*Note: Some runs involved training and surveillance and may be counted in both categories.

**Note: Some of the runs in the Tours, Labs & Demonstrations category consisted of operator training. They are not included in the training category.

To perform these runs the core produced 8.172 MWh (kWh meter change from 467472 kWh to 475644 kWh), with a corresponding burnup of 0.46 Grams of U-235.

III. SURVEILLANCE TESTS AND INSPECTIONS

All required surveillance tests and inspections were performed at the specified intervals. The required surveillance items for this reporting period include:

WATER SAMPLE TESTS

AIR SAMPLE TESTS

RADIATION SURVEYS

CONTROL ROD INSPECTION

CONTROL ROD DROP TEST

RAM CALIBRATION

SNM INVENTORIES

ALARA REVIEW

In addition to the above surveillance items, the following maintenance operations were performed on the indicated dates:

9/9/14 Dri-rite baked.
11/14/14 Replaced Exhaust Ram
12/9/14 Dri-rite replaced.
3/10/15 Dri-rite baked.
3/23/15 Changed resin in primary water system.
4/20/15 Replaced polyethylene tube on pneumatic transfer system.
6/9/15 Dri-rite replaced.

Additional minor maintenance was performed such as light bulb replacement and fine-tuning of equipment was performed as necessary.

IV. CHANGES TO FACILITY

There were no significant changes to the Facility during this reporting period.

V. ENVIRONMENTAL SURVEYS OF SURROUNDING AREAS

All continuous monitoring for this year was accomplished using fixed-mounted TLD badges throughout the interior of the reactor building itself. These badges recorded the following exposures:

<u>Monitor</u>	<u>Location</u>	<u>Deep Dose</u> <u>(mrem)</u>	<u>Shallow Dose</u> <u>(mrem)</u>	<u>Neutron</u> <u>(mrem)</u>
1	Control Room	0	0	0
2	Reactor Bridge	307	315	0
3	Hot Room	214	216	0
4	West Wall Upper	77	77	0
5	South Wall Upper	22	22	0
6	South Wall Lower	25	25	0
7	East Wall Lower	216	216	97
8	Water Room	1302	1302	800
9	North Wall Lower	100	100	0
10	West Wall Lower	54	54	0

VI. RADIOACTIVE RELEASE AND DISCHARGE TO THE ENVIRONMENT

The Reactor Storage Sump was not discharged during this reporting period.

The only radioactive material released from the MUTR into the environment consists of Argon-41. This is produced from the activation of the natural argon dissolved in pool water and from the activation of natural argon present in air, within the interstitial spaces of beams and ports. This Argon-41 subsequently escapes from the pool and to a much smaller extent, the beams and ports, into the MUTR reactor building and then leaks into areas outside of the building. When operating at 250 kW, the MUTR reactor building concentration of Argon-41 at equilibrium is 6.64×10^{-7} Ci m⁻³; this was derived from a detailed measurement study described in the University's letter to the NRC dated June 18, 2014.

In 2014, with the support of a professional engineer, the MUTR completed an assessment of the air flow and leakage rates from the reactor building to the areas outside. The assessment included a gap-analysis of MUTR penetrations, air velocity measurements throughout the MUTR facility and a fifty-year historical Baltimore-Washington Regional Wind Rose data review.

Building conditions and measurements show air flows from the unrestricted spaces within Building 90, into the MUTR reactor building. The air then flows out of the MUTR reactor building through the rollup door and a personnel door into the outside fenced in courtyard located on the north side of the facility. The combined air flow leakage rate at the rollup door and personnel door was determined to be 0.03702 m³s⁻¹. Thus, the primary path for Argon-41 to unrestricted areas is the leakage of air from the MUTR reactor building through the rollup door and personnel door to the outside. The maximally exposed individual would be the person at the boundary of the courtyard fence line, 4 meters away from the closest edge of the roll up door.

For this reporting period, the MUTR operated for 179 hours. The total Argon-41 activity leaving the rollup door was determined to be 1.6E-02 Ci. This was derived using the reactor building Argon-41 concentration at equilibrium, the combined leakage rate at the rollup door and personnel door, and the total operating hours. The Environmental Protection Agency Clean Air Act Assessment Package - 1988 [EPA CAP88], version 4.0 software was used to calculate the dose to an individual from Argon-41 leaking outside the MUTR building if the individual was continuously positioned at the boundary fence line. The model assumes a ground release and that all the air leakage occurs through one point of 0.06 sq. meters, nearest the individual.

EPA CAP88 calculates the dose from Argon-41, to the maximally exposed individual to be 0.1 mrem. The CAP88 report is presented at the end of this annual report.

During the 2014 MUTR reactor building evaluation, it was understood that a northerly prevailing wind could have the potential to reverse the air flow direction, resulting in outside fresh air flow into the MUTR reactor building from the roll up door and an exterior door gaps. This would cause air to then flow from MUTR reactor building into the adjacent unrestricted areas within Building 90. The fifty-year historical assessment found that during 10% of the year, an average wind of 1.6 miles per hour will come from the northerly direction; this included a weighted average of the wind speed blowing from the North-North -West, North and North-North-East. Under these conditions, the Argon-41 leakage will be from the MUTR reactor building to the adjacent unrestricted hallway of Building 90. The dose to an individual from Argon-41 leaking into the hallway was evaluated.

Applying the Argon-41 concentration at equilibrium, 10% of the total operating hours during this reporting period, and the leakage rate of $0.00236 \text{ m}^3\text{s}^{-1}$ from the MUTR reactor building door into the hallway, the dose to a person from Argon-41 leaking into the unrestricted hallway is calculated to be 0.2 mrem.

VII. ALARA REVIEW FOR FACILITY PERSONNEL AND VISTOR EXPOSURE

A review of exposure records and all facility operations were performed by facility management as part of the annual ALARA audit. For this reporting period, all badged personnel and students received doses less than ten per-cent of their annual dose limit.

The Pocket Dosimeters recorded minimal exposure for all guests and service personnel. Calibrations of these self-reading dosimeters were performed on an annual basis by the University of Maryland's Radiation Safety Office.

VIII. UNSCHEDULED SHUTDOWNS/REPORTABLE OCCURRENCES

There were two unscheduled shutdowns during this reporting period.

The first shutdown happened during operation number 4370 dated August 11, 2014 and was caused by an undercount on the exhaust radiation monitor.

The next unscheduled shutdown occurred on December 3, 2014, the operation number was 4388, and was again caused by an undercount on the exhaust radiation monitor.

Both of these were during periods of training and occurred while the MUTR was subcritical.

There were no reportable occurrences during this reporting period.

IX. SPECIAL EXPERIMENTS

There were no new special experiments performed during this reporting period. There was one experiment classified as special due to the fact that it utilized the thermal column. The experiment used the thermal column as a source of thermal neutrons in order to perform neutron imaging.

X. CHANGES IN FACILITY STAFF

There were no significant changes to staffing during this reporting period. During this reporting period, staff changes consisted of the addition of five new operators which included three new Senior Reactor Operators and two new Reactor Operators. Also this year, two operators' licenses were terminated, these terminations included one RO, and one SRO.

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C A P 8 8 - P C

Version 4.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment Thu Sep 24 10:05:34 2015

Facility: Maryland University Training Reactor MUTR

Address: Building 090
Stadium Drive

City: College Park

State: MD

Zip: 20742

Source Category: Source Type: Area

Emission Year: 2014 DOSE Age Group: Adult

Comments: MEI Ar-41 Dose at MUTR Fence Line

Fiscal July 2014 - Jun 2015 Year

Committed Effective Dose Equivalent (mrem)

1.16E-01

At This Location: 4 Meters West Northwest

Dataset Name: MUTR Ar41 2015 M

Dataset Date: Sep 23, 2015 09:57 AM

Wind File: C:\Program Files (x86)\CAP88\CAP88-PC 4\Default Files\W

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MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 4 Meters West Northwest
Lifetime Fatal Cancer Risk: 6.38E-08

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem)
Adrenal	1.01E-01
UB_Wall	1.01E-01
Bone_Sur	1.71E-01
Brain	1.30E-01
Breasts	1.35E-01
St_Wall	1.08E-01
SI_Wall	1.00E-01
ULI_Wall	1.03E-01
LLI_Wall	1.02E-01
Kidneys	1.09E-01
Liver	1.10E-01
Muscle	1.17E-01
Ovaries	1.04E-01
Pancreas	9.85E-02
R_Marrow	1.19E-01
Skin	1.91E-01
Spleen	1.10E-01
Testes	1.19E-01
Thymus	1.14E-01
Thyroid	1.23E-01
GB_Wall	1.02E-01
Ht_Wall	1.08E-01
Uterus	9.76E-02
ET_Reg	9.85E-02
Lung_66	1.20E-01
Effectiv	1.16E-01

RADIONUCLIDE EMISSIONS DURING THE YEAR 2014

Nuclide	Type	Size	Source #1 Ci/y	TOTAL Ci/y
Ar-41	B	0.000	1.6E-02	1.6E-02

SITE INFORMATION

Temperature: 12.800 degrees C
Precipitation: 103.630 cm/y
Humidity: 8.000 g/cu m
Mixing Height: 1800.0 m

User specified location of max exposed individual.
(ILOC, JLOC): WNW, 4 meters

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SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
Area (sq m): 0.06

Plume Rise							
Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m):	None	None	None	None	None	None	None

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.0800	0.0000	0.0100
Fraction From Assessment Area:	0.9200	1.0000	0.9900
Fraction Imported:	0.0000	0.0000	0.0000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

1	2	3	4	5	6	7
8	9	10	100	200	300	
500						