



**THE OHIO STATE UNIVERSITY**

College of Engineering

**Nuclear Reactor Laboratory**  
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September 9, 2022

U.S. Nuclear Regulatory Commission  
Document Control Desk  
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Rockville, MD 20852-2738

**Subject: Annual Report for The Ohio State University Research Reactor, License  
R-75, Docket 50-150**

Please find enclosed the annual report for The Ohio State University Research Reactor, Docket No. 50-150. This report is being submitted as required by our Technical Specifications, Section 6.6.1. If you have questions on the content of this report, please contact Mr. Andrew Kauffman, Senior Associate Director of the Nuclear Reactor Laboratory, at 614-688-8220 or kauffman.9@osu.edu.

I declare under penalty of perjury that the foregoing is true and correct.  
Executed on 09-Sep-2022.

Sincerely,

Lei Raymond Cao, Director  
OSU Nuclear Reactor Lab  
The Ohio State University  
(License R-75, Docket 50-150)

AD20  
NRR

THE OHIO STATE UNIVERSITY  
RESEARCH REACTOR

ANNUAL REPORT FOR FY 2021/2022

SEPTEMBER 2022

## Introduction

As stated in The Ohio State University Research Reactor (OSURR) Technical Specifications Section 6.6.1, *Operating Reports*, an annual report shall be made to the NRC by September 30 of each year. This report is to include the following seven information items:

1. A narrative summary of operating experience (including experiments performed) and of changes in facility design, performance characteristics, and operating procedures related to reactor safety occurring during the reporting period
2. A tabulation showing the energy generated by the reactor (in kilowatt hours) and the number of hours the reactor was in use
3. The results of safety related maintenance and inspections and the reasons for corrective maintenance of safety-related items
4. A table of unscheduled shutdowns and inadvertent scrams, including their reasons and the corrective actions taken
5. A summary of the safety analyses performed in connection with changes to the facility or procedures, which affect reactor safety, and performance of tests or experiments carried out under the conditions of 10 CFR 50.59
6. A summary of the nature and amount of radioactive gaseous, liquids, and solid effluents released or discharged to the environs beyond the effective control of the licensee as measured or calculated at or prior to the point of such release or discharge
7. A summary of radiation exposures received by facility personnel and visitors, including the dates and times of significant exposures

These seven information items are discussed below for the period July 1, 2021 through June 30, 2022, except as noted for exposure records.

### 1. Summary of Operating Experience and Changes

#### 1.A. Experiments Performed

The OSURR engages in a wide range of research, service, and education activities. Examples of recent types of research and industry service include: evaluation of material properties using neutron depth profiling, neutron transmission testing, and neutron activation analysis; evaluation of radiation response and damage for electronic components and other materials, such as optical fibers and optical fiber-based sensors; evaluation of neutron and gamma-ray radiation sensitive detector performance, including at high temperatures; and isotope production. The OSURR has been involved in the evaluation of a number of potential types of neutron and radiation detectors, including fiber-optic, solid-state, and scintillator-based, and it regularly tests fission chambers for use in commercial power reactors by characterizing their response to known neutron flux. Neutron transmission testing has been used to verify boron loading in borated aluminum, and neutron depth profiling has been used for battery-technology studies. Isotope production has typically been performed for medical research, but sources have been created for other uses, including testing of radiation-sensitive detectors.

In addition, educational student laboratories and demonstrations are performed at the OSURR, including reactivity worth measurements, spectrum and profile characterizations using flux-wire activation and analysis, radiation measurements using neutron and gamma-sensitive detectors, and reactor dynamics measurements. The OSURR provides these via educational tours and student laboratory sessions. The

OSURR also supports faculty-led student research, which provides invaluable experience for the next generation of researchers.

The following are typical laboratory topics taught at the OSURR:

- a. laboratory introduction, radiation safety training, radiological survey
- b. approach to critical (using banked control rods rather than fuel loading)
- c. control rod calibration by rod drop, positive period, and subcritical multiplication
- d. temperature coefficient measurement
- e. delayed neutron groups measurement
- f. core axial profile
- g. neutron spectrum measurement

For tour groups, neutron activation of small aluminum samples with a half-life measurement is typically performed.

The reactor utilization for July 1, 2021 through June 30, 2022 is summarized in the following reports. Please note that the utilization hours listed below only reflect actual reactor operating time. The list does not include hours spent on tasks supporting this reactor utilization.

**OSURR Utilization Summary  
July 1 - December 31, 2021**

User (Name)	Description	Hours <sup>1</sup>
OSU NE (Blue / Jones)	Optical fiber-based gamma thermometer	0.0 <sup>2</sup>
OSU NE (Cao / Oksuz)	Fast beam facility characterization (neutron flux)	6.8 <sup>2</sup>
OSU NE (Cao / Bisbee)	Fast beam facility characterization (imaging)	51.4 <sup>2</sup>
OSU NE (Cao / Downing)	Neutron Depth Profiling	12.3 <sup>2</sup>
OSU NE (Khafizov)	Radiation effects on SAW sensors	72.8
OSU NE 4505	Tour for class	2.4
OSU NE 4506	Lab class support	6.9
OSU ECE (Brillson)	Radiation effects on Ga <sub>2</sub> O <sub>3</sub>	16.7
OSU College of Engineering	Tour for open house	2.3
U. of Michigan (Jovanovic)	Radiation effects on optical components	51.4
Niowave, Inc.	Reactivity check	1.7
Orrvilon, Inc.	Neutron Transmission Testing	14.9
Reuter-Stokes, LLC	Fission chamber testing	41.1
NRL staff	Operator training & requalification	12.1 <sup>2</sup>

**Total: 292.8**

Notes:

1. Utilization reflects actual reactor operating time. This list does not include time spent on tasks supporting this reactor utilization (pre-start and post-shutdown checkout, experiment planning and setup, etc.).
2. The value listed does not include utilization when run as a secondary user concurrent with a primary user.

**OSURR Utilization Summary**  
**January 1 – June 30, 2022**

User (Name)	Description	Hours <sup>1</sup>
OSU NE (Cao)	Rad effects on GaN diodes	0.0 <sup>2</sup>
OSU NE (Cao / Kandlakunta)	Solar cells in fast beam facility	10.4
OSU NE (Cao / Kandlakunta)	Perovskite sensors in thermal beam facility	0.0 <sup>2</sup>
OSU NE (Cao / Bisbee)	Fast beam facility characterization (imaging)	37.0 <sup>2</sup>
OSU NE (Cao / Downing)	Neutron Depth Profiling in thermal beam facility	0.0 <sup>2</sup>
OSU NE (Khafizov / Chesser)	Radiation effects on SAW sensors	24.0
OSU NRL & NE program	Tours for student employees & NDP workshop	2.1
OSU NE 4505	Tour for class support	6.1
OSU NE 5742	Lab class support	3.0
OSU NE 6726	Lab class support	12.2
OSU Chemistry (Goldberg / Nelson)	NAA of PdSe <sub>2</sub> semiconductors	1.4
AFIT (McClory / Nichols)	Solar cells in fast beam facility	0.0 <sup>2</sup>
U. of Michigan (Jovanovic / Morgan)	Radiation effects on optical components	184.2
U. of Michigan (Jovanovic / Kavner)	Detector test in thermal beam facility	0.0 <sup>2</sup>
Lakeshore Cryotronics	NAA of temperature sensor	0.3
Orrvilon, Inc.	Neutron Transmission Testing, rad effects on coatings	16.3
Reuter-Stokes, LLC	Fission chamber testing	46.0
USNC-Tech	Tm-170 production	15.8
NRL staff	Operator training, maintenance, flux measurements	7.3 <sup>2</sup>

**Total: 366.1**

Notes:

1. Utilization reflects actual reactor operating time. This list does not include time spent on tasks supporting this reactor utilization (pre-start and post-shutdown checkout, experiment planning and setup, etc.).
2. The value listed does not include utilization when run as a secondary user concurrent with a primary user.

### **1.B. Changes in Facility Design**

There were no facility design changes that required a change to the Technical Specifications. 10 CFR 50.59 changes are described in Section 5.A of this report.

### **1.C. Changes in Performance Characteristics**

There have been no changes in performance characteristics related to reactor safety in the last year.

### **1.D. Changes in Operating Procedures**

There were no changes in operating procedures related to reactor safety in the last year. 10 CFR 50.59 changes are described in Section 5.B of this report.

## **2. Energy Generated and Hours of Use**

Kilowatt-Hours of Operation: 178,662.0 kW-hr

Hours of Utilization: 658.9 hr

## **3. Safety Related Maintenance**

None.

## **4. Unscheduled Shutdowns**

From July 1, 2021 to June 30, 2022, there were three unplanned shutdowns that are summarized below.

Reason	Corrective Action
Period safety scram due to noise on the log channel (3)	None required

## **5. Changes in Facility and Procedures in Accordance with 10 CFR 50.59**

### **5.A. Facility Modifications**

During the period July 1, 2021 to June 30, 2022, three OSURR Modification Requests were completed:

- 1) Makeup valves and conductivity meter replacement
- 2) Cooling system alarm panel Q module ALARM 2 setpoint change
- 3) Building exhaust fan and effluent flow indication

All of the modifications screened out of 10 CFR 50.59 evaluation per Procedure AP-16, *50.59 Screening and Evaluation*.

### 5.B. Procedure changes

The following is a list of procedure changes made under 10 CFR 50.59 from July 1, 2021 to June 30, 2022, in accordance with Administrative Procedure AP-06, *Format for Writing, Revising, and Approving Procedures*.

Procedure Number	Procedure Title	Revision Date
OM-01	Reactor Operations	06/27/22
OM-15	Process System Checks	10/01/21
OM-17	Thermal Beam Facility Use	08/20/21
IM-01	Scram Checks	06/14/22
IM-03	Pre-Startup Checkout	06/27/22
IM-04	Post-Shutdown Checkout	06/27/22

All of the procedure changes screened out of 10 CFR 50.59 evaluation per Procedure AP-16, *50.59 Screening and Evaluation*.

## 6. Radioactive Effluents

### 6.A. Gaseous Effluent

The only gaseous effluent releases made from operation of the OSURR are Ar-41 releases from activation of the naturally occurring noble gas Ar-40. For the period July 1 - December 31, 2021, Ar-41 releases measured 2.5% of the annual average concentration limit. From January 1 – June 30, 2022, releases measured 4.6% of the annual average concentration limit. In accordance with the requirements of 10 CFR 20.1101(d), the COMPLY code was run using the total Ar-41 release for the period July 1, 2021 – June 30, 2022 of 407 mCi. Using level 2 in the code, the effective dose equivalent rate at the facility fence was computed to be 0.3 mrem/yr. This is well below the 10 mrem/yr constraint specified in the regulation.

Any other releases were reported under the university's license with the state of Ohio.

### 6.B. Liquid Releases

Hot sink releases are recorded and reported through the OSU Office of Radiation Safety. No releases were made from operation of the OSURR, and other releases were reported under the university's license with the state of Ohio.

### 6.C. Solid Releases

No releases of solid radioactive material were made to the uncontrolled environment.



## 7. Radiation Exposures

Since the firm that maintains records for The Ohio State University keeps a year-to-date record, it is simpler to report radiation exposure records by the nearest completed calendar year. Therefore, dosimetry badge exposures in this report are for the period January 1, 2021 to December 31, 2021. Twenty individuals were monitored as radiation workers during this period, and the measured dose equivalent values are tabulated below in mrem.

Individual	Dose Equivalent (mrem)			
	DDE	LDE	SDE, WB	SDE, ME
Visitors	0	0	0	n/a
Staff member #1	34	34	33	0
Staff member #2	55	59	64	756
Staff member #3	116	117	123	259
Staff member #4	123	127	226	403
Staff member #5	54	54	54	324
Staff member #6	109	110	110	208
Staff member #7	19	23	26	n/a
Staff member #8	46	52	57	n/a
Staff member #9	7	7	7	39
Faculty member #1	71	71	73	85
Student #1	15	15	15	50
Student #2	395	403	406	288
Student #3	46	49	52	30
Student #4	461	468	468	271
Student #5	18	19	33	55
Student #6	37	36	38	58
Student #7	29	31	38	65
Student #8	1	1	17	0
Student #9	5	8	12	0
Visiting Scientist #1	2	2	3	46

COMPLY: V1.7.

7/ 1/2022 7:41

40 CFR Part 61  
National Emission Standards  
for Hazardous Air Pollutants

REPORT ON COMPLIANCE WITH  
THE CLEAN AIR ACT LIMITS FOR RADIONUCLIDE EMISSIONS  
FROM THE COMPLY CODE - V1.7.

Prepared by:

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1298 Kinnear Rd

Andrew Kauffman  
614-688-8220

Prepared for:

U.S. Environmental Protection Agency  
Office of Radiation and Indoor Air  
Washington, DC 20460

COMPLY: V1.7.

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OSU NRL FY2022

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SCREENING LEVEL 2  
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DATA ENTERED:  
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Nuclide	Release Rate (curies/YEAR)
AR-41	4.070E-01

Release height 10 meters.

Building height 11 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 15 meters.

Building width 25 meters.

Default mean wind speed used (2.0 m/sec).

NOTES:  
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Input parameters outside the "normal" range:

None.

RESULTS:  
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Effective dose equivalent: 0.3 mrem/yr.

\*\*\* Comply at level 2.

This facility is in COMPLIANCE.

It may or may not be EXEMPT from reporting to the EPA.

You may contact your regional EPA office for more information.

\*\*\*\*\* END OF COMPLIANCE REPORT \*\*\*\*\*