THE OHIO STATE UNIVERSITY

College of Engineering

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September 9, 2020

U.S. Nuclear Regulatory Commission
Document Control Desk
Attn: Xiaosong Yin
One White Flint North
11555 Rockville Pike
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-2020.

Sincerely,

Lei Raymond Cao

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

ADZD
NRR

THE OHIO STATE UNIVERSITY
RESEARCH REACTOR

ANNUAL REPORT FOR FY 2019/2020

SEPTEMBER 2020

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, 2019 through June 30, 2020, 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 endeavors, including radiation-damage studies, neutron and radiation sensitive detector evaluation, neutron transmission testing, neutron depth profiling, neutron imaging, isotope production, and neutron activation analysis (NAA). Most radiation-damage studies performed at the OSURR are for electronic and fiber-optic components, but studies have been performed for other materials. The OSURR has been involved in the development of a number of potential types of neutron and radiation detectors, including fiber-optic based systems, 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 historically been performed for medical research, but sources have been created for other uses, including testing of radiation-sensitive detectors. Much of the NAA work that has been performed at the OSURR is for geological and material science samples, but NAA is used for other purposes, such as industrial and biological. In addition, other experiments are performed at the OSURR, such as reactivity worth measurements and reactor neutron profile and spectrum characterizations using flux-wire activation and analysis.

The OSURR also provides a variety of instructional services ranging from general tours to individual and group laboratory sessions and research projects structured to student and faculty interests. Nuclear engineering and physics classes throughout Ohio have utilized the OSURR for the following basic experiments:

a. approach to critical (using banked control rods rather than fuel loading)
b. control rod calibration by rod drop, positive period, and subcritical multiplication
c. temperature coefficient measurements
d. radiological surveys

When the OSURR is used to introduce students, faculty or other experimenters to nuclear research, the following are typically done:

a. discuss nuclear reactions and radiological safety
b. operate the reactor at 10kW-100kW
c. have the individuals observe control room operations
d. complete a tour and demonstrate irradiation techniques

Neutron activation experiments are performed for students ranging from high school to graduate school.

The reactor utilization for July 1, 2019 through June 30, 2020 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.

The Ohio State University Nuclear Reactor Lab Reactor Utilization Report: July 1 - December 31, 2019

User (Name)	Description	Hours [1]
AFIT	Neutron spectrum measurement, radiation effects	3.5
Luna Innovations	Cladding optical fibers	15.8
NASA Glenn (Chaiken)	Radiation hardness testing of electronic components	12.6
NASA JPL (Patel)	Radiation effects on thermoelectric materials	1.4
NDSU (Lepper)	NAA of geology samples	1.4
NRL staff	Facility characterization, operator requal, etc.	14.9
Orrvilon, Inc.	Neutron transmission testing	19.8
ORNL (Howard)	Radiation effects on sensors	5.4
Reuter-Stokes, LLC	Fission chamber testing	58.9
OSU ECE (Ringel)	Radiation effects on gallium oxide	1.0
OSU NE (Blue)	Radiation effects on optical fibers	0.0 [2]
OSU NE (Cao)	Neutron imaging	4.2
OSU NE 4505	Class support	1.6
OSU NE 4506	Class support	3.4
Various[3]	Tours	8.8
	Total:	**152.7**

Notes:

1. Utilization hours reflect 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 reactor utilization when run as a secondary user concurrent with a primary user.
3. Tours were provided to support courses (IS 4701), the MAE and ECE departments, the College of Engineering, and the university (VP Stocki and the Office of Legal Affairs).

The Ohio State University Nuclear Reactor Lab Reactor Utilization Report: January 1 - June 30, 2020

User (Name)	Description	Hours [1]
Luna Innovations	Radiation effects on fiber-based sensors	7.5
NRL staff	Facility characterization, facility maintenance, etc.	1.3 [2]
Orrvilon, Inc.	Neutron transmission testing	19.6
Reuter-Stokes, LLC	Fission chamber testing	46.1
NSUF CINR (Daw / McCary)	Cladding sapphire fibers	16.1
NSUF RTE (Jones)	Cladding sapphire fibers	7.4
OSU NE (Blue / Birri)	Radiation effects on optical fibers	0.0 [2]
OSU NE (Cao / Kandlakunta)	Sensor testing	6.8
OSU NE (Cao / Oksuz)	Neutron imaging	6.9 [2]
OSU NE (Cao / Oksuz)	Fast beam facility characterization	5.1
OSU NE (Khafizov)	Radiation effects on SAW filters	8.7
OSU NE 6726	Class support	11.7
	Total:	**137.2**

Notes:

1. Utilization hours reflect 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 reactor 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: 34477.6 kW-hr

Hours of Utilization: 289.9 hr

3. Safety Related Maintenance

None.

4. Unscheduled Shutdowns

From July 1, 2019 to June 30, 2020, there were two unplanned shutdowns that are summarized below.

Reason		Corrective Action
Period Safety scram from noise on log channel	(2)	None required

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

5.A. Facility Modifications

During the period July 1, 2019 to June 30, 2020, seven OSURR Modification Requests were completed:

1) Shim Safety #2 Optical Rotary Encoder Replacement
2) Cooling Panel Power Safety Units Replacement
3) Linear Power Recorder Scram Setpoint Change
4) Effluent Monitor NIM Modules Replacement
5) Level Safety Modules Scram Setpoint Change
6) Wet Irradiation Facility (WIF) Installation
7) Beam Port #2 Replacement Collimator

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, 2019 to June 30, 2020, in accordance with Administrative Procedure AP-06, *Format for Writing, Revising, and Approving Procedures.*

Procedure Number	Procedure Title	Revision Date
OM-02	Control Rod Annual Inspections	08/09/19
OM-07	Fuel Element Inspections	08/12/19
OM-08	Reactor Operation Logbook Records	03/26/20
OM-16	Power Calibration	08/13/19
RS-01	Posting, Labeling, and Storage Requirements	12/27/19
RS-02	Radioactive Waste Disposal	08/30/19
RS-05	Pool Water Radioactivity	08/21/19
RS-06	Annual Radiation Monitor Calibrations	01/07/20
RS-08	Smear Surveys	01/22/20
RS-09	Area Radiation Surveys	03/19/20
RS-10	Receiving and Opening Packages	01/22/20
RS-11	Shipping Packages	02/17/20
RS-12	Decontamination	03/31/20
RS-15	Radiation Safety Instruction	10/03/19
RS-17	Ar-41 Release Calculations	09/24/19
IM-01	Scram Checks	06/23/20
IM-02	Adjusting Reactor Control Instrumentation Meter Zeros	03/27/20
IM-07	Rod Parameter Testing	08/08/19

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, 2019, Ar-41 releases measured 2.50% of the annual average concentration limit. From January 1 – June 30, 2020, releases measured 1.56% 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, 2019 - June 30, 2020 of 252.1 mCi. Using level 2 in the code, the effective dose equivalent rate at the facility fence was computed to be 0.2 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, 2019 to December 31, 2019. Seventeen 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	16	20	46	51
Staff member #2	69	75	101	273
Staff member #3	54	55	55	43
Staff member #4	78	80	91	421
Staff member #5	68	70	70	0
Staff member #6	8	8	8	n/a
Staff member #7	1	1	3	0
Student #1	12	12	12	0
Student #2	10	10	10	0
Student #3	3	3	4	0
Student #4	5	5	5	0
Student #5	22	22	22	30
Student #6	1	1	1	27
Student #7	11	11	11	0
Student #8	10	13	13	0
Student #9	16	16	16	26
Visiting Scientist #1	0	0	0	0

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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614-688-8220

Prepared for:

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

COMPLY: V1.7. 6/23/2020 9:48

OSURR FY2020

SCREENING LEVEL 2

DATA ENTERED:

Nuclide	Release Rate (curies/YEAR)
AR-41	2.521E-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:

Input parameters outside the "normal" range:

None.

RESULTS:

Effective dose equivalent: 0.2 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 **********