



**The Ohio State University  
Nuclear Reactor Laboratory**

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24-Sep-2009

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**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, Associate Director of the Nuclear Reactor Laboratory, at 614-688-8220.

I declare under penalty of perjury that the foregoing is true and correct.  
Executed on 24-Sep-2009.

Sincerely,

A handwritten signature in cursive script, appearing to read "Thomas E. Blue".

Thomas Blue, Director  
OSU Nuclear Reactor Lab  
The Ohio State University  
(License R-75, Docket 50-150)

c: Gregory N. Washington, Dean, OSU College of Engineering  
Randolph L. Moses, Associate Dean for Research, OSU College of Engineering  
Elizabeth Reed, US Nuclear Regulatory Commission  
A. Kauffman, OSU Nuclear Reactor Lab

A020  
NRR

THE OHIO STATE UNIVERSITY  
RESEARCH REACTOR

ANNUAL REPORT FOR FY 2008/2009

SEPTEMBER 2009

## **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, 2008 through June 30, 2009, 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 neutron activation analysis (NAA), radiation-damage studies, neutron and radiation sensitive detector development, isotope production, and biomedical experiments. Much of the NAA work performed at the OSURR is for geological samples, but NAA is used for other purposes, such as industrial and biological. Most radiation-damage studies performed at the OSURR are for electronic components, but studies have been performed for other materials, including fiber-optic components. 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. Isotope production has typically been performed for medical research, but sources have been created for other uses, including

testing of radiation-sensitive detectors. Biological sample irradiations performed at the OSURR have been for boron neutron capture therapy (BNCT) studies. In addition, other experiments are performed at the OSURR, such as reactivity worth measurements, spectrum characterizations using flux-wire activation and analysis, and physics experiments such as neutron irradiation of fullerenes.

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. measurement of the reactor transfer function by noise analysis
- d. temperature coefficient measurements
- e. 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 analysis experiments are performed for students ranging from high school to graduate school.

The reactor utilization for July 1, 2008 through June 30, 2009 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, 2008**

<b>User (Affiliation)</b>	<b>Description</b>	<b>Hours<sup>1</sup></b>
AFIT	Radiation damage in electronics	6.1
AFIT (Rockrohr)	Foil activation	0.6
AFIT (Rockrohr)	Cr-51 production	1.3
Frasca	Rad Effects	1.2
GE Reuter-Stokes	Fission chamber testing	83.1
Luna Innovations	Neutron spectrum measurement	3.4
NDSU (Lepper)	NAA of geology samples	1.5
OSURR	Calibrations, inspections, requal, loading	32.5 <sup>2</sup>
NUCON	Hg-203 Production	5.8
OSU MSE (Ralston)	NAA	8.6
OSU NE (Kulisek)	Damage to SiC diodes	4.3
OSU NE (Taylor)	Spectrum Measurements	2.9
Scintiprox	Na-24 production	0.3
Shafer	Fullerenes neutron irradiation	0.9
UC (Glover)	Irrad of silica discs	5.4
UC (Spitz)	NAA of air filters	3.8 <sup>2</sup>
Various	Tours	33.4 <sup>2</sup>

**Total: 195.1**

Notes:

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

**The Ohio State University Nuclear Reactor Lab Reactor Utilization Report:  
January 1 - June 30, 2009**

<b>User (Affiliation)</b>	<b>Description</b>	<b>Hours<sup>1</sup></b>
AFIT	Measure worth of CIF basket	1.1
AFIT	NAA of geological samples	1.0
GE Reuter-Stokes	Fission chamber testing	61.2
Glover (UC)	Silica discs	4.0
Kulisek, Blue (OSU NE)	Rad effects testing	0.8 <sup>2</sup>
Lepper (NDSU)	NAA of geology samples	1.4
Luna Innovations	Optical sensor evaluation	179.2
OSURR	Ops for core change, including new dry tube	27.4
OSU Mat. Sci. Eng.	Rad effect on materials	1.5 <sup>2</sup>
OSU NE	Classes and labs (NE 505, 742, 744, 793)	39.9
OSU NE (Tayloe)	Void coeff. measurements	1.0
Schafer	Fullerenes neutron irradiation	2.0
Scintiprox	Isotope production	1.1
Spitz (UC)	NAA	6.6 <sup>2</sup>
Various	Tours(excluding NE 505)	18.1 <sup>2</sup>
<b>Total:</b>		<b>346.3</b>

Notes:

1. The utilization hours listed above reflect actual reactor operating time. The list does not include hours spent on tasks supporting this reactor utilization (pre-start and post-shutdown checkout, experiment setup, etc.).
2. Does not include reactor utilization time 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. 10CFR50.59 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. 10CFR50.59 changes are described in Section 5.B of this report.

### 2. Energy Generated and Hours of Use

Kilowatt-Hours of Operation: 88851.0 kW-hr

Hours of Utilization: 541.4 hr

### 3. Safety Related Maintenance

None.

### 4. Unscheduled Shutdowns

From July 1, 2008 to June 30, 2009 there were 5 unplanned shutdowns. These are summarized below.

Reason	Corrective Action
Period Safety scram from noise on log channel (4)	None during this time period
Linear Channel scale (2)	Discussed with operators

## 5. Changes in Facility and Procedures in Accordance with 10CFR50.59

### 5.A. Facility Modifications

During the period July 1, 2008 to June 30, 2009, four OSURR Modification Requests were completed by the reactor staff and reviewed by the OSURR's safety committee.

- a) Replacement of in-pool UIC and CIC detectors
- b) Removal of rabbit monitoring system
- c) Replacement of startup recorder
- d) Installation of new "PIF" in-core dry tube

### 5.B. Procedure changes

The following is a list of procedure changes made under 10CFR50.59 from July 1, 2008 to June 30, 2009 in accordance with Administrative Procedure AP-05, entitled Format for Writing, Revising, and Approving Procedures.

Procedure Number	Procedure Title	Revision Date
AP-06	Format for Writing, Revising and Approving Procedures	12-Jan-2009
AP-11	Record Keeping	07-Jan-2009
AP-14	OSURR Modification Requests	13-Jan-2009
EP-01	Emergency Procedures	15-Apr-2009
EP-04	Emergency Equipment Inventory	17-Oct-2008
IM-02	Adjusting Meter Zeros	26-Mar-2009
IM-03	Pre-Start Checkout	10-Feb-2009
IM-04	Post-Shutdown Checkout	13-Feb-2009
OM-08	Reactor Operation Logbook Records	26-Mar-2009
RS-03	Calibrating Gaseous Effluent Monitor	13-Feb-2009
RS-11	Routine Shipment of Radioactive Material	06-Apr-2009

## 6. Radioactive Effluents

### 6.A. Gaseous Effluent

The only gaseous effluent measured is the release of Ar-41. For the period July 1 - Dec. 31, 2008, Ar-41 releases measured 0.44 % of the annual average concentration limit. From Jan. 1 - June 30, 2009, releases measured 0.91 % of the annual average concentration limit. In accordance with the requirements of 10CFR20.1101(d), the COMPLY code was run using the total Ar-41 release for the period July 1, 2008 - June 30, 2009 of 104 mCi. Using level 2 in the code, the effective dose equivalent rate at the facility fence was computed to be 0.07 mrem/yr. This is well below the 10 mrem/yr constraint specified in the regulation.



## 6.B. Liquid Releases

Hot sink releases are recorded and reported through the OSU Office of Radiation Safety. One release of 1.04 mCi of H-3 was made to the sanitary sewer system during the period July 1, 2008 to June 30, 2009.

## 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, 2008 to December 31, 2008. Sixteen individuals were monitored as radiation workers during this period, and the measured dose equivalent values are tabulated below in mrem. Many of the doses are higher than what is usually seen at the OSURR in a year, as whole-body doses are typically much less than 10% of the 10-CFR-20 occupational dose limit for adults. In July 2008 a scheduled maintenance outage was performed, during which those participating received the majority of the doses shown below. At all times, individuals adhered to the ALARA policy for The Ohio State University, and doses were kept well below the 10-CFR-20 occupational dose limit for adults.

Individual	Dose Equivalent (mrem)			
	DDE	LDE	SDE, WB	SDE, ME
Visitors	0	0	0	N/A
Staff member 1	1106	1134	1194	1230
Staff member 2	1724	1739	1795	1790
Staff member 3	342	457	598	650
Staff member 4	2568	2573	2558	2850
Staff member 5	1161	1162	1146	2110
Staff member 6	34	34	35	-
Student worker 1	0	0	2	0
Student worker 2	667	490	657	440
Student worker 3	23	17	23	0
Student worker 4	236	215	257	280
Student worker 5	1033	1032	1017	1270
Student worker 6	37	40	45	40
Student worker 7	338	254	331	430
Student worker 8	23	23	47	40
Student worker 9	28	38	47	0
Student worker 10	13	11	14	0

COMPLY: V1.6.

9/14/2009 10:37

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 - V1.6.

Prepared by:

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Andrew Kauffman  
614-688-8220

Prepared for:

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

NRL\_2009

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SCREENING LEVEL 2  
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DATA ENTERED:  
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Nuclide	Release Rate (curies/YEAR)
AR-41	1.040E-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: 7.2E-02 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 \*\*\*\*\*