UWNR **Nuclear Reactor Laboratory**
University of Wisconsin-Madison
1513 University Avenue, Room 1215 ME, Madison, WI 53706-1687, Tel: (608) 262-3392, FAX: (608) 262-8590
email: reactor@engr.wisc.edu, http://reactor.engr.wisc.edu

License R-74
Docket 50-156

July 31, 2015

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Dear Sir:

Enclosed is a copy of the 2014-2015 Annual Report for the University of Wisconsin Nuclear Reactor Laboratory as required by Technical Specification 6.7.1(1).

Sincerely,

Robert J. Agasie
Reactor Director

Enc. (Annual Report)

cc: Compliance Inspector, Craig Bassett
Facility Project Manager, Spyros Traiforos
Reactor Safety Committee, RSC 1245

A020
NRR

THE UNIVERSITY OF WISCONSIN
NUCLEAR REACTOR LABORATORY

FISCAL YEAR 2014-2015 ANNUAL OPERATING REPORT

Prepared to meet reporting requirements of:

U. S. Nuclear Regulatory Commission
License R-74
Docket 50-156
Technical Specification 6.7.1(1)

Prepared by:

Robert J. Agasie
Department of Engineering Physics

EXECUTIVE SUMMARY OF REACTOR UTILIZATION

Instruction: Teaching usage of the reactor during the year included:

- 105 Nuclear Engineering students in laboratory and lecture courses.
- 650 individuals from 12 organizations as part of the UW Nuclear Reactor Outreach Program.

Research: Neutron irradiations during the year included:

- 364 samples irradiated for departments at UW-Madison.
- 4 samples were irradiated for other educational and research institution research programs.

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A. SUMMARY OF OPERATIONS

1. INSTRUCTIONAL USE

Nuclear Engineering (NE) 231, "Survey of Nuclear Engineering" was offered in the spring semester with an enrollment of 11 students. The course is designed for freshmen students interested in nuclear engineering and consists of three lecture modules surveying fission, fusion and radiation science technologies. The fission module concludes with a reactor tour.

Four sections of NE 427 were offered during the academic calendar year with a total enrollment of 31 students. Several NE 427 experiments use materials that are activated in the reactor. One experiment entitled "Radiation Survey" requires that students make measurements of radiation levels in and around the reactor laboratory.

Three sections of NE 428 were offered during the academic calendar year with a total enrollment of 35 students. Three experiments in NE 428 require exclusive use of the reactor. These experiments ("Critical Experiment", "Control Element Calibration", and "Pulsing") required a total of 36 hours of exclusive reactor use. Other NE 428 laboratory sessions use material that has been irradiated in the reactor ("Fast Neutron Flux Measurements by Threshold Foil Techniques" and "Resonance Absorption").

Individual class sections for Nuclear Engineering 408, "Ionizing Radiation" were held at the Reactor Laboratory, with 28 students participating.

The Reactor Laboratory's continued commitment to its educational outreach program and community service attracts large numbers of community organizations who visit the reactor. A listing of individual schools and educational programs that have visited or received services is provided below in section A.2 of this report.

2. OUTREACH AND COMMUNITY SERVICE

Participating Institution	Number of Participants

Abundant Life Christian High School 15

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor.

Beloit College 0

Analyzed swipe tests to leak check radioactive sources and performed detector calibrations.

Boy Scouts of America 489

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor. Program included hands on demonstrations of radiation detection and shielding. Program co-sponsored by the UW student branch of the American Nuclear Society in support of the Scouts Atomic Energy Merit Badge program.

Bradley Learning Community 22

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor.

Davis-Bahcall Scholars
Black Hills State University 10

Reactor tour with a discussion of the nuclear processes during fission. The Davis-Bahcall Scholars Program is a program for South Dakota high school seniors or college freshmen exploring the world of modern scientific research at the Sanford Underground Research Facility. The program includes a road trip to the Soudan Underground Laboratory and NOvA facility in Minnesota, the UW-Madison, Argonne National Laboratory and Fermilab in Illinois.

Evansville High School 18

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor.

Girl Scouts of USA 14

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor. Program included hands on demonstrations of radiation detection and shielding. Program co-sponsored by the UW student branch of the American Nuclear Society.

Participating Institution	Number of Participants

Mount Horeb School 19

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor.

Phoenix Nuclear Lab 4

Reactor tour with a discussion on applications and the use the neutron radiography facility at the UW nuclear reactor.

UW Engineering Physics Department
Graduate Student Recruitment Program 16

Reactor tour with a discussion on the capabilities and uses of the UW nuclear reactor in support of graduate research recruitment program.

UW-Whitewater
Department of Physics 0

Analyzed swipe tests to leak check radioactive sources and performed detector calibrations.

Wisconsin Energy Institute 43

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor. The Wisconsin Energy Institute is a world-class leader in clean energy research, education and outreach. The mission of the institute is American energy independence through energy discoveries.

OUTREACH AND COMMUNITY SERVICE USER SUMMARY:

Organizations: 12

Participants: 650

3. SAMPLE IRRADIATIONS AND NEUTRON ACTIVATION ANALYSIS SERVICES

There were 368 individual samples irradiated during the year. Of these samples, 219 were irradiated for 15 minutes or less. Samples accumulated 148.9 irradiation space hours and 366.9 sample hours. Many samples were irradiated and then counted at the Reactor Laboratory as part of our neutron activation analysis program. In the listing below the notation (NAA) indicates that the samples were processed by our neutron activation analysis program.

Department of Anthropology, UW-Madison (NAA)
189 samples, 155.7 sample hours
NAA to characterize fragments of steatite manufacturing debris excavated from the archaeological site of Harappa, Pakistan.

Department of Electrical & Computer Engineering, UW-Madison
3 samples, 0.3 sample hours
Irradiation of hafnium dioxide semi-conductors to induce damage that will change the electrical properties of the material.

Department of Engineering Physics, UW-Madison
6 samples, 6.2 sample hours
Irradiation of fiber optics and diamond diodes temperature sensors as part of the Advanced Instrumentation for Transient Reactor Testing program at the UW-Madison in support of the DOE TREAT transient reactor restart initiative.

Department of Engineering Physics, UW-Madison
Nuclear Instrumentation Laboratory
111 samples, 92.3 sample hours
Irradiation of foil sources for radiation detector experiments, including absolute counting for neutron flux measurements and activation of samples for neutron activation analysis experiment.

Department of Engineering Physics, UW-Madison
NE 428

24 samples, 25.9 sample hours

Irradiation of foils for resonance absorption measurements and fast neutron flux measurements.

Department of Engineering Physics, UW-Madison
UW Nuclear Reactor Laboratory

31 samples, 82.3 sample hours

Production of calibration sources for required reactor measurements and development of methods for instrumental neutron activation analysis.

Oak Ridge National Laboratory (NAA)

4 samples, 4.2 sample hours

A proof of concept experiment to identify materials on a cotton swipe inside a plastic bag without opening the bag in support of policies pertaining to the Nuclear Non-Proliferation Treaty.

4. CHANGES IN PERSONNEL, FACILITY AND PROCEDURES

Any changes reportable under 10 CFR 50.59 are indicated in section E of this report.

Other changes to the facility included the replacement of the waste hold tank manometer level indicator with an ultrasonic level indicator, the installation of a pressure transducer to provide a wide range pool level monitor and the replacement of the water softeners.

Personnel changes during the year were as follows:

The following Operator Licenses were terminated:

Name	License	Effective Date
Joshua Havertape	OP-71100	December 17, 2014
Lucas Zachow	OP-71216	June 15, 2015

Effective February 20, 2015, Dr. Douglass L. Henderson became the chair of the department of Engineering Physics at the University of Wisconsin at Madison (UW-Madison) replacing Dr. James (Jake) P. Blanchard.

5. RESULTS OF SURVEILLANCE TESTS AND INSPECTIONS

The program of inspection and testing of reactor components continues, satisfactorily meeting procedural acceptance criteria. Inspection of underwater components during the annual maintenance showed no deterioration or abnormal wear.

The pool leak surveillance program continues to monitor the pool evaporation rate, the pool make-up volume, and pool water radioactivity. The pool leak surveillance program indicated that no water effluent has been released to the environment.

B. OPERATING STATISTICS AND FUEL EXPOSURE

Operating Period	Critical Hours	MW-Hrs	Runs	Pulses
Fiscal Year 2014-2015	267.33	200.13	70	9
Cumulative TRIGA 30/20 LEU	2,015.23	1,289.73	849	227

Core K21-R6 was operated throughout the year. The excess reactivity of this core was determined to be 4.110%ρ.

C. EMERGENCY SHUTDOWNS AND INADVERTENT SCRAMS

There were two automatic SCRAMS or manual emergency shutdowns during the year. Each is described below in chronological sequence.

November 11, 2014; SCRAM from Core Inlet Monitor. Deterioration of the thermocouple connector from the core inlet monitor thermocouple led to a momentary open in the thermocouple circuit. Due to the upscale burnout feature of the core inlet monitor a core inlet temperature high trip occurred. The thermocouple connector was replaced.

January 20, 2015; SCRAM from Core Inlet Monitor. Following an extended outage during which the reactor pool had cooled

below the core inlet monitor low temperature alarm the reactor was operated at full power. As the pool temperature increased to the core inlet monitor low temperature alarm set point the on duty operator did not understand that hysteresis prevented the core inlet monitor from automatically resetting the low temperature alarm. The operator chose to attempt to manually reset the low temperature alarm by depressing the core inlet monitor trip reset. As a result of a failsafe feature, the core inlet monitor temporarily opens the trip relay before attempting to close it during a reset; therefore the reactor scrammed.

D. MAINTENANCE

The Preventive Maintenance Program continues to maintain equipment and systems in good condition. Routine replacement of demineralizer resins occurred on October 29, 2014.

Corrective maintenance performed as a follow up action necessary for reactor restart following an automatic SCRAM is covered in section C of this report. Additional corrective maintenance was performed on the following installed systems, structures and components (SSC) as described in the SAR:

On August 21, 2014 following the argon correlation gas calibration test the gas heads of the Stack Air Monitor (SAM) and Continuous Air Monitor (CAM) were subject to a significant vacuum which ruptured the beta channel detector's thin windows. Both beta channel detectors were replaced and the SAM and CAM recalibrated. The systems were returned to service after the calibration.

On February 25, 2015 the Stack Air Monitor (SAM) System vacuum pump failed as a result of the graphite vanes breaking. The vanes were replaced and the vacuum pump verified to operate within design specifications.

E. CHANGES IN THE FACILITY OR PROCEDURES REPORTABLE UNDER 10 CFR 50.59

There no changes to the facility reportable pursuant to 10 CFR 50.59 completed during the year.

F. SUMMARY OF RADIATION EXPOSURE OF PERSONNEL (01/01/14 - 12/31/14)

The personnel radiation monitoring program at the University of Wisconsin for the past calendar year used Landauer Luxel brand monitors for whole body and extremity exposure. No personnel received any significant radiation exposure for the above period. The highest annual doses recorded were 11 mrem to the whole body and 40 mrem to the extremities.

The highest dose received by a member of the public visiting the reactor lab was 0.094 mrem, as measured by Siemens brand Electronic Personal Dosimeters.

Monthly radiation surveys continue to demonstrate acceptable radiation dose rates within the reactor laboratory and no contamination.

G. RESULTS OF ENVIRONMENTAL SURVEYS (01/01/14 - 12/31/14)

The environmental monitoring program at the University uses Landauer Luxel brand area monitors located in areas surrounding the reactor laboratory. Table 1 indicates the dose a person would have received if continuously present in the indicated area for the entire 2014 calendar year.

H. RADIOACTIVE EFFLUENTS

1. LIQUID EFFLUENTS

Liquid waste discharges to the sanitary sewer from the facility during the year are detailed in Table 2.

No liquid effluents were released to the environment during the year.

2. EXHAUST EFFLUENTS

Table 3 presents information on stack discharges during the year.

3. SOLID WASTE

Solid waste transferred from the facility during the year are detailed in Table 4.

TABLE 1 ANNUAL ENVIRONMENTAL MONITORING DOSE DATA (01/01/14 - 12/31/14)

Location	Annual Dose (mrem)
Dose Inside Reactor Laboratory Stack	<1
Highest Dose in Non-restricted Area	17
Highest Dose in Occupied* Non-restricted Area	7
Average Dose in all Non-restricted Areas (26 Monitor Points)	2.39

*Occupied areas include classrooms, offices, and lobbies/meeting areas where an individual might reasonably spend in excess of 2 hours per day

TABLE 2 LIQUID RADIOACTIVE WASTE DISCHARGED TO SEWER

Release Date:	07/24/2014
Gallons Released:	1525
Total µCi:	7.91
Sum of Fraction of MPC w/o dilution:	0.0343
Sum of Fraction of MPC w/ daily dilution:	0.0022

Isotope	MPC (µCi/ml)	Released	
Co-58	2.00E-04	1.60	µCi
		2.77E-07	µCi/ml
		0.0014	Fraction of MPC
Co-60	3.00E-05	5.64	µCi
		9.77E-07	µCi/ml
		0.0326	Fraction of MPC
Mn-54	3.00E-4	0.67	µCi
		1.17E-07	µCi/ml
		0.0004	Fraction of MPC

Total volume of water released to the sanitary sewer (gallons)	=	1525
Total activity released to the sanitary sewer (µCi)	=	7.91
Average daily sewage flow for dilution (gallons)	=	2.37E+4
Maximum fraction of MONTHLY release limit with DAILY dilution	=	0.0022
Maximum fraction of MONTHLY release limit with MONTHLY dilution	=	7.23E-5

TABLE 3 EFFLUENT FROM STACK

1. Particulate Activity

There was no discharge of particulate activity above background levels.

2. Gaseous Activity - All Argon-41

Month	Activity Discharged (Curies)	Maximum Concentration (µCi/ml)	Average Concentration (µCi/ml)
July 2014	0.096	7.330E-7	6.334E-9
August	0.081	3.900E-7	4.967E-9
September	0.121	3.673E-7	7.541E-9
October	0.158	3.850E-7	9.645E-9
November	0.117	5.011E-7	7.240E-9
December	0.041	3.850E-7	2.377E-9
January 2015	0.066	6.237E-7	3.862E-9
February	0.192	5.690E-7	1.254E-8
March	0.112	2.850E-7	6.586E-9
April	0.066	3.670E-7	4.063E-9
May	0.012	2.210E-7	0.731E-9
June	0.009	2.430E-7	0.597E-9
	Total	Maximum	Average
	1.071	7.330E-7	5.540E-9

Using the Gaussian Plume model, as described in section 13.1.7.2 of the "Safety Analysis Report for the University of Wisconsin Nuclear Reactor", a concentration of 6E-5 µCi/ml at the stack discharge would result in a maximum air concentration of 1E-8 µCi/ml at any point downwind.

TABLE 4 SOLID WASTE

Date:	11/20/14	TOTAL VOLUME
Volume:	15.6 ft^3	15.6 ft^3
Constituents:	Routine Consumables	
Isotope	Activity (mCi)	Total Activity by Isotope (mCi)
Co-57	0.0001	0.0001
Co-58	0.0002	0.0002
Co-60	0.5200	0.5200
Mn-54	0.0077	0.0077
Zn-65	0.0007	0.0007
Total Activity per Transfer (mCi):	0.5287	**TOTAL ACTIVITY** 0.5287 mCi