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License R-74
Docket 50-156

August 1, 2011

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

Dear Sir:

Enclosed is a copy of the 2010-2011 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, Mike Morlang
Facility Project Manager, Geoffrey A. Wertz
Reactor Safety Committee, RSC 1098

A020
NRR

THE UNIVERSITY OF WISCONSIN
NUCLEAR REACTOR LABORATORY

FISCAL YEAR 2010-2011 ANNUAL OPERATING REPORT

Prepared to meet reporting requirements of:

U. S. Department of Energy
Special Master Task Research Subcontract No. C96-175937

and

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Docket 50-156
Technical Specification 6.7.1(1)

Prepared by:

Robert J. Agasie
Department of Engineering Physics

THE UNIVERSITY of WISCONSIN
MADISON

EXECUTIVE SUMMARY OF REACTOR UTILIZATION

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

- 101 Nuclear Engineering students in laboratory and lecture courses.
- 29 students and staff from other UW-Madison departments and programs.
- 665 individuals from 20 organizations as part of the UW Nuclear Reactor Outreach Program.

Research: Neutron irradiations during the year included:

- 204 samples irradiated for departments at UW-Madison.

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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 34 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.

NE 427 was offered in the fall and spring semesters with a total enrollment of 30 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.

NE 428 was offered in the fall and spring semester with a total enrollment of 37 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 18 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 Mechanical Engineering 349, "Engineering Design Projects", Medical Physics 569, "Health Physics", and Anthropology 311, "Archaeological Chemistry", where held at the Reactor Laboratory, with 29 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 14

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

Academic and Medical Radiation Safety Officer Group (AMRSO)
Medical College of Wisconsin 12

Reactor tour with a discussion of radiation safety principles and practices at the UW nuclear reactor.

Beloit College 0

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

Boy Scouts of America 237

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.

Capital Science & Engineering Fair 20

Reactor tour with a discussion on applications of nuclear energy and uses of the UW nuclear reactor. Part of the Capital Science & Engineering Fair which was established to provide high school students from South Central Wisconsin a unique opportunity to perform science and engineering and learn from University faculty and staff.

Cornell University 1

Provided health physics support for the conduct of a MEMS battery experiment using a Ni-63 source.

Exelon Nuclear
Quad Cities Nuclear Generating Station 16

Week long reactor physics seminar provided to initial license trainees. Details of the training program can be found in section A.4 of this report.

Participating Institution	Number of Participants

Girl Scouts of the USA 115

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 Girl Scouts Atomic Merit Badge.

Knolls Atomic Power Laboratory 2

Reactor tour with a discussion on the capabilities of the UW nuclear reactor and future collaborations.

Marshall High School 10

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

Mount Horeb High School 39

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

Spring Harbor Middle School 96

Provided lecture to students on nuclear energy and a reactor demonstration using remote distance education technology as described in section A.4 of this report.

UW Engineering Physics Department
Graduate Student Recruitment Program 24

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

UW Foundation
World President's Organization 35

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

UW Naval Reserve Officer Training Corps 18

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

UW Police Department 0

Provided calibration services for radiation detection equipment.

Participating Institution	Number of Participants

UW Radiation Safety Department 5

Introduction of the UW nuclear reactor for new hires. Reactor tour with a discussion of radiation safety principles and practices at the UW nuclear reactor.

UW-Stevens Point
Department of Physics 6

Reactor tour with a discussion of reactor physics and neutron activation analysis (NAA) for the Physics 470, "Experimental Physics" course.

Wisconsin Home School Cooperative 15

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

OUTREACH AND COMMUNITY SERVICE USER SUMMARY:

Organizations: 20

Participants: 665

3. SAMPLE IRRADIATIONS AND NEUTRON ACTIVATION ANALYSIS SERVICES

There were 204 individual samples irradiated during the year. Of these samples, 101 were irradiated for 15 minutes or less. Samples accumulated 57.3 irradiation space hours and 206.1 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.

Engineering Physics Department, UW-Madison
UW Nuclear Reactor Laboratory
8 samples, 10.8 sample hours
Physics testing in support of the reactor LEU conversion restart program, production of calibration sources for required reactor measurements and development of methods for instrumental neutron activation analysis.

Engineering Physics Department, UW-Madison
Instrumentation Laboratory
134 samples, 121.3 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.

Engineering Physics Department, UW-Madison
NE 428
26 samples, 38.0 sample hours
Irradiation of foils for resonance absorption measurements and fast neutron flux measurements.

Department of Dairy Science, UW-Madison (NAA)
36 samples, 36.0 sample hours
NAA to analyze cobalt in bovine milk, blood plasma, and liver samples.

4. OTHER MAJOR EDUCATIONAL, RESEARCH, & OPERATIONAL ACTIVITIES

Reactor Laboratory staff successfully disassembled 25 irradiated TRIGA FLIP 8.5 w/o, 70% enriched HEU fuel clusters in preparation for conducting a spent nuclear fuel shipment on July 21, 2010. All remaining HEU fuel was removed from the facility on September 21, 2010.

In November 2010 the Reactor Laboratory partnered with Exelon Nuclear's Quad Cities Nuclear Generating Station to provide a week long seminar investigating reactor behavior for the station's Initial Licensed Training (ILT) class. Sixteen professionals who aspire to become nuclear reactor operators participated. The program was a hands-on, laboratory based seminar where the participants investigated sub critical, super critical and prompt critical reactor behavior. Participants measured rod worth using the rod bump rising period method and the rod drop method. They then applied this measurement to power versus temperature data to derive the prompt negative fuel temperature coefficient of reactivity and finally witnessed the effects of the prompt negative fuel temperature coefficient of reactivity during reactor pulse operations.

In December 2010 the facility conducted four reactor demonstrations "offered at a distance" with Spring Harbor Middle School. Ninety six children participated in a lecture and demonstration that was broadcast over the internet. Adobe Connect Pro software was utilized to provide the connectivity between the Spring Harbor Middle School and the UW Nuclear Reactor Lab. The reactor demonstration included a supercritical power excursion and demonstration of the prompt negative fuel temperature coefficient of reactivity that ended with a reactor scram to show the shutdown characteristics of a nuclear reactor.

This capability was funded through a NRC Educational Curriculum Development Grant, entitled "Remote Nuclear Reactor Measurements Laboratory: Development of innovative web-based nuclear engineering measurement modules to be offered at a distance".

On March 25, 2011 the facility was notified by the U.S. Nuclear Regulatory Commission (NRC) that facility license R-74 was renewed for 20 years and will expire at midnight on March 25, 2031.

5. CHANGES IN PERSONNEL, FACILITY AND PROCEDURES

Any changes reportable under 10 CFR 50.59 are indicated in section E of this report. No other changes to the facility were completed during the year.

Personnel changes during the year were as follows:

The following Reactor Operator Licenses were terminated effective August 30, 2010:

Scott J. Grutzik	OP-70599
Erik T. Nygaard	OP-70600
Matthew V. Pagel	OP-70601

The following Senior Reactor Operator license was terminated effective March 22, 2011:

Kevin T. Austin	SOP-70483

The following individuals were appointed as Reactor Operators effective August 30, 2010:

Zachary R. Bundies	OP-71022
Matthew J. DeHart	OP-71026
Samuel R. Maslonkowski	OP-71024
David J. Ozburn	OP-71025
Angela M. Weier	OP-71027

6. 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 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 indicates there has been no water effluent released to the environment.

B. OPERATING STATISTICS AND FUEL EXPOSURE

Operating Period	Critical Hours	MW-Hrs	Runs	Pulses
Fiscal Year 2010-2011	545.30	434.31	119	21
Cumulative TRIGA 30/20 LEU	949.99	605.00	345	77

Core J21-R14 was operated throughout the year. The excess reactivity of this core was determined to be 3.402%ρ.

C. EMERGENCY SHUTDOWNS AND INADVERTENT SCRAMS

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

July 9, 2010; SCRAM from picoammeter number 1. While performing a routine reduction in power maneuver, a reactor operator was down ranging the picoammeters in order to monitor the decrease in reactor power. The operator inadvertently down ranged the picoammeter range switch too soon. As a result, a reactor SCRAM from a neutron high flux trip at 125% occurred.

August 24, 2010; SCRAM from Pool Level Monitor. While performing the annual calorimetric heat balance power calibration procedure the increase in pool water temperature led to a volumetric expansion of the pool water. As a result, a reactor SCRAM from a pool level high trip occurred.

November 11, 2010; SCRAM from picoammeter number 1 and number 2. While setting up to conduct a routine NE 428 Critical Experiment, the auxiliary log count rate start up channel was connected to the main control console high voltage distribution box, while the range switches for picoammeter number 1 and 2 were set to the 100mW range. The resulting perturbation in the high voltage distribution box was sufficient to cause a neutron high flux trip at 125% to occur and the resulting SCRAM.

November 12, 2010; SCRAM from picoammeter number 1. While performing a normal reactor startup, a reactor operator failed to uprange the picoammeter to the next higher range. As a result, a reactor SCRAM from a neutron high flux trip at 125% occurred.

December 2, 2010; SCRAM from picoammeter number 2. While performing a routine reduction in power maneuver, a reactor operator trainee was down ranging the picoammeters in order to monitor the decrease in reactor power. The trainee inadvertently down ranged the picoammeter range switch two ranges. As a result, a reactor SCRAM from a neutron high flux trip at 125% occurred.

April 8, 2011; SCRAM from picoammeter number 2. While performing a normal reactor startup, electronic switch noise on the picoammeter range switch led to a neutron high flux trip at 125% and the resulting SCRAM.

April 21, 2011; SCRAM from picoammeter number 2. While performing a normal reactor startup, a reactor operator inadvertently down ranged the picoammeter range switch instead of up range. As a result, a reactor SCRAM from a neutron high flux trip at 125% occurred.

D. MAINTENANCE

The Preventive Maintenance Program continues to maintain equipment and systems in good condition. Routine regeneration of the demineralizer occurred on September 8, 2010, November 11, 2010, February 28, 2011 and May 3, 2011. Exhausted demineralizer resins were replaced on June 16, 2011.

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 reactor systems:

On August 24, 2010 excessive noise was observed from the gamma chamber input to the Pulse Channel. The gamma chamber was removed from the dry tube and observed to have corrosion around the high voltage and signal lead connectors as a result of water incursion to the dry tube. The dry tube O-rings were replaced and the spare gamma chamber was placed in service.

On December 24, 2010 the Radiation Building Evacuation Alarm system reported a battery fault trouble condition. The system backup batteries had been in continuous service since 2006 and were subsequently replaced.

On February 9, 2011, the Stack Air Monitor (SAM) had gone into trouble. An investigation revealed the SAM trouble alarm to be as a result of a low flow condition. The rotary vane vacuum pump had failed. The graphite vanes were replaced and the pump was placed back into service.

In March 2011 the Reactor Cooling System's intermediate loop pump differential pressure instrumentation piping was founding to be leaking. A 0.25 inch stainless steel nipple had sheared as a result of vibration. The nipple was replaced and all joints on the instrumentation piping were sealed with a flexible pipe sealant.

During the NE 428 Critical Experiment on April 8, 2011, the auxiliary Log Count Rate Start-Up Channel preamplifier stopped working. An investigation revealed the input diode had failed short. The diode was replaced and the gain and discriminator were checked. The unit was reinstalled as an installed spare.

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

There was one change to the facility reportable pursuant to 10 CFR 50.59 completed during the year. The change is summarized below.

The Radiation Building Evacuation Alarm system was modified to incorporate a variable time delay timer. The system originally incorporated a fixed time delay. The new timer also integrates a signal from the Pool Level Monitor as an input to the delay time logic.

F. SUMMARY OF RADIATION EXPOSURE OF PERSONNEL (01/01/10 - 12/31/10)

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 71 mrem to the whole body and 110 mrem to the extremities.

The highest dose received by a member of the public visiting the reactor lab was 0.76 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 (01/15/10 - 01/14/11)

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 2010 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.

There was no liquid activity released to the environment during the year.

2. EXHAUST EFFLUENTS

Table 3 presents information on stack discharges during the year.

3. SOLID WASTE

All solid waste was transferred to the UW Broad Scope license for ultimate disposal in accordance with radioactive materials license number WI 25-1323-01. The amount and activity are detailed in Table 4.

TABLE 1 ANNUAL ENVIRONMENTAL MONITORING DOSE DATA
(01/15/10 - 01/14/11)

Location	Annual Dose (mrem)
Dose Inside Reactor Laboratory Stack	15
Highest Dose in Non-restricted Area	31
Highest Dose in Occupied* Non-restricted Area	22
Average Dose in all Non-restricted Areas (26 Monitor Points)	14

*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:	11/12/2010	03/15/2011	05/12/2011
Gallons Released:	900	1450	700
Total µCi:	2.007	151.2	47.27
Sum of Fraction of MPC w/o dilution:	0.020	0.119	0.052
Sum of Fraction of MPC w/ daily dilution:	0.001	0.007	0.002

Isotope	MPC (µCi/ml)	Released	Released	Released	
Co-58	2.00E-4	-	71.21	14.32	µCi
		-	1.30E-05	5.40E-06	µCi/ml
		-	0.065	0.027	Fraction of MPC
Co-60	3.00E-05	2.007	5.786	1.336	µCi
		5.89E-07	1.05E-06	5.04E-07	µCi/ml
		0.020	0.035	0.017	Fraction of MPC
Cr-51	5.00E-03	-	46.14	26.78	µCi
		-	8.41E-06	1.01E-05	µCi/ml
		-	0.002	0.002	Fraction of MPC
Mn-54	3.00E-04	-	28.04	4.837	µCi
		-	5.11E-06	1.83E-06	µCi/ml
		-	0.017	0.006	Fraction of MPC

Total volume of water released to the sanitary sewer (gallons)	=	3050
Total activity released to the sanitary sewer (µCi)	=	200.4
Average daily sewage flow for dilution (gallons)	=	2.37E+4
Maximum fraction of MONTHLY release limit with DAILY dilution	=	0.007
Maximum fraction of MONTHLY release limit with MONTHLY dilution	=	0.0004

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 x 1E-6)	Average Concentration (µCi/ml x 1E-6)
July 2010	0.000	0.000	0.000
August	0.105	0.935	0.007
September	0.428	1.600	0.029
October	0.422	0.683	0.027
November	0.190	1.340	0.012
December	0.127	0.522	0.008
January 2011	0.173	1.280	0.011
February	0.365	1.280	0.024
March	0.468	0.777	0.028
April	0.267	0.974	0.017
May	0.511	0.544	0.033
June	0.000	0.000	0.000
	Total	Maximum	Average
	3.056	1.600	0.016

Using the Gaussian Plume model, as described in section 13.1.7.2 to the "LEU Conversion 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:	08/09/10	11/23/10	02/07/11	05/03/11	TOTAL VOLUME
Volume:	8.7 ft^3	15.6 ft^3	16.0ft^3	96.0 ft^3	136.3 ft^3
Constituents:	Routine Consumables	Routine Consumables	Activated Reactor Components	Activated Reactor Components	
Isotope	Activity (mCi)	Activity (mCi)	Activity (mCi)	Activity (mCi)	Total Activity by Isotope (mCi)
Co-58	0.014	-	-	0.040	0.054
Co-60	0.116	0.091	0.498	20.30	21.01
Cs-134	-	-	-	0.030	0.030
Cs-137	14.00	-	-	-	14.00
Eu-152	-	-	0.061	26.01	26.07
Mn-54	0.021	0.003	-	0.030	0.054
Zn-65	-	-	-	0.030	0.030
Total Activity per Transfer (mCi):	14.15	0.094	0.559	46.44	**TOTAL ACTIVITY** 61.24 mCi