

# **Idaho State UNIVERSITY**

## **Nuclear Engineering and Health Physics**

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**SUBJECT: Transmittal of Annual Report for Calendar Year 2014**

Attached is the annual report for the calendar year 2014 for the AGN-201 training reactor at Idaho State University.

Sincerely,



Jay F. Kunze, PhD, PE, CHP  
Reactor Administrator  
Emeritus Professor

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**Idaho State University**  
**AGN-201M Reactor Facility**  
**License R-110, Docket No. 50-284**  
**Annual Operating Report for 2014 Calendar Year**

**1. Narrative Summary**

**A. Changes in Facility Design, Performance Characteristics, and Operating Procedures:**

There were no changes in facility design, performance characteristics, and operating procedures relating to reactor safety during the reporting period. Two operation procedures (OP-1 and OP-1) not safety related were modified during the reporting period.

**B. Results of Major Surveillance Tests and Inspections:**

(1) The period, count rate, and power level measuring channels were calibrated and set points were verified. Channels 1, 2, & 3 were tested on 5/22/2014, 5/28/2014 & 6/11/2014 respectively.

(2) Power level (2/26/14) and period check (5/28/2014) experiments were performed with satisfactory results.

(3) The shield water tank was inspected (5/23/2014) and no leaks or excessive corrosion were observed. The water level interlock tested satisfactorily (5/23/2014).

(4) The seismic displacement & temperature interlocks were tested and found satisfactory on 5/23/2014 and 5/27/2014 respectively.

(5) (a) Control element capsules (cladding) were inspected (5/6/2014) and found to be in good condition with no evidence of deterioration since the previous inspection.

(b) The control rod drive mechanisms were inspected (5/6/2014) and tested with satisfactory results.

(c) Ejection times were measured (6/27/2015) for all SCRAM-able rods, SR-1, SR-2 and CCR and were found to be 0.057, 0.040 and 0.051 seconds respectively. The requirement that the ejection times be less than 1 second is satisfied.

(d) The reactivity worth of all safety and control rods were measured, as well as the time required to drive each rod to its fully inserted position. The largest reactivity insertion rate was  $0.0256\% \Delta k/k \text{ s}^{-1}$  ( $0.034 \text{ s}^{-1}$ ), which is less than the prescribed limit of  $0.065\% \Delta k/k \text{ s}^{-1}$ .

(e) On 7/18/14 the shutdown margin with both the most reactive SCRAM-able rod and the fine control rod remaining fully inserted was determined to be  $1.49\% \Delta k/k$  ( $2.01$ ) (at the maximum allowable  $k$  excess of  $0.65\% \Delta k/k$ ) and satisfies the requirement that it be greater than  $1\% \Delta k/k$ .

(f) All surveillances were within the appropriate Technical Specification requirements.

**C. NRC Inspection**

The annual inspection was conducted on July 21 – 24, 2014. There were no violations or significant findings.

2. Operating History and Energy Output.

The reactor was operated at power levels up to 4.9 watts for a total of 72.8 watt-hours of thermal energy during this reporting period. A summary of monthly operations for 2014 is given in Table I.

Table I. Summary of Monthly Reactor Operations  
(1 January 2014 through 31 December 2014)

<b>Month</b>	<b>Energy (W-hr)</b>
January	5.6
February	16.4
March	3.2
April	8.3
May	17.2
June	0.1
July	2.2
August	0.0
September	5.1
October	9.0
November	4.1
December	1.6
<b>Total</b>	<b>72.8</b>

The 0.0728 kWh consumed 3.7 micrograms of U-235.

During the calendar year, a number of students went through reactor operator training. During the calendar year, two students took NRC licensing exams and were awarded Reactor-Operator (RO) licenses.

3. A. Unscheduled Shutdowns and Corrective Actions Taken.

None.

B. Inadvertent Scrams and Action Taken.

There were 5 inadvertent scrams during this reporting period. Table II summarizes the inadvertent scrams, known or suspected cause, and action taken.

Table II. Summary of Inadvertent Scrams  
(1 January 2014 through 31 December 2014)

Date	Time	Scram Type	Cause	Action
1/27/14	14:55	Channel 2 Low	Tubes Not Warmed Up	Restart
3/17/14	15:26	Channel 3 Low	Range Change Error By Operator	Restart
3/17/14	15:35	Channel 3 Low	Range Change Error By Operator	Restart
7/17/14	11:23	Channel 3 Low	Range Change Error By Operator	Restart
9/11/14	21:28	Channel 1 Low	Attempting To Operate At Too Low Of Power	Restart

#### 4. Safety-Related Corrective Maintenance:

1/17/14: Replaced thermo-switch.

4/8/14: The light indicating the magnet on Safety Rod 1 had engaged the base plate failed to turn on. Upon investigation it was determined the micro-switch attached to the magnet on SR1 had worn out. The micro-switch was replaced and a large washer was installed on the base plate to ensure better contact between the base plate and the micro-switch.

5/21/14: Channel 2 wire connecting channel 2 to the chart recorder was repaired.

5/30/14: Electric contacts on the seismic sensor were cleaned.

6/12/14: Vacuum tubes V7 (6AV6) and the 4102 pair were replaced. The N-type battery was also replaced.

7/11/14 On channel 2 the V10 (12AU7) vacuum tube was replaced and the transformer repaired.

9/17/14: The V15 (OA2) and V17 (12AX7) vacuum tubes on channel 2 were replaced.

9/17/14: The V6 (12BH7A) and V17 (12AX7) vacuum tubes on channel 2 were replaced.

10/13/14: A cold solder joint on the channel 2 V17 receptacle was repaired.

#### 5. Modifications.

##### A. Changes in Facility Design.

None

##### B. Changes to Procedures.

Start up procedures OP-1 and OP-2 were updated to reflect changes made to channel 1 in 2013. The start up check off sheet was similarly updated with additional minor changes made for clarity.

C. Changes to Experiments.

None

D. Reactor Safety Committee.

As of the end of the reporting period, membership of the Reactor Safety Committee (RSC) consisted of the following individuals:

Frank H. Just – Chair (retired from INL)  
Jay F. Kunze - Reactor Administrator  
Adam L. Mallicoat - Reactor Supervisor  
Richard R. Brey – Dean of College  
Peter Farina – Radiation Safety Officer  
Robert Boston, PE, CHP (DOE-ID)  
Kermit Bunde (DOE-ID)  
Richard E. McCracken (retired from INL)  
Benjamin Banker (INL)

6. Summary of Changes Subject to 10 CFR 50.59 Analyses.

Start up procedures OP-1 and OP-2 were updated to reflect changes made to channel 1 in 2013. The start up check off sheet was similarly updated with additional minor changes made for clarity.

7. Radioactive Effluents.

A. Liquid Waste - Total Activity Released: None.

B. Gaseous Waste - Total Estimated Activity Released: 7.0  $\mu\text{Ci}$  of Ar-41.

The AGN-201 Reactor was operated for 72.8 watt-hours at power levels up to approximately 4.9 watts. At this power level Ar-41 production is negligible and substantially below the effluent concentration limit given in 10 CFR 20 Appendix B, Table 2. The total activity of Ar-41 released to the environment was conservatively estimated at 7.0  $\mu\text{Ci}$ . This activity corresponds to the total activity of all gaseous radioactive effluent from the facility. A monthly summary of calculated gaseous releases is given in Table IV.

Table IV. Summary of Monthly Gaseous Radioactive Effluent Releases  
(1 January 2014 through 31 December 2014)

Month	Ar-41 ( $\mu\text{Ci}$ )
January	0.5
February	1.6
March	0.3

April	0.8
May	1.7
June	0.0
July	0.2
August	0.0
September	0.5
October	0.9
November	0.4
December	0.2
<b>Total</b>	<b>7.0</b>

C. Solid Waste - Total Activity: None.

8. The latest environmental radiation surveys, performed at the facility boundary while the reactor was operating at 100% of full licensed power (5.0 watt), measured a maximum combined neutron and gamma dose equivalent rate of  $0.62 \text{ mrem hr}^{-1}$  or less at the outside walls of the building proximal to the reactor. The requirement that the total equivalent dose rate be less than  $2.0 \text{ mrem hr}^{-1}$  was satisfied.

9. Radiation Exposures.

The Radiation Safety Officer reviews personnel radiation exposures quarterly. Annual reports of ionizing radiation doses are provided by the Radiation Safety Officer to all monitored personnel as required under the provisions of 10 CFR 19.

Personnel with duties in the reactor laboratory on either a regular or occasional basis have been issued radiation dosimeters by the Idaho State University Technical Safety Office. The whole body exposures for the 2014 monitoring period of personnel are summarized in Table V:

Table V. Personnel Radiation Monitored for 1/1/2014-12/31/2014

Name	Exposure by Type (mrem)		
	Deep	Lens	Shallow
Baker, Benjamin	<1	<1	<1
Bealieu, Quinton	2	2	1
Bitikofer, Christopher	<1	<1	<1
Boaz, Trevor	<1	<1	<1
Byambadorj, Biljuun	<1	<1	<1
Chase, Benjamin	<1	<1	<1
Crawford, Shiloh	1	1	1
Daniels, Maxwell	<1	<1	<1
Day, Keeshia	2	2	1

Deaven, Jenna	<1	<1	<1
Horkley, Matt	2	2	1
Imel, George	<1	<1	<1
Krieger, Michael	2	2	2
Kunze, Jay	<1	<1	<1
Langbehn, Adam	2	2	1
Loveland, Ryan	<1	<1	<1
Lum, Edward	<1	<1	<1
Mallicoat, Adam	1	1	2
Muchmore, Cody	1	1	1
Mulvaaney, John	<1	<1	<1
Pope, Chad	<1	<1	<1
Riley, Tony	<1	<1	1
Robinson, Seth	<1	<1	<1
Womack, Cody	<1	<1	<1
Giegel, Sam	<1	<1	<1
King, Garret	<1	<1	<1
Andersen, Brian	<1	<1	<1
Nester, Katelyn	<1	<1	<1
Alwashmi, Hamad	<1	<1	<1
Beatty, Matthew	1	1	1
Lehmer, Jacob	1	1	1
Seegmiller, Shawn	1	1	2
Unruh, Troy	<1	<1	1
Pierson, Paul	1	1	1
Measurable Total	17	17	17

The 10 CFR 20.1201 occupational dose limits to adults are: total 5 rem, lens of eye 15 rem, shallow 50 rem, and deep 50 rem. The doses received for all reactor laboratory personnel during 2014 are well below the dose limits of 10 CFR 20.1201, and well below ISU ALARA limits (1 REM per year, 0.3 REM per quarter).

Anytime a member of the public visits the reactor pin dosimeters are issued for the extent of the tour. A minimum of 1 dosimeter to every 5 people is issued for a representative group dose. During the 2014 calendar year there were 515 recorded visitors to the facility. A summary of the public dose exposure is presented in Table VI.

Table VI. Summary Whole-Body Exposures to the Public  
(1 January 2014 through 31 December 2014)

Estimated whole-body exposure range (mrem):	Number of individuals in each range:
No Observable Dose	510
1.0 mrem*	4

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Greater than 1.0 but below 5.0 mrem	1
Greater than 5.0 but below 10.0 mrem	0
<hr/>	
Total number of individuals reported	515

\*Below 1.0 mrem is considered un-measureable

None of the 515 visitors to the facility during 2014 received a measurable dose that would exceed the annual 0.5 rem dose limit of 10 CFR 20.1301.

Therefore, the average and maximum doses received by personnel and the public are well within NRC guidelines.

Report prepared by:

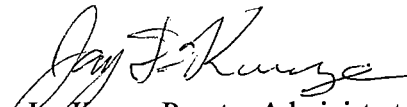


Ryan Loveland, Senior Reactor Operator  
June 15, 2015

Reviewed and approved by:



Adam Mallicoat, Reactor Supervisor  
June 23, 2015



Jay Kunze, Reactor Administrator  
June 23, 2015