Idaho State
UNIVERSITY
Nuclear Engineering Program
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30 June 2016

Mr. Xiaosong Yin
US Nuclear Regulatory Commission
Research and Test Reactors Licensing Branch
Office of Nuclear Regulatory Regulation
Washington, D.C. 20555-0001
301-415-1404

Subject: Transmittal of Annual Report for License R-110 (AGN-201)

Dear Mr. Yin,

Please find attached the Annual Report for the AGN-201 Reactor at Idaho State University, license R-110, Docket # 50.284.

I will also submit this report to the Document Control Desk.

Thank you,

Mary Lou Dunzik-Gougar, PhD
Reactor Administrator

Cc: Mr. Ossy Font, Reactor Inspector

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NRR

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Idaho State University
AGN-201M Reactor Facility
License R-110, Docket No. 50-284
Annual Operating Report for 2015 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.

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 5/29/2015, 56/1/2015 & 6/1/2015 respectively.

(2) Power level (3/16/2015) and period check (6/1/2015) experiments were performed with satisfactory results.

(3) The shield water tank was inspected (6/2/2015) and no leaks or excessive corrosion were observed. The water level interlock tested satisfactorily (6/2/2015).

(4) The seismic displacement & temperature interlocks were tested and found satisfactory on 6/5/2015 and 6/8/2015 respectively.

(5) (a) Control element capsules (cladding) were inspected (6/25/2015) and found to be in good condition with no evidence of deterioration since the previous inspection.

(b) The control rod drive mechanisms were inspected (6/25/2015) and tested with satisfactory results.

(c) Ejection times were measured (6/26/2015) for all SCRAM-able rods, SR-1, SR-2 and CCR and were found to be 0.14, 0.12 and 0.14 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 0.0241 $\%\Delta k/k\ s^{-1}$ ($0.0325 s^{-1}), which is less than the prescribed limit of $0.065\%\Delta k/k\ s^{-1}$.

(e) On 8/17/2015 the shutdown margin with both the most reactive SCRAM-able rod and the fine control rod remaining fully inserted was determined to be $1.507\%\Delta k/k$ ($2.033) (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 13-16, 2015. No findings of significance

were identified. A minor violation was identified for one licensee not performing the functions of Senior Reactor Operator (SRO) for a minimum of a full four hours per calendar quarter.

2. Operating History and Energy Output.

The reactor was operated at power levels up to 4.9 watts for a total of 116.9 watt-hours of thermal energy during this reporting period. A summary of monthly operations for 2015 is given in Table I.

Table I. Summary of Monthly Reactor Operations
(1 January 2015 through 31 December 2015)

Month	Energy (W-hr)
January	2.2
February	7.4
March	31.0
April	10.2
May	5.1
June	4.8
July	2.9
August	12.5
September	14.8
October	8.4
November	9.6
December	8.0
Total	116.9

The 0.1169 kWh consumed 5.9 micrograms of U-235.

During the calendar year, a number of students went through reactor operator training. During the calendar year, six students took NRC licensing exams and five were awarded Reactor-Operator (RO) licenses, one was awarded a Senior Reactor-Operator (SRO) license.

3. A. Unscheduled Shutdowns and Corrective Actions Taken.

None.

B. Inadvertent Scrams and Action Taken.

There were 34 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 2015 through 31 December 2015)

Date	Time	Scram Type	Cause	Action
2/3/15	19:32	Channel 3 High	Range Change Error By Operator	Restart
2/3/15	21:54	Channel 3 High	Range Change Error By Operator	Restart
2/10/15	15:58	Channel 1 Low	Attempting To Operate At Too Low Of Power	Shut Down
3/9/15	13:21	Period	Tubes Not Warmed Up	Restart
3/9/15	13:28	Period	Unknown	Shut Down & Inspect
3/11/15	14:24	Channel 3 High	Range Change Error By Operator	Restart
3/15/15	13:43	Channel 2 Low	Attempting To Operate At Too Low of Power	Restart
3/15/15	16:35	Channel 1 Low	Signal Irregularity After Cable Was Bumped	Shut Down
4/5/15	10:14	Period	Signal Irregularity	Shut Down & Inspect
6/16/15	21:18	Channel 3 High	Range Change Error By Operator	Restart
6/19/15	11:11	Period	Signal Irregularity	Restart
8/12/15	14:02	Channel 3 High	Range Change Error By Operator	Restart
8/12/15	16:17	Channel 3 High	Range Change Error By Operator	Restart
8/17/15	14:50	Channel 2 High	Signal Irregularity	Restart
8/17/15	15:30	Channel 2 High	Signal Irregularity	Shut Down & Inspect
9/14/15	14:37	Period	Electrical Malfunction	Shut Down & Inspect
9/15/15	13:40	Channel 3 High	Range Change Error By Operator	Restart
9/20/15	13:12	Period	Signal Irregularity	Restart
9/22/15	14:22	Channel 3 High	Removed Samplee Too Quickly	Restart
9/25/15	17:07	Channel 3 High	Range Change Error By Operator	Shut Down
9/28/15	14:31	Period	Signal Irregularity	Restart
9/28/15	14:35	Period	Signal Irregularity	Restart
9/29/15	13:42	Period	Signal Irregularity	Restart
10/12/15	14:09	Period	Signal Irregularity	Shut Down
10/27/15	12:36	Channel 2 Low	Signal Irregularity	Restart
11/2/15	14:17	Channel 3 High	Range Change Error By Operator	Restart
11/16/15	12:55	Period	Signal Irregularity	Restart
11/16/15	13:02	Period	Signal Irregularity	Shut Down & Inspect
11/17/15	13:02	Period	Signal Irregularity	Restart
12/4/15	16:09	Channel 3 High	Range Change Error By Operator	Shut Down
12/5/15	16:45	Channel 2 High	Scram Set Too Low	Recalibrate & Restart
12/11/15	11:02	Channel 3 High	Range Change Error By Operator	Restart
12/11/15	11:50	Channel 2 High	Electrical Problem	Shut Down & Inspect
12/12/15	14:35	Channel 2 High	Signal Irregularity	Restart

4. Safety-Related Corrective Maintenance:

2/13/15: A cold solder joint on the channel 2 V14 receptacle was repaired.

3/6/15: Corrosion was cleaned from the channel 3 range switch at the 10^{-11} contact. 5 vacuum tubes (5886) were replaced in channel 3.

3/9/15: Channel 2 signal cable was replaced.

3/11/15: A solder joint on the log connector was repaired.

4/12/15: Channel 2 detector was replaced with a detector of the same model number. Waterproofing on the detector canister was replaced. Channel 2 cabling replaced.

6/18/15: Adjusted faceplate screw on channel 2. Replaced channel 1 NIM bin with equivalent model.

6/22/15: The V17 (12AX7) vacuum tube was replaced.

7/22/15: The FCR position indicator gearing was adjusted.

8/7/15: The gearing on the FCR and CCR synchro generators was adjusted and tightened to ensure better meshing.

9/11/15: SR1 magnet and magnet plate polished. Solder joints on SR1 chassis repaired.

12/7/15: Channel 3 signal cabling changed.

12/10/15: Channel 1 signal cabling changed.

5. Modifications.

A. Changes in Facility Design.

None

B. Changes to Procedures.

None

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)
Mary Lou Dunzik-Gougar - Reactor Administrator
George Imel – Assistant 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 Baker (INL)
Jay F. Kunze – Former Reactor Administrator

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

The signal cables for Channels 1, 2 and 3 were upgraded to RG 213 for additional noise reduction.

OP-1 checklist was reproduced to have a digital copy.

7. Radioactive Effluents.

A. Liquid Waste - Total Activity Released: None.

B. Gaseous Waste - Total Estimated Activity Released: 11.3 μCi of Ar-41.

The AGN-201 Reactor was operated for 116.9 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 11.3 μCi. 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 2015 through 31 December 2015)

Month	Ar-41 (μCi)
January	0.2
February	0.7

March	3.0
April	1.0
May	0.5
June	0.5
July	0.3
August	1.2
September	1.4
October	0.8
November	0.9
December	0.8
Total	**11.3**

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 0.43 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 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 2015 monitoring period of personnel are summarized in Table V:

Table V. Personnel Radiation Monitored for 1/1/2015-12/31/2015

Name	Exposure by Type (mrem)		
	Deep	Lens	Shallow
Anderson, Brian D	<1	<1	<1
Bealieu, Quinton	<1	<1	<1
Beatty, Matthew W	<1	<1	<1
Beveridge, Lucas B	<1	<1	<1
Boaz, Trevor R	<1	<1	<1
Byambadorj, Bilguun	<1	<1	<1
Daniel, Maxwell J	<1	<1	<1
Deaven, Jenna M	<1	<1	<1

Giegel, Sam H	3	3	3
Imel, George	<1	<1	<1
King, Garret B	<1	<1	<1
Kunze, Jay F	<1	<1	<1
Lehmer, Jacob P	<1	<1	<1
Loveland, Ryan K	<1	<1	<1
Lum , Edward S	<1	<1	<1
Mallicoat, Adam	<1	<1	<1
Mulvaaney, John V	<1	<1	<1
Pierson, Paul B	<1	<1	<1
Pizzichemi, Bryan M	2	2	2
Pope, Chad L	<1	<1	<1
Suresh, Sneha	<1	<1	<1
Thompson, Aaron M	3	3	2
Womack, Cody	<1	<1	<1
Wynn, Ian J	<1	<1	<1
Barker, Joseph J	<1	<1	<1
Maas, Andrew M	<1	<1	<1

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 2015 calendar year there were 527 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 2015 through 31 December 2015)

Estimated whole-body exposure range (mrem):	Number of individuals in each range:
No Observable Dose	518
1.0 mrem*	3
Greater than 1.0 but below 5.0 mrem	5
Greater than 5.0 but below 10.0 mrem	0
Greater than 10.0 but below 15.0 mrem	1*
Total number of individuals reported	527

*Below 1.0 mrem is considered un-measureable

None of the 527 visitors to the facility during 2015 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. *Note there was one reading that was above 5 mrem, this is likely due to the shock of dropping the dosimeter.

Report prepared by:

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June 27, 2016

Reviewed and approved by:

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June 27, 2016

Mary Lou Dunzik-Gougar
Reactor Administrator
June 27, 2016