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

Subject: Transmittal of Annual Facility Operating Report for 2006

Dear Madam/Sir:

Enclosed please find a copy of the Annual Operating Report for the Idaho State University AGN-201M Reactor, License No. R-110, Docket No. 50-284, for calendar year 2006. Submission of this report satisfies the requirements of AGN Technical Specification 6.9.1.

If you have any questions concerning the report, please call me at (208) 282-3351.

Sincerely,

John S. Bennion  
Reactor Manager/Supervisor

Cc: Mr. Daniel E. Hughes, Project Manager  
Non-Power Reactors and Decommissioning Project Directorate  
Operating Reactor Improvements Program  
Office of Nuclear Reactor Regulation

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**Idaho State University  
AGN-201M Reactor Facility  
License R-110, Docket No. 50-284  
Annual Operating Report for 2006**

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) Channel tests performed on all safety channels and scram interlocks were found to be satisfactory and within specifications.
- (2) Power and period calibrations were performed with satisfactory results.
- (3) The shield water tank was inspected and no leaks or excessive corrosion were observed.
- (4) The seismic displacement interlock was tested satisfactorily.
- (5)
  - (a) Control element capsules (cladding) were inspected and found to be in good condition with no evidence of deterioration since last inspection.
  - (b) The control rod drive mechanisms were inspected and tested with satisfactory results.
  - (c) Ejection times were measured for all scrammable rods and found to be less than 130 milliseconds
  - (d) The reactivity worths of all safety and control rods were measured, as well as the time required to drive each rod to its fully inserted position. Reactivity insertion rates were determined to be less than  $0.036\% \Delta k/k \text{ s}^{-1}$  ( $\$0.048 \text{ s}^{-1}$ ) for all rods.
  - (e) The shutdown margin was determined to be greater than  $1.50\% \Delta k/k$  ( $\$2.03$ ) with both the most reactive scrammable rod and the fine control rod fully inserted.
  - (f) All surveillances were within the appropriate Technical Specification requirements.

2. Operating History and Energy Output.

The reactor was operated at power levels up to 4 watts for a total 121.5 hours thereby generating 1.46 watt-days (40.8 watt-hours) of thermal energy during this reporting period. A summary of monthly operations for 2006 is given in Table I.

Table I. Summary of Monthly Reactor Operations  
(1 January 2006 through 31 December 2006)

<u>Month</u>	<u>Hours</u>	<u>Energy (W-hr)</u>
January	6.4	2.45
February	15.2	4.24
March	20.1	12.45
April	13.0	4.58
May	16.3	2.45
June	12.1	1.13
July	24.6	12.89
August	13.7	0.59
September	0.0	0.00
October	0.0	0.00
November	0.0	0.00
<u>December</u>	<u>0.0</u>	<u>0.00</u>
Total	121.5 hr	40.77 W-hr

3. A. Unscheduled Shutdowns and Corrective Actions Taken.

None.

B. Inadvertent Scrams and Action Taken.

There were 25 inadvertent scrams during this reporting period. Table II summarizes the inadvertent scram, its known cause, and action taken. Most of the scrams (44%) resulted from suspected voltage transients associated with the building line power. 40% of the scrams were caused by student operators who were operating the reactor as part of undergraduate and graduate nuclear engineering laboratory courses. The remaining scrams (16%) were caused by drift in the Channel 2.

Table II. Summary of Inadvertent Scrams  
(1 January 2006 through 31 December 2006)

Date	Scram Type	Cause	Action
1/31/06	No Cause Indicated	Line Power Transient	Restart
2/7/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart
2/17/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart
2/21/06	No Cause Indicated	Line Power Transient	Restart
2/21/06	No Cause Indicated	Line Power Transient	Restart
2/21/06	No Cause Indicated	Line Power Transient	Restart
2/24/06	No Cause Indicated	Line Power Transient	Restart
3/21/06	Channel 2 - High	Meter drift	Verified setpoint. Restart
3/24/06	Channel 2 - High	Meter drift	Restart
3/24/06	Channel 2 - High	Meter drift	Verified setpoint. Restart
4/4/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart
5/12/06	No Cause Indicated	Line Power Transient	Terminated run.
6/10/06	No Cause Indicated	Line Power Transient	Restart
6/30/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart
7/1/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart
7/1/06	No Cause Indicated	Line Power Transient	Restart
7/1/06	No Cause Indicated	Line Power Transient	Restart
7/1/06	No Cause Indicated	Line Power Transient	Restart
7/1/06	No Cause Indicated	Line Power Transient	Terminated run.
7/27/06	Channel 2 - High	Meter drift	Verified setpoint. Restart
7/28/06	Manual	Operator Error	Cautioned trainee. Restart
7/28/06	Channel 3 - Low	Operator Error	Instructed trainee on proper technique. Restart
7/28/06	Channel 3 - Low	Operator Error	Instructed trainee on proper technique. Restart
7/28/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart
7/28/06	Channel 3 - High	Operator Error	Instructed trainee on proper technique. Restart

4. Safety-Related Corrective Maintenance

- 1/6/06: Several vacuum tubes (V-1, V-2, V-4, V-5, V-7, V-8, and V-9) in the Channel No. 2 amplifier were replaced to correct inability to adjust the amplifier balance at  $10^{-13}$  A. This action corrected the problem and all calibration points were able to be set satisfactorily.
- 6/8/06: The control rods and dashpots were inspected for any evidence of possible deterioration. All were found in good condition with no signs of degradation or indication of incipient defects in cladding since the previous inspection. All dashpots were determined to provide satisfactory damping action.
- 7/27/06: The Channel 1 high voltage power supply was found to be inoperable and was replaced by a spare unit.

5. Modifications.

A. Changes in Facility Design.

There were no changes to the facility design to the extent that changed a description of the facility in the application for license and amendments thereto during 2006.

B. Changes to Procedures.

None.

C. Experiments.

No new or untried experiments or tests were performed during 2006.

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  
Michael E. Vaughan – Alternate Chair  
Jay F. Kunze - Dean, College of Engineering and Reactor Administrator  
John S. Bennion - Reactor Supervisor  
Richard R. Brey - Radiation Safety Officer  
Thomas F. Gesell  
Robert Boston  
Todd Gansauge

Richard Brey replaced Thomas Gesell as the RSO for the University in January 2006. Richard T Jacobsen replaced Jay Kunze as dean of the ISU College of Engineering in July 2006. Arthur Vailas became ISU President in July 2006, succeeding Michael Gallagher, who served as acting president after replacing Richard Bowen in October 2005.

6. Summary of Changes Reportable under 10 CFR 50.59.

None.

7. Radioactive Effluents.

A. Liquid Waste - Total Activity Released: None.

B. Gaseous Waste - Total Estimated Activity Released: 0.88  $\mu\text{Ci}$ .

The AGN-201 Reactor was operated for 121.5 hours at power levels up to approximately 4 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 0.88  $\mu\text{Ci}$ . This activity corresponds to the total activity of all gaseous radioactive effluent from the facility. A monthly summary of gaseous releases is given in Table IV.

Table IV. Summary of Monthly Gaseous Radioactive Effluent Releases  
(1 January 2006 through 31 December 2006)

<u>Month</u>	<u>Ar-41 (<math>\mu\text{Ci}</math>)</u>
January	0.053
February	0.092
March	0.269
April	0.099
May	0.053
June	0.024
July	0.279
August	0.013
September	0.000
October	0.000
November	0.000
<u>December</u>	<u>0.000</u>
Total activity:	0.883 $\mu\text{Ci}$

C. Solid Waste - Total Activity: None.

8. The latest environmental radiation surveys, performed at the facility boundary while the reactor was operating at 40% of full licensed power (2.0 watts), measured a maximum combined neutron and gamma dose equivalent rate of less than 0.2 mrem  $\text{hr}^{-1}$  at the outside walls of the building proximal to the reactor. The total equivalent dose rate at 100% power at these locations is less than 1 mrem  $\text{hr}^{-1}$ .

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 duty category and monitoring period of personnel are summarized in Table V:

Table V. Personnel Monitored for Exposure to Ionizing Radiation

Name	Monitoring Period	Duty Category
John S. Bennion	1/1/06 - 12/31/06	Regular
Todd Gansauge	1/1/06 - 12/31/06	Occasional
Kenyon Hart	1/1/06 - 12/31/06	Occasional
Ann Havlicak	1/1/06 - 12/31/06	Occasional
Tammy Hobbes	1/1/06 - 12/31/06	Occasional
Eugene Hochhalter	1/15/06 - 6/30/06	Occasional
Derek Hounshel	1/15/06 - 6/30/06	Occasional
Curtis Johnson	1/15/06 - 6/30/06	Occasional
Chris Juchau	1/15/06 - 6/30/06	Occasional
Jay F. Kunze	1/1/06 - 12/31/06	Occasional
Daniel Montenegro	1/1/06 - 12/31/06	Occasional
Ashoak Nagarajan	1/1/06 - 12/31/06	Occasional
Mark White	1/1/06 - 12/31/06	Occasional
Clinton Wilson	9/1/06 - 12/31/06	Occasional

Dose Equivalent summary for Reporting Period:

#### Measured Doses

1/1/2006 - 12/31/2006 Whole-Body Dose Equivalents: less than 10 mrem for most personnel.  
Minimum Detectable Dose Equivalent per Monthly Badge = 10 mrem.

None of the 170 visitors to the facility during 2006 received a measurable dose. Therefore, the average and maximum doses are all within NRC guidelines. A summary of whole-body exposures for facility personnel is presented in Table VI.

Table VI. Summary of Whole-Body Exposures  
(1 January 2006 through 31 December 2006)

Estimated whole-body exposure range (rem):	Number of individuals in each range:
No Measurable Dose	13
Less than 0.10	1
0.10 to 0.25	0
0.25 to 0.50	0
0.50 to 0.75	0
0.75 to 1.00	0
1.00 to 2.00	0
2.00 to 3.00	0
3.00 to 4.00	0
4.00 to 5.00	0
Greater than 5 rem	0
Total number of individuals reported:	14

Report prepared by: John S. Bennion, Reactor Manager/Supervisor  
July 17, 2007