

August 23rd, 2006

Document Control Desk  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555  
Re: Docket No. 50-27; Facility License R-76

In accordance with Technical Specifications for Facility License R-76 and the provisions of 10 CFR 50.59, paragraph (6), the attached Annual Report prepared by Eric Corwin, Reactor Supervisor of the WSU Facility, is hereby submitted. The report covers the period July 1, 2005 to June 30, 2006.

Sincerely,



Dr. Donald Wall,  
Facility Director

A020

**ANNUAL REPORT ON THE OPERATION OF THE  
WASHINGTON STATE UNIVERSITY TRIGA REACTOR**

Facility License R-76 for the Reporting Period of  
July 1, 2005 to June 30, 2006

**A. Narrative Summary of the Year's Operation**

**I. Operating Experience**

The Washington State University Reactor has accumulated 1233 Megawatt hours on core 34-A during the reporting period. A total of 949 samples were irradiated, for a total of 13,278.58 user-hours. In addition, 11 pulses greater than \$1.00 of reactivity addition were performed during this reporting period. The quarterly operations summaries are shown in Table I Section B.

**II. Changes In Facility Design, Performance Characteristics, and Operating Procedures Related to Reactor Safety.**

No changes requiring a 50.59 notification were made to the NRC during the reporting period.

**III. All surveillance tests and requirements were performed and completed within the prescribed time period.**

**B. Energy and Cumulative Output**

The quarterly operations summaries are given in Table I.

TABLE I  
Fiscal Year Summary of Reactor Operations

	<b>J-A-S</b>	<b>O-N-D</b>	<b>J-F-M</b>	<b>A-M-J</b>	<b>TOTALS</b>
<b>Hours of Operation</b>	355.10	396.37	241.17	409.05	1,401.69
<b>Megawatt Hours</b>	299.94	325.34	235.97	372.10	1,233.35
<b>No of Sample Irradiations<sup>1</sup></b>	35	13	13	31	92
<b>No. of Samples</b>	382	108	104	355	949
<b>No. of Iridium Cans Irradiated</b>	26	24	23	21	94
<b>No. of Silicon Disks Irradiated</b>	8	10	10	8	56
<b>User Hours</b>	2,422.32	3,130.48	3,357.04	4,368.74	13,278.58
<b>No. Pulses &gt; \$1.00</b>	0	8	0	3	11

<sup>1</sup>This table has been modified for clarity. Numbers of Samples and Sample Irradiations do not include Iridium and Silicon data. Those data are listed in individual format. User hours denotes the total user hours, including Iridium and Silicon.

The cumulative energy output since criticality of the TRIGA core (1967) is 1120 Megawatt Days, The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 854 Megawatt Days.

### C. Emergency Shutdowns and Inadvertent Scrams

There were no emergency shutdowns that occurred during the reporting period. The dates and causes of the 16 inadvertent SCRAMS are listed in Table II. No SCRAMS were due to a violation of the Limiting Safety Systems Set points.

TABLE II  
Inadvertent SCRAMS

7/20/05	Short of 24VAC power supply during work in reactor console.
9/13/05	Operator inadvertently downscaled linear channel resulting in scram.
9/28/05	Operator knocked blade #2 into core while performing maintenance.
9/29/05	High Radiation due to iridium handling.
10/5/05	Operator manually selected linear channel scale to low, forcing scram.
10/5/05	Operator manually selected linear channel scale to low, forcing scram.
10/5/05	Operator manually selected linear channel scale to low, forcing scram.
10/13/05	Operator kicked reactor console causing scram.
11/14/05	Seismic switch scram, unknown reason.
11/14/05	Seismic switch scram, unknown reason.
11/14/05	Seismic switch scram, unknown reason.
11/17/05	Seismic switch scram, operator performing routine maintenance.
11/21/05	Operator error, bumped the HV Scram switch on the NPP-1000.
5/1/06	Operator bumped HV signal cable for NLW-1000, causing scram
5/16/06	High power from NPP-1000 due to stuck raise button.
6/12/06	High power scram from Iridium handling

**D. Major Maintenance**

All routine planned maintenance items were completed within the reporting period. No major maintenance items were completed during the reporting period.

**E. Changes, Tests and Experiments performed Under 10 CFR 50.59 Criteria**

No changes requiring a 50.59 notification were made to the NRC during the reporting period.

**F. Radioactive Effluent Discharges****I. Radioactive Liquid Releases**

A total of 0.0 microcuries was released in 10,644.39 gallons of liquid during the reporting period. As determined by calibrated HPGe detectors and associated software, there was no detectable activity in the waste water that was greater than background. A breakdown of the liquid releases is shown in Table III.

TABLE III  
Radioactive Liquid Releases

Date	Volume Released (cu. feet)	Volume Released (gallons)	Activity (mCi)
5/5/2006	476.10	3561.50	0.0
6/27/2006	946.85	7082.89	0.0

## 2. Radioactive Gaseous Release

During the reporting period, no significant quantity of any gaseous or particulate material with a half-life greater than eight days was released.

During the reporting period, at no time did the Argon-41 release exceed 20% of the Effluent Release Limit.

A total of 7.723 Curies of Argon-41 was released, with an average concentration of Argon-41 of  $1.165 \times 10^{-7}$  uCi/cc before dilution. The monthly releases are summarized in Table IV on Page 4.

TABLE IV  
Monthly Argon-41 Releases

Month	Conc. Before Dilution, uCi/ml	% Release Limit Before Dilution <sup>1</sup>	% DAC Limit Before Dilution <sup>2</sup>	Quantity mCi
July 2005	$5.206 \times 10^{-8}$	2.08	0.00694	286
August	$1.180 \times 10^{-7}$	4.72	0.0157	649
September	$1.388 \times 10^{-7}$	5.55	0.0185	763
October	$1.298 \times 10^{-7}$	5.19	0.0173	714
November	$1.122 \times 10^{-7}$	4.49	0.0150	617
December	$9.952 \times 10^{-8}$	3.98	0.0133	547
January 2006	$8.818 \times 10^{-8}$	3.52	0.0176	485
February	$1.305 \times 10^{-7}$	5.22	0.0174	718
March	$1.534 \times 10^{-7}$	6.14	0.0205	844
April	$7.766 \times 10^{-8}$	3.10	0.0104	427
May	$1.339 \times 10^{-7}$	5.36	0.0179	736
June	$1.704 \times 10^{-7}$	6.82	0.0227	937

<sup>1</sup> Based on 10 CFR 20 effluent release limit of  $1.0 \times 10^{-8}$  uCi/ml for <sup>41</sup>Ar (Table 2, Col.1), and a dilution factor of  $4.0 \times 10^{-3}$  (S.A.R. 6.4.2) for a before dilution limit of  $2.5 \times 10^{-6}$  uCi/cc. (20% of limit is  $5.0 \times 10^{-7}$  uCi/ml).

<sup>2</sup> Based on 10 CFR 20 DAC limit of  $3.0 \times 10^{-6}$  uCi/ml for <sup>41</sup>Ar (Table 1, Col. 3) and a dilution factor of  $4.0 \times 10^{-3}$  for a before dilution DAC limit of  $7.5 \times 10^{-4}$  uCi/ml.

## 3. Radioactive Solid Waste Disposal

During the reporting period, the following solid waste was transferred to the WSU Radiation Safety Office for packaging and disposal.

- 30.305 millicuries in 16 cubic feet of non-compacted solid waste.

### G. Personnel and Visitor Radiation Exposures

The quarterly exposures of selected Nuclear Radiation Center reactor staff and experimenters who routinely utilize the W.S.U. reactor are given in Table V on Page 5. The maximum quarterly exposure of a reactor staff member was 70 millirem, whole body.

A total of 1966 individual persons visited the Nuclear Radiation Center during the reporting period, of which 786 entered a Restricted Area. All exposures as determined by digital pocket dosimeter were less than 1 millirem.

A total of 36 group tours, consisting of 251 individuals, visited the Center during the reporting period. As determined by digital pocket dosimeter, all exposures were less than 1 millirem.

TABLE V  
Quarterly Reactor and Experimenter Staff Exposure  
(in millirem)

Badge No.	Jul-Aug-Sep 05	Oct-Nov-Dec 05	Jan-Feb-Mar 06	Apr-May 06 <sup>2</sup>
6296	4	6	9	1
4045	- <sup>1</sup>	-	-	-
3504	4	1	-	-
7224	6	2	N/A	N/A
5718	70	6	38	23
1035	45	43	7	-

<sup>1</sup> The “-“ denotes a dosimeter reading that is less than or equal to the background radiation level for that quarter.

<sup>2</sup> Data for the Month of June and the 2<sup>nd</sup> Quarter 2006 totals was not received at the time of submittal.

### H. Reactor Facility Radiation and Contamination Levels

The routine area radiation surveys of the building in non-reactor vital areas<sup>1</sup> had an average dose level of 0.135 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 1.356 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 8.642 mR/Hr., which occurred in Room 201, Reactor Pool Room east. The lowest average dose in a routinely accessible reactor vital area was 0.030 mR/Hr., which occurred in Room 201B, the Reactor Shop area. The average dose in the radiochemistry sample hoods was 0.852 mR/Hr. The highest average on site dose level was 15.256 mR/Hr. which occurred in Room 2 East, the Beam Room storage area. This area is accessible only through a locked room, and is not accessible to the public.

Routine building surveys for removable contamination in non-reactor vital areas<sup>1</sup> had an average level of  $1.55 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$ , while the average level in the reactor vital areas was  $2.74 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$ . The highest average value in the reactor vital areas was  $1.24 \times 10^{-5} \mu\text{Ci}/100 \text{ cm}^2$  which was found on the north side of the pool room. The lowest average value in the reactor vital areas was  $8.87 \times 10^{-7} \mu\text{Ci}/100 \text{ cm}^2$  which was in Room 2 north, the floor of the beam room. The average level of removable contamination in the radiochemistry hoods was  $3.49 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$ .

<sup>1</sup> A non-reactor vital area is an area in the building where radioactive materials are used or stored but which is not a part of the Licensed reactor facility.

## I. Environmental Monitoring Program

The environmental monitoring program uses thermoluminescent dosimeters (TLD's) at locations both near and at distances around the reactor facility building. The quarterly exposures in the vicinity of the Nuclear Radiation Center are listed in Table VI. The average ambient gamma radiation levels for this area (80 mile radius) is 243  $\mu\text{Rem}/\text{day}$  as reported in the 30th Annual Report of the Environmental Radiation Program, Washington State Department of Health, Environmental Health Program, Table A-12, Page 131.

The values observed indicate there is no significant effect on the environmental radiation levels due to reactor operation.

TABLE VI  
Environmental Radiation Levels in the Vicinity of the Nuclear Radiation Center<sup>1</sup>  
(Exposure in  $\mu\text{Rem}/\text{day}$ )

Jul-Aug-Sep 05	Oct-Nov-Dec 05	Jan-Feb-Mar 06	Apr-May-Jun 06 <sup>3</sup>	Average
350.64	453.62	409.33	358.48	393.02
345.45 <sup>2</sup>	402.6 <sup>2</sup>	344.83 <sup>2</sup>	329.90 <sup>2</sup>	355.70 <sup>2</sup>

<sup>1</sup> For sampling stations located 25 meters or greater from the Nuclear Radiation Center.

<sup>2</sup> TLD attached to "decorative" granite display on Compton Union Building Mall approximately 1300 meters from the Nuclear Radiation Center.

<sup>3</sup> Due to extensive construction of a new golf course surrounding the facility, numerous dosimeters were lost in the second quarter of 2006. Measures have been taken to ensure minimal loss of detectors during ongoing construction.

Quarterly exposures at locations adjacent to the reactor facility are listed in Table VII. No significant effect on the environmental radiation levels by reactor operation was noted.

TABLE VII  
Environmental Radiation Levels Adjacent to the Nuclear Radiation Center <sup>1</sup>  
(Exposure in  $\mu\text{Rem}/\text{day}$ )

Location	Jul-Aug-Sep 04	Oct-Nov-Dec 04	Jan-Feb-Mar 05 <sup>3</sup>	Apr-May-Jun 05	Average
<b>E. Loading Dock</b>	318.18	415.58	390.8	309.28	358.46
Rad. Storage Shed	627.27	714.29	781.61	711.34	708.63
<b>Rx Rm E. Secr. Gate</b>	354.55	467.53	390.8	329.9	385.70
<b>Cooling Tower Fence</b>	472.73	662.34	563.22	453.61	537.98
<b>Liquid Waste Tank</b>	363.64	493.51	436.78	0 <sup>3</sup>	431.31
Building Roof West	836.36	922.08	988.51	814.43	890.35
<b>Building W. Side</b>	336.36	506.49	459.77	360.82	415.86
Rx. Room Exh. Vent	318.18	441.56	379.31	340.21	369.82
Rx. Room W. Vent <sup>2</sup>	390.91	506.49	448.28	412.37	439.51
Pool Room E. Vent	336.36	415.58	379.31	350.52	370.44
Building Roof East	272.27	454.55	379.31	319.59	356.43
<b>S. Bldg. Entrance</b>	327.27	441.56	402.3	350.52	380.41

<sup>1</sup> For sampling stations located less than 25 meters from the Nuclear Radiation Center.

<sup>2</sup> Pool Room West Vent. TLD on roof, directly above reactor core.

<sup>3</sup> Dosimeter lost for this period.

**BOLD print locations indicate areas that are readily accessible by the public.**

Technical Specifications ALARA effluent releases in 3.12(2) specify annual radiation exposures at the closest off-site extended occupancy shall not, on an annual basis, exceed the average local off-site background radiation level by more than 20%. For the reporting period, the average total background radiation level for sampling points 25 meters or greater from the facility was 393  $\mu\text{R}/\text{day}$ , while the average total radiation level at the closest extended occupied area 930 meters away was 425.52  $\mu\text{R}/\text{day}$ , indicating no significant exposure level above natural background.