

August 13<sup>th</sup>, 2007

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, 2006 to June 30, 2007.

Sincerely,



Dr. Donald Wall,  
Facility Director

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

Facility License R-76 for the Reporting Period of  
July 1, 2006 to June 30, 2007

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

### I. Operating Experience

The Washington State University Reactor has accumulated 1272.53 Megawatt hours on core 34-A during the reporting period. A total of 542 samples were irradiated, for a total of 11,521.45 user-hours. In addition, 18 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.

Only one major upgrade to the facility was performed during the reporting period. The Fuel Temperature Indication System was replaced under a 10CFR50.59 change as approved by the WSU Reactor Safeguards Committee. All changes were performed according to appropriate procedures.

### 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

	J-A-S	O-N-D	J-F-M	A-M-J	TOTALS
Hours of Operation	286.63	366.77	412.38	355.33	1,421.11
Megawatt Hours	277.27	329.54	356.97	308.75	1272.53
No of Sample Irradiations <sup>1</sup>	35	28	15	33	111
No. of Samples	192	96	110	144	542
No. of Iridium Cans Irradiated	21	18	30	21	90
No. of Silicon Containers Irradiated	12	4	0	6	22
User Hours	2,807.03	2,374.38	3,612.70	2,727.34	11,521.45
No. Pulses > \$1.00	0	7	5	6	18

<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 1173 Megawatt Days, The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 907 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 15 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

9/25/06	Operator manually selected linear channel scale to low, forcing scram.
9/28/06	Operator manually selected linear channel scale to low, forcing scram.
9/28/06	Operator manually selected linear channel scale to low, forcing scram.
9/28/06	Operator manually selected linear channel scale to low, forcing scram.
9/28/06	Operator manually selected linear channel scale to low, forcing scram.
10/2/06	Operator manually selected linear channel scale to low, forcing scram.
10/2/06	Operator manually selected linear channel scale to low, forcing scram.
10/16/06	Operator placed mode switch into "test" instead of "rundown".
1/26/07	Fuel Temperature scram due to maintenance. No limits exceeded.
2/15/07	Manual air scram due to low air pressure.
4/12/07	Linear Power SCRAM due to Iridium handling.
5/8/07	Loss of building power.
5/8/07	Loss of building power.
5/8/07	Loss of building power.
5/8/07	Loss of building power.

#### **D. Major Maintenance**

All routine planned maintenance items were completed within the reporting period. A single major upgrade was completed during this reporting period; the replacement of the fuel temperature indication system.

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

The Fuel Temperature Indication System was replaced in September 2006 under a 50.59 change. Approval for this change was granted by the WSU Reactor Safeguards Committee in December of 2005. The notice of change was submitted to the Commission in January of 2007. All upgrades were made in accordance with applicable procedures and no major complications resulted.

#### **F. Radioactive Effluent Discharges**

##### **I. Radioactive Liquid Releases**

A total of 0.0 microcuries was released in 11,470.31 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 ( $\mu$ Ci)
8/25/06	972.37	7,273.80	0.0
6/18/06	560.99	4,196.51	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 11.988 Curies of Argon-41 was released, with an average concentration of Argon-41 of  $1.82 \times 10^{-7}$  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 2006	1.171E-07	4.68	0.0156	644
August	1.210E-07	4.84	0.0161	665
September	1.147E-07	4.59	0.0153	631
October	7.509E-08	3.00	0.0100	413
November	1.594E-07	6.37	0.0213	877
December	4.343E-07	17.37	0.0579	2389
January 2007	3.234E-07	12.94	0.0431	1779
February	1.837E-07	7.35	0.0245	1010
March	2.596E-07	10.38	0.0346	1428
April	6.612E-08	2.64	0.0088	364
May	1.738E-07	6.95	0.0232	956
June	1.514E-07	6.06	0.0202	832

<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 Ar-41 (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:

- 61.823 millicuries in 33.352 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 47 millirem, whole body.

A total of 1772 individual persons visited the Nuclear Radiation Center during the reporting period, of which 1204 entered a Restricted Area. All exposures as determined by digital pocket dosimeter were less than 1 millirem.

A total of 44 group tours, consisting of 335 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 2006	Oct-Nov-Dec 2006	Jan-Feb-Mar 2007	Apr-May 2007 <sup>2</sup>
6296	5	10	11	32
4045	- <sup>1</sup>	6	- <sup>1</sup>	7
3504	- <sup>1</sup>	- <sup>1</sup>	- <sup>1</sup>	22
7108	22	22	14	26
5718	9	47	25	39
1035	- <sup>1</sup>	2	- <sup>1</sup>	15

<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 2007 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 0.170 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.659 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 4.186 mR/Hr., which occurred in Room 201 East, behind a shielded storage area. The lowest average dose in a routinely accessible reactor vital area was 0.040 mR/Hr., which occurred in Room 201B, the Reactor Shop area. The average dose in the radiochemistry sample hoods was 1.462 mR/Hr. The highest average on site dose level was 8.904 mR/Hr., which occurred in Room 2 East. 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  $1.26 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$ , while the average level in the reactor vital areas was  $1.55 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$ . The highest average value in the reactor vital areas was  $4.56 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$  which was found on the Thermal Column in Room 2. The lowest average value in the reactor vital areas was  $1.04 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$  which was in Room 106, the Ion Exchanger Room. The average level of removable contamination in the radiochemistry hoods was  $1.72 \times 10^{-6} \mu\text{Ci}/100 \text{ cm}^2$ .

<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.

In comparison to a large decorative granite structure located in the center of the WSU campus, a structure freely accessible to the public, 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 2006	Oct-Nov-Dec 2006	Jan-Feb-Mar 2007	Apr-May-Jun 2007	Average
465.53	448.79	498.38	408.14	455.21
489.80 <sup>2</sup>	483.52 <sup>2</sup>	486.49 <sup>2</sup>	352.94 <sup>2</sup>	453.19 <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.

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  $\mu\text{Rem/day}$ )

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>	418.37	450.55	486.49	400	438.85
Rad. Storage Shed	704.08	703.3	783.78	635.29	706.61
<b>Rx Rm E. Secr. Gate</b>	459.18	461.54	500	423.53	461.06
<b>Cooling Tower Fence</b>	581.63	461.54	594.59	517.65	538.85
<b>Liquid Waste Tank</b>	510.2	428.57	527.03	400	466.45
Building Roof West	1112.24	670.33	1054.05	835.29	917.98
<b>Building W. Side</b>	479.59	472.53	513.51	388.24	463.47
Rx. Room Exh. Vent	500	483.52	500	411.76	473.82
Rx. Room W. Vent <sup>2</sup>	540.82	648.35	554.05	470.59	553.45
Pool Room E. Vent	459.18	868.13	513.51	400	560.21
Building Roof East	459.18	450.55	459.46	388.24	439.36
<b>S. Bldg. Entrance</b>	469.39	494.51	472.97	411.76	462.16

<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.

**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 455.21  $\mu\text{R/day}$ , while the average total radiation level at the closest extended occupied area 930 meters away was 448.34  $\mu\text{R/day}$ , indicating no significant exposure level above natural background.