



**Washington State University**

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**Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555**

**Re: Docket No. 50-27; Facility License R-76**

Dear Sir:

In accordance with the Technical Specifications for Facility License R-76 and the provisions of 10 CFR 50.59, paragraph (6), the attached Annual Report prepared by Stephanie L. Sharp, Reactor Supervisor of the WSU facility, is hereby submitted. The report covers the period July 1, 2002 to June 30, 2003.

Sincerely,

A handwritten signature in cursive script, reading 'G. E. Tripard'.

Gerald E. Tripard  
Director

GET/pw

Enclosure

cc: S.L. Sharp  
Office of Nuclear Reactor Regulation  
American Nuclear Insurers

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

**Facility License R-76 for the Reporting Period of  
July 1, 2002 to June 30, 2003**

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

### **I. Operating Experience**

The Washington State University Reactor has accumulated 1000 Megawatt hours on Core 33-X hours during the reporting period. A total of 1305 samples were irradiated, for a total of 4333.2 sample-hours. In addition, 10 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.**

There were no major changes made to the reactor facility during the reporting period.

### **III. All surveillance tests and requirements were performed and completed within the prescribed time period. The results of all inspections revealed no abnormalities.**

## **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>	296.98	202.83	271.18	295.23	1066.2
<b>Megawatt Hours</b>	272.12	190.01	257.70	280.45	1000.3
<b>No. of Irradiations</b>	166	161	211	185	723
<b>No. of Samples Irradiated</b>	690	223	289	103	1305
<b>User Hours</b>	1231.07	860.43	1061.74	1179.96	4333.2
<b>No. Pulses &gt; \$1.00</b>	2	4	0	4	10

The cumulative energy output since criticality of the TRIGA core since 1967 is 957 Megawatt Days, The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 691 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 8 inadvertent SCRAMS are listed in Table II.

**TABLE II**  
**Inadvertent SCRAMS**

8/9/02	Operator Switched mode to Pulse, SCRAMming pulse rod
10/1/02	Short Period at Power. Believed due to electrical noise.
10/8/02	Seismograph SCRAM due to crane movement vibration.
12/2/02	Short Period at Power. Believed due to electrical noise.
12/6/02	Power SCRAM Safety Channel #2. Due to switch fault.
3/4/03	Short Period at Power. Believed due to electrical noise.
6/17/03	Manual SCRAM by operator due to fire alarm.
6/23/03	Trainee switched mode switch to test instead of rundown.

### D. Major Maintenance

All major maintenance performed was routine planned maintenance items.

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

There have been no changes to the facility made under 10 CFR 50.59 criteria within the reporting period.

### F. Radioactive Effluent Discharges

#### I. Radioactive Liquid Releases

A total of 2276.6 microcuries was released in 1327 gallons of liquid during the reporting period. The releases are listed in Table III on Page 3.

**TABLE III**  
**Radioactive Liquid Releases**

Date	Nuclide	Activity ( $\mu\text{Ci}/\text{ml}$ )	Release Limit	Percent of Release Limit
8/6/2002	$^{192}\text{Ir}$	$2.05 \times 10^{-6}$	$1.00 \times 10^{-4}$	2.05%
	$^{54}\text{Mn}$	$3.05 \times 10^{-7}$	$3.00 \times 10^{-4}$	0.10%
	$^{57}\text{Co}$	$1.52 \times 10^{-6}$	$6.00 \times 10^{-4}$	0.25%
	$^{58}\text{Co}$	$1.32 \times 10^{-6}$	$8.00 \times 10^{-3}$	0.02%
	$^{60}\text{Co}$	$3.59 \times 10^{-7}$	$3.00 \times 10^{-3}$	1.20%
	$^{124}\text{Sb}$	$2.15 \times 10^{-5}$	$7.00 \times 10^{-5}$	30.69%
	$^{46}\text{Sc}$	$5.76 \times 10^{-7}$	$1.00 \times 10^{-4}$	0.58%
	$^{51}\text{Cr}$	$1.07 \times 10^{-6}$	$5.00 \times 10^{-3}$	0.03%
	$^{65}\text{Zn}$	$9.00 \times 10^{-6}$	$5.00 \times 10^{-5}$	18.00%
	$^{103}\text{Rh}$	$1.04 \times 10^{-4}$	$5.00 \times 10^{-4}$	20.81%
	Total Activity Released in 664 ft <sup>3</sup> water: 1956.5 $\mu\text{Ci}$			
4/18/2003	$^{46}\text{Sc}$	$8.89 \times 10^{-8}$	$1.00 \times 10^{-4}$	0.09%
	$^{51}\text{Cr}$	$4.68 \times 10^{-7}$	$5.00 \times 10^{-3}$	0.01%
	$^{54}\text{Mn}$	$4.84 \times 10^{-8}$	$3.00 \times 10^{-4}$	0.02%
	$^{57}\text{Co}$	$3.49 \times 10^{-8}$	$6.00 \times 10^{-4}$	0.01%
	$^{58}\text{Co}$	$7.59 \times 10^{-6}$	$2.00 \times 10^{-4}$	3.8%
	$^{60}\text{Co}$	$5.78 \times 10^{-8}$	$3.00 \times 10^{-3}$	0.19%
	$^{65}\text{Zn}$	$2.41 \times 10^{-6}$	$5.00 \times 10^{-5}$	4.82%
	$^{103}\text{Rh}$	$1.71 \times 10^{-5}$	$5.00 \times 10^{-4}$	3.43%
	$^{124}\text{Sb}$	$4.32 \times 10^{-6}$	$7.00 \times 10^{-5}$	6.18%
	$^{192}\text{Ir}$	$8.70 \times 10^{-7}$	$1.00 \times 10^{-4}$	0.87%
	Total Activity Released in 663 ft <sup>3</sup> water: 320.1 $\mu\text{Ci}$			

## 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 9.8 Curies of Argon-41 was released, with an average concentration of Argon-41 of  $1.485 \times 10^{-7}$   $\mu\text{Ci}/\text{cc}$ . 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
Jul. 02	$2.052 \times 10^{-7}$	8.21	0.0274	1129
Aug. 02	$1.69 \times 10^{-7}$	6.75	0.0225	930
Sep. 02	$1.21 \times 10^{-7}$	4.83	0.0162	666
Oct. 02	$1.106 \times 10^{-7}$	4.43	0.0148	608
Nov. 02	$9.416 \times 10^{-8}$	3.77	0.0126	518
Dec. 02	$1.363 \times 10^{-7}$	5.45	0.0182	750
Jan. 03	$2.155 \times 10^{-7}$	8.62	0.0287	1185
Feb. 03	$1.369 \times 10^{-7}$	5.26	0.0183	753
Mar. 03	$1.190 \times 10^{-7}$	4.76	0.0159	654
Apr. 03	$1.542 \times 10^{-7}$	6.17	0.0206	848
May. 03	$1.549 \times 10^{-7}$	6.19	0.0207	852
Jun. 03	$1.655 \times 10^{-7}$	6.62	0.0221	910

<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 Campus Radiation Safety Office for packaging and disposal.

0.32 millicuries in 28 cubic feet of non-compacted solid waste.

0.1 millicuries in 7.5 cubic feet, (1 - 7.5 cuft barrel), 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 28 millirem, whole body.

A total of 1687 individual persons visited the Nuclear Radiation Center during the reporting period, of which 571 entered a Restricted Area. All exposures as determined by digital pocket dosimeter were less than 1 millirem.

A total of 35 group tours, consisting of 408 individuals, visited the Center during the reporting period. As determined by digital pocket dosimeter, all exposures were less than 1 millirem.

During Dad's Weekend, the reactor hosted 6 group tours, a total of 13 people, with all exposures less than 1 mrem.

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

Badge No.	Jul-Aug-Sep 02	Oct-Nov-Dec 02	Jan-Feb-Mar 03	Apr-May-Jun 03
5855	10	4	6	8
5922	0	0	0	N/A
4045	0	0	0	1
6296	28	7	9	17
3497	0	0	0	N/A
587	0	0	N/A	N/A
5723	N/A	N/A	N/A	13
6619	N/A	N/A	N/A	7
3504	N/A	N/A	N/A	3

#### 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 0.073 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.12 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 0.43 mR/Hr., which occurred in Room 201, Reactor Pool Room, on the reactor bridge. The lowest average dose in a routinely accessible reactor vital area was 0.02 mR/Hr., which occurred in Room 201A, the Reactor Shop area. The average dose in the Reactor Control Room was 0.02 mR/Hr. The average dose in the radiochemistry sample hoods was 0.15 mR/Hr. The highest average on site dose level was 9.6 mR/Hr. which occurred in Room 2A, Cave Room, which is a locked storage area where radioactive material and radioactive sources are stored.

Routine building surveys for removable contamination in non-reactor vital areas<sup>1</sup> had an average level of  $1.02 \times 10^{-6}$   $\mu\text{Ci}/100 \text{ cm}^2$ , while the average level in the reactor vital areas was  $8.18 \times 10^{-7}$   $\mu\text{Ci}/100 \text{ cm}^2$ . The highest average value in the reactor vital areas was  $2.5 \times 10^{-6}$   $\mu\text{Ci}/100 \text{ cm}^2$  which was found on the heat exchanger pit floor. The lowest average value in the reactor vital areas was  $4.38 \times 10^{-7}$   $\mu\text{Ci}/100 \text{ cm}^2$  which was in Room 201, the Reactor Bridge, north side. The average level of removable contamination in the radiochemistry hoods was  $9.62 \times 10^{-6}$   $\mu\text{Ci}/100 \text{ cm}^2$ .

<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 building facility. 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 uRem/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 environment radiation levels due to reactor operation.

**TABLE VI**  
**Environmental Radiation Levels in the Vicinity of the Nuclear Radiation Center<sup>1</sup>**  
**(Exposure in uRem/day)**

Jul-Aug-Sep 02	Oct-Nov-Dec 02	Jan-Feb-Mar 03 <sup>3</sup>	Apr-May-Jun 03	Average
153.8	207.5	469.88	152.5	171.3
Dosimeter placed elsewhere	672.73 <sup>2</sup>	469.88 <sup>2</sup>	727.27 <sup>2</sup>	478.34 <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 abnormal background TLD reading, all dosimeters save at the granite rock read below background in first quarter 03. These readings are not included in the overall average calculation to ensure conservative reporting.

Quarterly exposures at locations at the reactor facility are listed in Table VII on Page 7. 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 uR/day)**

Location	Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar <sup>3</sup>	Apr-May-Jun	Average
<b>E. Loading Dock</b>	152	218	<BKG	117	162
<b>Rad. Storage Shed</b>	163	209	145	156	176
<b>Rx Rm W. Secr. Gate</b>	185	236	36	195	205
<b>Cooling Tower Fence</b>	315	218	169	169	234
<b>Liquid Waste Tank</b>	174	218	<BKG	143	178
<b>Building Roof West</b>	130	182	<BKG	143	152
<b>Building W. Side</b>	196	245	<BKG	182	208
<b>Rx. Room Exh. Vent</b>	120	173	<BKG	117	137
<b>Rx. Room W. Vent <sup>2</sup></b>	609	473	434	584	555
<b>Pool Room E. Vent</b>	345	355	205	429	376
<b>Building Roof East</b>	141	191	<BKG	117	150
<b>S. Bldg. Entrance</b>	228	missing	362	221	225

<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> 1<sup>st</sup> quarter 2003 samples compared against abnormal background dosimeter. This quarter not included in averages.

**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 172 uR/day, while the average total radiation level at the closest extended occupied area 930 meters away was 161 uR/day, indicating no significant exposure level above natural background.