



Washington State University



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August 8, 1997

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 Jerry A. Neidiger, Reactor Supervisor of the WSU facility, is hereby submitted. The report covers the period July 1, 1996 to June 30, 1997.

Sincerely,

Gerald E. Tripard  
Director

GET/pw

Enclosure

cc: J.A. Neidiger  
Office of Nuclear Reactor Regulation  
American Nuclear Insurers

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Non-Power Reactors and Decommissioning Project Directorate  
Division of Reactor Program Management  
Office of Nuclear Reactor Regulation  
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Rockville, MD 20852-2738

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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, 1996 to June 30, 1997

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

### 1. Operating Experience

The Washington State University Reactor has accumulated 310 Megawatt hours on Core 33-X during the reporting period. A total of 175 irradiations for a total of 4284 samples were performed. 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.

2. There were no changes in design, performance characteristics, or procedures that related to reactor safety during the reporting period.

3. 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 below.

TABLE I  
Fiscal Year Summary of Reactor Operations

	J-A-S	O-N-D	J-F-M	A-M-J	TOTALS
Hours of Operation	90	97	72	107	366
Megawatt Hours	68	79	71	92	310
No. of Irradiations	64	42	38	31	175
No. of Samples Irradiated	1407	959	1019	899	4284
No. Pulses > \$1.00	1	6	3	1	11

The cumulative energy output since criticality of the TRIGA core since 1967 is 772 Megawatt Days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 506 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 6 inadvertent SCRAMS are listed in Table II below.

TABLE II  
Inadvertent SCRAMS

DATE	CAUSE
07/16/96	Malfunction of Fuel Temperature Channel #2 Thermalcouple Transmitter.
08/28/96	Pulse Rod SCRAM - Loss of Pulse Rod air pressure.
09/18/96	Period/Loss HV - No indication - probable power spike.
02/18/97	Reactor bridge Area Radiation Monitor - Activated sample removed from reactor pool.
03/26/97	Log-N spike - Period SCRAM while at 100% power.
04/16/97	No apparent signal.

**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 was one item performed and documented under 10 CFR 50.59 criteria during the reporting period.

05/14/97 Approval to install new Continuous Air Monitoring System.

**F. Radioactive Effluent Discharges**

1. Radioactive Liquid Releases

A total of 0.304 microcuries was released in 1,496,702 liters of liquid during the reporting period. The releases are listed in Table III.

TABLE III  
Radioactive Liquid Releases

Date	Quantity uCi	Tank Release Conc, uCi/ml	Tank Release Vol, Liters	WSU Sewer Vol, Liters	Total Dilute Vol, Liters	Sewer Conc uCi/ml	% <sup>(1)</sup> MPC
12/09/96	0.160	$8.28 \times 10^{-9}$	18,691	480,000	498,691	$3.21 \times 10^{-10}$	1.60
01/09/97	0.070	$3.66 \times 10^{-9}$	19,031	480,000	499,031	$1.40 \times 10^{-10}$	0.70
03/27/97	0.074	$3.91 \times 10^{-9}$	18980	480,000	498,980	$1.49 \times 10^{-10}$	0.74

<sup>(1)</sup>Based on a release limit of  $4.0 \times 10^{-8}$  uCi/ml for unknown mixture, 10 CFR 20, Table 3.

## 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 2.84 Curies of Argon-41 was released in  $5.86 \times 10^{13}$  cc of air which yields an average monthly concentration of Argon-41 of  $4.85 \times 10^{-8}$  uCi/cc. The monthly releases are summarized in Table IV.

TABLE IV  
Monthly Argon-41 Releases

Month	Conc. Before Dilution, uCi/ml	% Release Limit <sup>(1)</sup> Before Dilution	% DAC Limit <sup>(2)</sup> Before Dilution	Quantity mCi
Jul. (1996)	$3.58 \times 10^{-8}$	1.43	<0.01	179
Aug.	$6.04 \times 10^{-8}$	2.42	0.01	302
Sep.	$3.84 \times 10^{-8}$	1.54	0.01	186
Oct.	$5.79 \times 10^{-8}$	2.32	0.01	289
Nov.	$4.64 \times 10^{-8}$	1.86	0.01	232
Dec.	$3.44 \times 10^{-8}$	1.38	<0.01	172
Jan. (1997)	$4.48 \times 10^{-8}$	1.79	0.01	224
Feb.	$5.13 \times 10^{-8}$	2.05	0.01	232
Mar.	$4.37 \times 10^{-8}$	1.75	0.01	218
Apr.	$5.38 \times 10^{-8}$	2.15	0.01	260
May	$5.26 \times 10^{-8}$	2.10	0.01	263
Jun.	$5.85 \times 10^{-8}$	2.34	0.01	283

<sup>(1)</sup> Based on 10 CFR 20 limit of  $1.0 \times 10^{-8}$  uCi/cc 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 of  $5.0 \times 10^{-7}$  uCi/cc.)

<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 limit of  $7.5 \times 10^{-4}$  uCi/ml.

## 3. Radioactive Solid Waste Disposal

During the reporting period, 34 cubic feet of non-compacted solid waste for a total of 0.32 milliCuries and one (1) 55 gallon drum of compacted, dewatered ion

exchanger spent resin containing 0.24 milliCuries of Activity was transferred to the Campus Radiation Safety Office for packaging and disposal.

#### G. Personnel and Visitor Radiation Exposures

The average quarterly exposures of Nuclear Radiation Center reactor staff and experimenters who routinely utilize the WSU reactor are given in Table V. The maximum quarterly exposure of a reactor staff member was 50 millirem, whole body.

A total of 2240 non-Nuclear Radiation Center staff or routine facility user individuals visited the Center during the reporting period, out of which 1100 enter Restricted Areas. As determined by digital pocket dosimeter, the average individual exposure was <1.0 millirem.

A total of 36 group tours, consisting of 423 individuals, visited the Center during the reporting period. As determined by digital pocket dosimeter, the average group exposure was <1.0 millirem.

TABLE V  
Average Quarterly Reactor and Experimenter Staff Exposure  
(in millirems)

Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun <sup>(1)</sup>
<10	<10	<10	<10

<sup>(1)</sup>June's film badge results not available from the vendor at the time this report was prepared.

Note: 10 millirem minimum exposure reported by vendor.

#### H. Reactor Facility Radiation and Contamination Levels

The routine area radiation surveys of the building had an average dose level of 0.02 mR/Hr., while routinely accessible reactor areas had an average dose level of 0.03 mR/Hr. The highest average dose level in a reactor area was 0.3 mR/Hr., which occurred in Room 201, Reactor Pool Room. The lowest average dose in a reactor 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 0.06 mR/Hr. The highest average on site dose level was 10 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 had an average level of  $2.5 \times 10^{-6}$   $\mu\text{Ci}/100 \text{ cm}^2$ , while the average level in reactor areas was  $5.6 \times 10^{-6}$   $\mu\text{Ci}/100 \text{ cm}^2$ . The highest average value in a reactor area was  $4.2 \times 10^{-4}$   $\mu\text{Ci}/100 \text{ cm}^2$  which was found on the platform where experimenters stand to insert and withdraw their samples from the reactor.

The lowest average value in a reactor area was  $2 \times 10^{-6}$   $\mu\text{Ci}/100 \text{ cm}^2$  which was in Room 201A, the Reactor Control Room Floor. The average level of removable contamination in the radiochemistry sample hoods was  $5.7 \times 10^{-5}$   $\mu\text{Ci}/100 \text{ cm}^2$ .

NOTE: A reactor area is an area in the building which is adjacent to and through which access can be obtained to the reactor pool or pool wall.

## 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 uR/day)

Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun <sup>(1)</sup>	Median
186	108	179	129	151

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

Quarterly exposures at locations at 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 uR/day)

Location	J-A-S	O-N-D	J-F-M	A-M-J <sup>(1)</sup>	Median
E. Loading Dock	221	196	181	188	197
Rad. Storage Shed	209	188	169	200	192
Rx Rm E. Secr. Gate	122	188	193	188	173
Cooling Tower Fence	233	196	145	176	188
Liquid Waste Tank	209	188	169	165	183
Building Roof West	163	143	145	141	148
Building W. Side	233	214	205	200	213
Pool Room Exh. Vent	163	107	108	106	121
Pool Room W. Vent	407	259	253	282	300
Pool Room E. Vent	291	214	181	212	225
Building Roof East	151	143	108	118	130
S. Bldg. Entrance	244	268	205	212	232

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

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 400 meters or greater from the facility was 151 uR/day, while the average total radiation level at the closest extended occupied area 930 meters away was 158 uR/day. This yields a ratio of 5%, indicating no significant exposure level above natural background.