



Washington State University

Nuclear Radiation Center

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August 29, 2002

Non-Power Reactors and Decommissioning Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

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, 2001 to June 30, 2002.

Sincerely,

A handwritten signature in black ink, appearing to read 'G. E. Tripard'.

Gerald E. Tripard
Director

GET/pw

Enclosure

cc: S.L. Sharp
American Nuclear Insurers
U.S. NRC, Document Control Desk

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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, 2001 to June 30, 2002

A. Narrative Summary of the Year's Operation

I. Operating Experience

The Washington State University Reactor has accumulated 916 Megawatt hours on Core 33-X hours during the reporting period. A total of 2643 samples were irradiated, for a total of 4171.13 sample-hours. In addition, 9 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 was one major upgrade performed under 10CFR 50.59 criteria in this reporting year.

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

	J-A-S	O-N-D	J-F-M	A-M-J	TOTALS
Hours of Operation	253.77	235.13	223.9	283.2	996
Megawatt Hours	234.86	218.39	209.25	253.33	915.83
No. of Irradiations	136	144	157	223	658
No. of Samples Irradiated	644	556	607	836	2643
User Hours	1004.08	1057.82	949.96	1159.26	4171.12
No. Pulses > \$1.00	0	4	1	4	9

The cumulative energy output since criticality of the TRIGA core since 1967 is 915 Megawatt Days, The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 649 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 9 inadvertent SCRAMS are listed in Table II.

TABLE II
Inadvertent SCRAMS

8/15/01	Operator unintentionally placed mode switch into 'Test' position.
10/16/01	Trainee placed mode switch into 'Pulse' position
12/12/01	Trainee placed mode switch into 'Test' position
1/10/02	Signal from new channel while testing in progress, no setpoint exceeded.
1/10/02	Same as Above.
1/10/02	Same as Above.
4/10/02	High Power Scram at 112%. Limit not exceeded.
5/13/02	High Power Scram while pulsing. Channel not set into 'zero-check' mode.
5/29/02	High Power Scram due to operator pressing trip test button, no setpoint exceeded.

D. Major Maintenance

All other major maintenance performed were routine planned maintenance items, except for a full cleaning of the pulse rod cylinder and guide tube.

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

There was one major modification that began during the reporting period that was documented under 10 CFR 50.59 criteria; the old linear channel and safety channel 2 were replaced with a newer General Atomic linear channel and pulse and power channel. The old pulse channel was left installed for comparison measurements.

F. Radioactive Effluent Discharges

I. Radioactive Liquid Releases

A total of 191.9 microcuries was released in 37381 liters of liquid during the reporting period. The releases are listed in Table III on Page 3.

TABLE III
Radioactive Liquid Releases

Date	Nuclide	Activity ($\mu\text{Ci/ml}$)	Release Limit	Percent of Release Limit
12/18/01	^{46}Sc	4.37×10^{-8}	1.00×10^{-4}	0.04%
	^{51}Cr	4.96×10^{-8}	5.00×10^{-3}	0.00%
	^{54}Mn	8.29×10^{-9}	3.00×10^{-4}	0.00%
	^{57}Co	9.44×10^{-9}	6.00×10^{-4}	0.00%
	^{58}Co	4.14×10^{-9}	2.00×10^{-4}	2.07%
	^{105}Rh	2.62×10^{-8}	1.00×10^{-7}	26.21%
	^{192}Ir	1.76×10^{-7}	1.00×10^{-4}	0.18%
Total Activity Released in 660.45 ft ³ water: 77.4 μCi				
4/10/02	^{192}Ir	5.97×10^{-7}	1.00×10^{-4}	0.60%
	^{57}Co	6.84×10^{-9}	6.00×10^{-4}	0.00%
	^{58}Co	6.13×10^{-6}	8.00×10^{-3}	0.08%
	^{60}Co	1.81×10^{-8}	3.00×10^{-5}	0.06%
	^{124}Sb	1.93×10^{-6}	7.00×10^{-5}	2.75%
Total Activity Released in 660 ft ³ water: 114.5 μCi				

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 8.7 Curies of Argon-41 was released, with an average concentration of Argon-41 of 1.318×10^{-07} $\mu\text{Ci/cc}$. 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 ¹	% DAC Limit Before Dilution ²	Quantity mCi
Jul. 01	1.18×10^{-7}	4.74	0.016	649
Aug. 01	1.51×10^{-7}	6.06	0.020	831
Sep. 01	1.25×10^{-7}	5.02	0.017	688
Oct. 01	1.64×10^{-7}	6.56	0.022	902
Nov. 01	1.78×10^{-7}	4.71	0.024	979
Dec. 01	1.13×10^{-7}	4.53	0.015	622
Jan. 02	7.2×10^{-8}	2.88	0.0096	396
Feb. 02	1.43×10^{-7}	5.72	0.019	787
Mar. 02	1.3×10^{-7}	5.21	0.017	715
Apr. 02	1.22×10^{-7}	4.88	0.016	671
May. 02	1.42×10^{-7}	5.69	0.019	781
Jun. 02	1.23×10^{-7}	4.89	0.016	677

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

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

0.001 millicuries in 8 cubic feet of non-compacted solid waste.

7.5 millicuries in 15 cubic feet, (2 - 7.5 cuft barrels), 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 2168 individual persons visited the Nuclear Radiation Center during the reporting period, of which 521 entered a Restricted Area. All exposures as determined by digital pocket dosimeter were less than 1 millirem.

A total of 18 group tours, consisting of 229 individuals, visited the Center during the reporting period. As determined by digital pocket dosimeter, all exposures were less than 1 millirem.

During Mom's Weekend, the reactor hosted 66 group tours, a total of 186 people, with all exposures less than 1 mrem.

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

Badge No.	Jul-Aug-Sep 01	Oct-Nov-Dec 01	Jan-Feb-Mar 01	Apr-May-Jun 01
5855	13	28	6	5
5922	N/A	N/A	N/A	2
1035	12	14	N/A	N/A
4045	0	0	2	0
6296	N/A	0	14	7
3497	0	0	0	1
587	0	5	3	N/A

H. Reactor Facility Radiation and Contamination Levels

The routine area radiation surveys of the building in non-reactor vital areas¹ had an average dose level of 0.075 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.23 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 0.47 mR/Hr., which occurred in Room 201, Reactor Pool Room, south-side. 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 0.043 mR/Hr. The average dose in the radiochemistry sample hoods was 0.78 mR/Hr. The highest average on site dose level was 11.6 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 areas¹ had an average level of 4.65×10^{-6} $\mu\text{Ci}/100 \text{ cm}^2$, while the average level in the reactor vital areas was 2.95×10^{-6} $\mu\text{Ci}/100 \text{ cm}^2$. The highest average value in the reactor vital areas was 1.03×10^{-5} $\mu\text{Ci}/100 \text{ cm}^2$ which was found on the sample drop tube. The lowest average value in the reactor vital areas was 1.2×10^{-6} $\mu\text{Ci}/100 \text{ cm}^2$ which was in Room 201A, the Reactor Shop Floor. The average level of removable contamination in the radiochemistry hoods was 5.4×10^{-5} $\mu\text{Ci}/100 \text{ cm}^2$.

¹ 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 Center¹
(Exposure in uRem/day)

Jul-Aug-Sep 01	Oct-Nov-Dec 01	Jan-Feb-Mar 01	Apr-May-Jun 01	Average
141.16	140.11	213.05	105.70	150.0

¹ 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 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 ¹
(Exposure in uR/day)

Location	Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun	Average
E. Loading Dock	79	143	172	102	124
Rad. Storage Shed	206	241	1172	255	468
Rx Rm W. Secr. Gate	333	250	672	183	360
Cooling Tower Fence²	619	205	1000	244	517
Liquid Waste Tank	126	169	207	132	159
Building Roof West	142	142	172	102	140
Building W. Side	222	196	224	142	196
Rx. Room Exh. Vent	48	125	137	92	101
Rx. Room W. Vent ³	492	410	827	387	529
Pool Room E. Vent	301	294	482	255	333
Building Roof East	63	125	207	102	125
S. Bldg. Entrance	253	232	258	173	229

¹ For sampling stations located less than 25 meters from the Nuclear Radiation Center.

² The large dose rates in January, February, and March at the Cooling Tower Fence and the Rad. Storage Shed are due to the storage of a specific source by the university Radiation Safety Office. The RSO estimates that the maximally exposed member of the public would have been in the exposed area for less than 24 hours a month during the time of source storage, and therefore would have received less than four millirems dose.

³ 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 400 meters or greater from the facility was 150 uR/day, while the average total radiation level at the closest extended occupied area 930 meters away was 147 uR/day, indicating no significant exposure level above natural background.



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August 29, 2002

American Nuclear Insurers
Town Center, Suite 300S
29 South Main Street
West Hartford, CT 06107-2445
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