Washington State University
Nuclear Radiation Center

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August 26, 1999

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, 1998 to June 30, 1999.

Sincerely,

GE Tripard

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
One White Flint North
11555 Rockville Pike
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, 1998 to June 30, 1999

A. Narrative Summary of the Year's Operation

I. Operating Experience

The Washington State University Reactor has accumulated 1180 Megawatt hours on Core 33-X hours during the reporting period. A total of 833 irradiations for a total of 5913 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.

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

There were no changes in design, performance characteristics, or procedures that related to reactor safety 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

	J-A-S	O-N-D	J-F-M	A-M-J	TOTALS
Hours of Operation	344	268	231	418	1261
Megawatt Hours	306	247	221	406	1180
No. of Irradiations	281	227	72	253	833
No. of Samples Irradiated	2318	1280	1190	1125	5913
No. Pulses > $1.00	1	6	0	4	11

The cumulative energy output since criticality of the TRIGA core since 1967 is 841 Megawatt Days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 575 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 14 inadvertent SCRAMS are listed in Table II.

TABLE II
Inadvertent SCRAMS

DATE	CAUSE
07/09/98	Log-N High Voltage Failure - HV in spec. No other indication.
08/04/98	Log-N High Voltage Failure - No other indication.
09/24/98	Reactor Scram at full power - No other indication.
12/02/98	Pulse rod and control blades dropped - No other indication.
12/02/98	SCRAM - No other indication. Weather stormy with high winds.
12/02/98	SCRAM - No other indication. Weather stormy with high winds.
12/02/98	SCRAM - No other indication. Weather stormy with high winds.
12/02/98	SCRAM - Control Power key switch inadvertently de-energized.
12/21/98	SCRAM at 80% power. Logic Element lit. No other indication.
12/21/98	SCRAM at 80% power. Logic Element lit. No other indication.
12/21/98	SCRAM at 80% power. Logic Element lit. No other indication.
12/21/98	SCRAM at 80% power. Logic Element lit. No other indication.
12/21/98	SCRAM at 80% power. Logic Element lit. No other indication.
12/21/98	SCRAM at 80% power. Logic Element lit. No other indication. *

* Logic Element opto-isolator IC replaced 12/22/98. No further spurious SCRAMS

D. Major Maintenance

All other major maintenance performed was routine planned maintenance items.

E. Changes, Tests and Experiments preformed 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 replacement of the reactor pool cooling system heat exchanger, primary and secondary pumps, and the cooling tower.

F. Radioactive Effluent Discharges

I. Radioactive Liquid Releases

A total of 54.27 microcuries was released in 2,073,495 liters of liquid during the reporting period. The releases are listed in Table III on Page 3.

TABLE III
Radioactive Liquid Releases

Date	Quantity uCi	Release Concen. uCi/ml	Release Volume Liters	WSU Sewer Volume Liters	Total Dilut. Volume Liters	Sewer Concen. uCi/ml	% MPC
08/11/98	1.15	$2.72x10^{-09}$	422,973	480,000	902,973	$1.27x10^{-10}$	0.60 [1]
09/01/98	1.65	$6.16x10^{-09}$	267,440	480,000	747,440	$1.54x10^{-10}$	7.70 [1]
09/17/98	1.63	$9.95x10^{-08}$	16,335	480,000	496,335	$3.28x10^{-09}$	16.42 [1]
09/23/98	10.08	$5.42x10^{-07}$	18,620	480,000	498,620	$2.02x10^{-08}$	0.05 [2]
10/02/98	8.49	$3.71x10^{-07}$	22,812	480,000	502,812	$1.69x10^{-08}$	0.04 [2]
10/16/98	2.58	$1.38x10^{-07}$	18,708	480,000	498,708	$5.17x10^{-09}$	0.01 [2]
11/16/98	4.46	$1.68x10^{-07}$	26,513	480,000	506,513	$8.81x10^{-09}$	0.02 [2]
12/04/98	0.61	$8.37x10^{-09}$	72,377	480,000	522,377	$1.10x10^{-09}$	5.52 [1]
12/31/98	1.95	$1.54x10^{-08}$	126,786	480,000	606,786	$3.21x10^{-09}$	16.07 [1]
04/16/99	1.29	$1.09x10^{-08}$	117,590	480,000	597,590	$2.16x10^{-09}$	10.79 [1]
05/07/99	1.77	$1.72x10^{-08}$	103,130	480,000	583,130	$3.04x10^{-09}$	15.18 [1]
05/18/99	4.55	$1.95x10^{-08}$	233,382	480,000	713,382	$6.38x10^{-09}$	31.89 [1]
05/28/99	2.28	$4.00x10^{-08}$	57,019	480,000	537,019	$4.25x10^{-09}$	0.01 [2]
06/08/99	0.013	$6.45x10^{-10}$	20,269	480,000	500,269	$2.60x10^{-11}$	0.13 [1]
06/17/99	7.10	$1.93x10^{-08}$	367,718	480,000	847,718	$8.38x10^{-08}$	41.88 [1]
06/29/99	4.67	$2.57x10^{-08}$	181,823	480,000	661,823	$7.06x10^{-09}$	0.02 [2]

[1] Based on a release limit of $2.0x10^{-08}$ uCi/ml for unknown mixture, 10 CFR 20, Table 3.
[2] Isotope found to be K^{40}. Release limit is $4.0x10^{-05}$ uCi/ml, 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 that 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 7.87 Curies of Argon-41 was released in $5.86x10^{13}$ cc of air, which yields an average concentration of Argon-41 of $1.341x10^{-07}$ uCi/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. 97	8.08×10^{-08}	3.23	0.01	551
Aug. 97	1.41×10^{-07}	5.64	0.02	725
Sep. 97	1.98×10^{-07}	7.92	0.03	991
Oct. 97	7.60×10^{-08}	3.04	0.01	343
Nov. 97	1.33×10^{-07}	5.32	0.02	642
Dec. 97	1.09×10^{-07}	4.36	0.01	598
Jan. 98	1.03×10^{-07}	4.12	0.01	566
Feb. 98	1.11×10^{-07}	4.44	0.01	413
Mar. 98	1.02×10^{-07}	4.08	0.01	476
Apr. 98	1.31×10^{-07}	5.24	0.02	719
May. 98	1.69×10^{-07}	6.76	0.02	765
Jun. 98	1.53×10^{-07}	6.12	0.02	1083

[1] Based on 10 CFR 20 effluent release limit of 1.0x10-8 uCi/ml for 41Ar (Table 2, Col.1), and a dilution factor of 4.0x10-3 (S.A.R. 6.4.2) for a before dilution limit of 2.5x10-6 uCi/cc. (20% of limit is 5.0x10-7 uCi/ml).

[2] Based on 10 CFR 20 DAC limit of 3.0x10-6 uCi/ml for 41Ar (Table 1, Col. 3) and a dilution factor of 4.0x10-3 for a before dilution DAC limit of 7.5x10-4 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.

50.41 millicuries in 67 cubic feet of non-compacted solid waste.
13.38 millicuries in 30 cubic feet, (4 - 7.5 cuft barrels), of non-compacted solid waste.
5.25 millicuries in 200 cubic feet of reactor grade graphite.

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 2,240 individual persons visited the Nuclear Radiation Center during the reporting period, of which 1,205 entered a Restricted Area. All exposures as determined by digital pocket dosimeter were less than 1 millirem.

A total of 19 group tours, consisting of 246 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 98	Oct-Nov-Dec 98	Jan-Feb-Mar 99	Apr-May-Jun 99
1	60	30	31	23
2	70	40	54	35
3	50	40	36	22
4	0	0	36	0
5	0	0	32	1

H. Reactor Facility Radiation and Contamination Levels

The routine area radiation surveys of the building in non-reactor vital areas[1] had an average dose level of 0.02 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.03 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 0.40 mR/Hr., which occurred in Room 201, Reactor Pool Room, north-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 0.03 mR/Hr. The average dose in the radiochemistry sample hoods was 0.25 mR/Hr. The highest average on site dose level was 81 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[1] had an average level of 1.8×10^{-06} uCi/100cm2, while the average level in the reactor vital areas was 3.4×10^{-06} uCi/100cm2. The highest average value in the reactor vital areas was 2.1×10^{-05} uCi/100cm2 which was found on the platform where experimenters stand to insert and withdraw their samples from the reactor. The lowest average value in the reactor vital areas was 1.15×10^{-07} uCi/100cm2 which was in Room 201B, the Reactor Control Room Floor. The average level of removable contamination in the radiochemistry hoods was 6.2×10^{-06} uCi/100cm2.

[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 thermaluminecent dosimeters (TLD's) at locatic ns 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 [1]
(Exposure in uRem/day)

Jul-Aug-Sep 98	Oct-Nov-Dec 98	Jan-Feb-Mar 99	Apr-May-Jun 99	Median
154	165	141	143	151
725	764	733	missing	741 [2]

[1] For sampling stations located 25 meters or greater from the Nuclear Radiation Center.
[2] TLD attached to "Decorative" granite display on Compton Union Building Mall approximately 1300 meters 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	Median
E. Loading Dock	140	130	126	110	127
Rad. Storage Shed	236	250	184	264	234
Rx Rm W. Secr. Gate	253	261	195	187	224
Cooling Tower Fence	180	272	253	253	240
Liquid Waste Tank	missing	239	230	231	233
Building Roof West	174	163	149	154	160
Building W. Side	219	217	207	165	202
Rx. Room Exh. Vent	135	141	126	121	131
Rx. Room W. Vent [2]	674	674	575	835	690
Pool Room E. Vent	461	500	414	495	468
Building Roof East	146	141	126	132	136
S. Bldg. Entrance	281	261	230	209	245

[1] For sampling stations located less that 25 meters from the Nuclear Radiation Center.

[2] 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 144 uR/day, while the average total radiation level at the closest extended occupied area 930 meters away was 148 uR/day. This yields a ratio of 2.78%, indicating no significant exposure level above natural background.