



Washington State University

Nuclear Radiation Center

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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 Jerry A. Neidiger, Reactor Supervisor of the WSU facility, is hereby submitted. The report covers the period July 1, 1995 to June 30, 1996.

Sincerely,

Gerald E. Tripard
Director

GET/pw

Enclosure

cc: J.A. Neidiger
NRC, Region IV, Office of Regional Administrator
American Nuclear Insurers

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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, 1995 to June 30, 1996

A. Narrative Summary of the Year's Operation

1. Operating Experience

The Washington State University Reactor has accumulated 396 Megawatt hours on Core 33-X hours during the reporting period. A total of 170 irradiations for a total of 4832 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.

TABLE I

	J-A-S	O-N-D	J-F-M	A-M-J	TOTALS
Hours of Operation	109	85	110	150	454
Megawatt Hours	86	73	102	135	396
No. of Irradiations	34	30	47	59	170
No. of Samples Irradiated	2015	1665	801	1351	4832
No. Pulses > \$1.00	0	7	2	2	11

The cumulative energy output since criticality of the TRIGA core since 1967 is 759 Megawatt Days, The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 493 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.

TABLE II
Inadvertent SCRAMS

DATE	CAUSE
10/16/95	Loss of building/site power.
11/18/95	Log Power Channel Loss of H.V. - No other indication. Possible line power fluctuations due to high winds.
11/14/95	Loss on Control Console Power. - Power CB inadvertently cycled.
01/03/96	Seismometer bumped by worker in Control Room.
04/18/96	Loss of building/site power.
04/18/96	No Indication - Possible power line transients.

D. Major Maintenance

09/19/95: Pulse Rod mechanism support plate penetration opening enlarged to allow removal of drive without disassembly of lower limit switches.

All other major maintenance performed was routine planned maintenance items.

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

There were two items performed and documented under 10 CFR 50.59 criteria during the reporting period:

11/16/95. Approval to install a remote Reactor Manual SCRAM button in the Beam Port Room (Rm.2).(Related to the BNCP project).

12/14/95: Replacement mechanical pulse rod air low air pressure alarm with combination digital air pressure display/low pressure alarm unit mounted in Reactor Console.

F. Radioactive Effluent Discharges

1. Radioactive Liquid Releases

A total of 1.81 microcuries was released in 224,748 liters of liquid during the reporting period. The releases are listed in Table III.

TABLE III
Radioactive Liquid Releases

Date	Quantity uCi/ml	Tank Release Vol, Liters	Tank Release Vol., Liters	Time ⁽¹⁾ Hrs.	Sewer Conc uCi/ml	% ⁽²⁾ MPC
07/24/95	0.81	9.69×10^{-9}	83,799	5.0	6.31×10^{-10}	3.2
09/28/95	0.27	1.43×10^{-8}	10,615	2.5	4.18×10^{-10}	2.1
11/15/95	0.04	2.16×10^{-9}	18,804	2.0	8.02×10^{-11}	0.4
12/14/95	0.12	6.45×10^{-9}	18,333	2.0	2.41×10^{-10}	1.2
02/03/96	0.16	8.69×10^{-10}	19,059	2.0	3.21×10^{-10}	1.6
03/04/96	0.17	8.87×10^{-10}	18,946	2.0	2.41×10^{-10}	0.7
05/28/96	0.24	1.30×10^{-8}	18,691	2.0	4.81×10^{-10}	2.4

⁽¹⁾ Time of 2 hours is used if release time is not measured. Average release time is 4-6 hours.

⁽²⁾ Based on a release limit of 2.0×10^{-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 4.03 Curies of Argon-41 was released in 5.86×10^{13} cc of air, which yields an average monthly concentration of Argon-41 of 6.88×10^{-8} uCi/cc. The monthly releases are summarized in Table IV.

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TABLE IV
 Monthly Argon-41 Releases

Month	Conc. Before Dilution, uCi/ml	% Release Limit ⁽¹⁾ Before Dilution	% DAC Limit ⁽²⁾ Before Dilution	Quantity mCi
Jul.(1995)	7.84×10^{-8}	3.14	0.01	392
Aug.	6.58×10^{-8}	2.6	0.01	329
Sep.	4.17×10^{-8}	1.6	0.01	204
Oct.	6.96×10^{-8}	2.78	0.01	208
Nov.	7.20×10^{-8}	2.8	0.01	352
Dec.	4.91×10^{-8}	1.96	0.01	245
Jan.(1996)	5.63×10^{-8}	2.25	0.01	281
Feb.	5.73×10^{-8}	2.2	0.01	259
Mar.	5.50×10^{-7}	2.20	0.01	286
Apr.	1.66×10^{-8}	6.64	0.02	812
May	7.18×10^{-8}	2.87	0.02	351
Jun.	6.44×10^{-8}	2.58	0.01	315

(1) Based on 10 CFR 20 effluent release limit of 1.0×10^{-8} uCi/ml for ^{41}Ar (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 ^{41}Ar (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 waste was transferred to the Campus Radiation Safety Office for packaging and disposal:

1. Twenty four (24) cubic feet (29 boxes) of non-compacted solid waste for a total of 0.042 milliCuries of activity.
2. One (1) 55 gallon drum of compacted, dewatered ion exchanger spent resin containing 0.002 milliCuries of activity.

G. Personnel and Visitor Radiation Exposures

The average quarterly exposures of Nuclear Radiation Center reactor staff and experimenters who routinely utilize the W.S.U. reactor are given in Table V. The maximum quarterly exposure of a reactor staff member was 20 millirem, whole body.

A total of 2208 non-Nuclear Radiation Center staff or routine facility user individuals visited the Center during the reporting period, out of which 978 enter Restricted Areas. As determined by digital pocket dosimeter and an exposure recorded, the average individual exposure was <1.0 millirem.

A total of 19 group tours, consisting of 206 individuals, visited the Center during the reporting period. As determined by digital pocket dosimeter and an exposure recorded, the average group exposure was <1.0 millirem.

TABLE V
Average Quarterly Reactor and Experimenter Exppsure
(in millirem)

Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun ⁽¹⁾
10	10	20	10

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

Note: 10 mR minimum exposure reported by vendor.

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 0.2 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 0.015 mR/Hr. The average dose in the radiochemistry sample hoods was 0.08 mR/Hr. The highest average on site dose level was 8.0 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 3.6×10^{-7} uCi/cm², while the average level in the reactor vital areas was 6.32×10^{-7} uCi/cm². The highest average value in the reactor vital areas was 6.24×10^{-5} uCi/cm² 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 1.63×10^{-7} uCi/cm² which was in Room 201, the Reactor Room Floor. The average level of removable contamination in the radiochemistry sample hoods was 6.03×10^{-6} uCi/cm².

⁽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 Center⁽¹⁾
(Exposure in uR/Day)

Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun	Median
198	161	176	171	177
768 ⁽²⁾	703	793	767	740

⁽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. 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
Rad. Storage Shed	223	220	207	209	215
Rx Rm W. Secr. Gate	195	231	221	219	217
<u>Cooling Tower Fence</u>	205	198	256	233	223
<u>L. E. Loading Dock</u>	232	264	220	221	234
<u>Liquid Waste Tank</u>	214	165	195	209	196
Building Roof West	179	187	163	134	160
<u>Building W. Side</u>	232	209	233	133	202
Pool Room Exh. Vent	152	143	163	134	148
Pool Room W. Vent ⁽²⁾	330	297	407	378	353
Pool Room E. Vent	268	264	293	290	279
Building Roof East	214	154	152	134	164
<u>S. Bldg. Entrance</u>	214	231	213	244	226

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

(2) Pool Room West Vent. TLD on roof, directly above reactor core.

Underlined locations indicate areas that are readily accessible.

Technical Specifications 3.12(2) ALARA effluent releases 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 157 uR/day, while the average total radiation level at the closest extended occupied area 930 meters away was 170 uR/day. This yields a ratio of 8%, indicating no significant exposure level above natural background.