



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, 1994 to June 30, 1995.

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, 1994 to June 30, 1995

A. Narrative Summary of the Year's Operation

1. Operating Experience

The Washington State University Reactor has accumulated 371 Megawatt hours on Core 33-X hours during the reporting period. A total of 228 irradiations for a total of 6734 samples were performed. 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.

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
Fiscal Year Summary of Reactor Operations

	J-A-S	O-N-D	J-F-M	A-M-J	TOTALS
Hours of Operation	148	81	88	106	423
Megawatt Hours	126	69	80	96	371
No. of Irradiations	84	48	39	57	228
No. of Samples Irradiated	1764	1449	1347	2174	6734
No. Pulses > \$1.00	3	5	2	0	10

The cumulative energy output since criticality of the TRIGA core since 1967 is 742 Megawatt Days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 476 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 7 inadvertent SCRAMS are listed in Table II.

TABLE II
Inadvertent SCRAMS

DATE	CAUSE
09/23/94	Power Line Spike. No Indication.
12/05/94	High Voltage Failure SCRAM due to failure of sensing relay.
12/05/94	High Voltage Failure SCRAM due to defective voltage regulator tube in power supply.
12/15/94	SCRAM due to complete loss of building power.
/15/94	SCRAM due to loss of building power.
04/14/95	Period SCRAM due to circuit spike signal noise during start-up.
05/18/95	Period SCRAM due to line spike circuit noise during start-up.

D. Major Maintenance

07/01/94 Replacement of Compensated Ion Chamber #2 for Safety Power Level Channel #2.

All other 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 and was documented as such to ensure approval of the modification to satisfy Technical Specification requirement 6.5 and 6.6 for Quality Assurance criteria. On 06/22/94, the Log-N, Linear Power, and Fuel Temperature measuring channels strip chart recorders (3) were replaced with a single 3-channel, 3-pen strip chart recorder.

F. Radioactive Effluent Discharges

1. Radioactive Liquid Releases

A total of 141.75 microcuries was released in 661,482 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	Time ⁽¹⁾ Hrs	Sewer Conc, uCi/ml	% MPC
12/08/94	0.89	9.88×10^{-9}	89,803	2	1.58×10^{-9}	7.90 ⁽²⁾
01/11/95	3.69	4.10×10^{-8}	90,086	2	6.54×10^{-9}	32.70 ⁽²⁾
03/27/95	0.10	6.92×10^{-9}	14,282	2	2.05×10^{-10}	1.03 ⁽²⁾
04/25/95	137.07	2.93×10^{-7}	467,311	37.55	1.46×10^{-8}	0.005 ⁽³⁾

(1) A 2-hour discharge time 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.

(3) Isotopes determined to be ^3H , ^{14}C , and ^{35}S beta emitters. Discharge activity limit of 3.0×10^{-4} uCi/ml for ^{14}C is used.

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 4.08 Curies of Argon-41 was released in 5.86×10^{13} cc of air, which yields an average monthly concentration of Argon-41 of 6.96×10^{-8} uCi/cc. The monthly releases are summarized in Table IV.

TABLE V
Monthly Ar-41 Releases

Month	Conc. Before Dilution, uCi/ml	% Release Limit ⁽¹⁾ Before Dilution	% DAC Limit ⁽²⁾ Before Dilution	Quantity mCi
Jul.(1994)	1.25×10^{-7}	5.00	0.02	625
Aug	6.65×10^{-8}	2.66	0.01	332
Sep	5.73×10^{-8}	2.29	0.01	277
Oct	6.47×10^{-8}	2.59	0.01	323
Nov	5.75×10^{-8}	2.30	0.01	278
Dec	6.16×10^{-8}	2.46	0.01	308
Jan.(1995)	5.94×10^{-8}	2.38	0.01	293
Feb	5.61×10^{-8}	2.24	0.01	253
Mar	4.87×10^{-8}	1.95	0.01	243
Apr	8.10×10^{-8}	3.24	0.01	392
May	9.52×10^{-8}	3.81	0.01	476
Jun	5.77×10^{-8}	2.31	0.01	279

(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, 20 cubic feet of non-compacted solid waste for a total of 1.38 milliCuries and one (1) 55 gallon drum of compacted, dewatered ion exchanger spent resin containing 0.02 milliCuries of activity was transferred to the Campus Radiation Safety Office for disposal.

The transfer dates are given in Table V.

TABLE V
Radioactive Solid Waste Disposal Shipments

DATE	ACTIVITY in milliCuries	VOLUME in Cubic
09/12/94	0.015	7.5 compacted, dewatered spent resin.
09/26/94	1.38	20 non-compacted low level waste in 10 - 2 cuft boxes.

The Campus Radiation Safety Office transferred 5 shipments of radioactive solid waste offsite on the dates given below.

February 25, 1994
 July 7, 1994
 November 16, 1994
 February 1, 1995
 April 26, 1995

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 VI. The maximum quarterly exposure of one individual, who is a reactor staff member and who routinely prepares irradiated samples for shipment and calibrates radiation survey meters, was 30 millirem, whole body.

A total of 2405 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 28 group tours, consisting of 378 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 VI
 Average Quarterly Reactor and Experimenter Staff Exposure
 (in millirem)

Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun ⁽¹⁾
10	25	10	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 0.03 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.04 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 0.1 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 0.020 mR/Hr. The average dose in the radiochemistry sample hoods was 0.10 mR/Hr. The highest average on site dose level was 9.54 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 3.2×10^{-7} uCi/cm², while the average level in the reactor vital areas was 8.56×10^{-7} uCi/cm². The highest average value in the reactor vital areas was 4.55×10^{-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 2.20×10^{-7} uCi/cm² which was in Room 201, the Reactor Room Floor. The average level of removable contamination in the radiochemistry sample hoods was 8.43×10^{-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 thremoluminecent 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 VII. 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 VII
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
195	156	176	177	177
(2)714	727	789	729	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 VIII. No significant effect on the environmental radiation levels by reactor operation was noted.

TABLE VIII
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
<u>E. Loading Dock</u>	208	208	211	212	210
Rad. Storage Shed	234	291	324	224	268
Pool Rm Truck Door	377	300	254	259	298
<u>Cooling Tower Fence</u>	156	191	282	165	199
<u>Liquid Waste Tank</u>	208	173	197	200	195
Building Roof West	169	173	169	176	185
<u>Building W. Side</u>	208	209	225	212	214
Pool Room Exh. Vent	143	136	155	141	144
Pool Room W. Vent ⁽²⁾	351	283	352	376	341
Pool Room E. Vent	247	227	239	271	246
Building Roof East	143	155	155	153	152
<u>S. Bldg. Entrance</u>	208	169	200	200	194

(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 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 160 uR/day, while the average total radiation level at the closest extended occupied area 930 meters away was 168 uR/day. This yields a ratio of 5.0%, indicating no significant exposure level above natural background.