Annual Report on the Operation
of the Washington State University
TRIGA Reactor - Facility License R-76
For the Period July 1, 1979 to June 30, 1980

A. Narrative Summary of the Year's Operation

The W.S.U. TRIGA reactor has accumulated 655 megawatt hours during the reporting period. The quarterly operation summaries are shown in Table I.

Table I

Fiscal Year Summary of Reactor Operations

	JAS	OND	JFM	AMJ	TOTAL
Hours of Operation	255	137	138	136	666
Megawatt Hours	254	136	132	133	655
Number of Irradiations	292	120	224	217	853
Number of Samples Irradiated	4785	1558	724	1656	8723

In addition, fourteen pulses were performed. Five of these had $2.00 of reactivity inserted per pulse. The remainder had less than $2.00 of reactivity inserted per pulse. For the $2.00 pulses, the average peak power was 732 megawatts with an average peak fuel temperature of 350 °C.

The cumulative energy output since the initial criticality of the TRIGA core in 1967 is 409 megawatt days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 148 megawatt days since initial criticality.

B. Emergency Shutdowns and Inadvertent Scrams

No emergency shutdowns occurred during the reporting period.

The descriptions and/or causes of the seven inadvertent scrams which occurred during the reporting period are listed in Table II.

Table II

Inadvertent Scrams

Number	Description or Cause
1	Released Pulse rod with no indication
1	Released pulse rod and blades 1 and 4 with no indication
1	Released blade 1 with no indication
1	Loss of building power
1	Loss of console power
1	Seismometer activated with no apparent cause
1	Manual scram of pulse rod due to low (pulse) air pressure

C. Changes, Tests and Experiments Carried Out Under 10 CFR 50.59

Four items were evaluated under this category. They were the installation of a battery power supply for selected reactor instrumentation, removal of the reactor horns, addition of a back flush valve to the radioactive liquid waste discharge system and the installation of a drain valve and filters to the reactor pool water ion exchange system.

Under the present SAR none of the above items involved a change in the facility as described, a change in procedures as described or a test or experiment not described. Since a new SAR has been submitted, but not yet approved, the last two items were further evaluated and documented as though the new SAR were in effect. In both cases no changes were required in the Technical Specifications nor were there any unreviewed safety questions.

A brief summary of each change or modification is included below.

A battery backup power system was installed to provide emergency power for the reactor pool level monitor, the evacuation sirens and the radiation area monitoring systems. Since these systems will remain

energized at all times, increased protection results.

The reactor horns signaled that the console had been energized which usually implied that the reactor was commencing startup. With fire evacuation and reactor evacuation sirens, it was felt that the additional signal for a normal occurrence was unwarranted. The function of the horns was replaced by an announcement over the PA system that the reactor would be starting up. The change more accurately indicates the operating status of the reactor and should increase the sensitivity of building occupants to conditions which require immediate action, i.e., evacuation.

The addition of the back flushing valve to the radioactive liquid waste system allows for back flushing the submersible pump while it is in the holdup tank. On these occasions pumping efficiency can be restored without requiring entry down into the holdup tank to remove the pump for cleaning.

The drain valve installed on the resin tank in the reactor pool ion exchange system makes changing resin columns an easier and neater job. The filters were installed in order to extend the lifetime of each resin column.

D. Major Maintenance Operations

During February 1980 a replacement compensated ion chamber was installed on Safety Channel No. 2. This unit replaced an identical model which had failed and was returned to the manufacturer.

This was the only item in this category during the reporting period.

E. Radioactive Liquid Releases

During the reporting period the average monthly release concentration was 2.64×10^{-7} $\mu Ci/cm^3$. This yielded a total of 69.8 microcuries released in a total of 42,946 gallons of liquid effluent. The monthly releases are shown in Table III.

Table III

Radioactive Liquid Releases

	Quantity μCi	Concentration $\mu Ci/cm^3$	Percent* of MPC	Volume gallons
July	———	No release	———	———
August	0.343	0.190×10^{-7}	4.75	4768
September	0.692	0.388×10^{-7}	9.55	4711
October	0.523	0.277×10^{-7}	6.93	4987
November	———	No release	———	———
December	3.56	1.94×10^{-7}	49.3	4852
January	6.99	3.80×10^{-7}	95.0	4862
February	20.2	9.28×10^{-7}	0.09	5754
March	———	No release	———	———
April	17.2	9.15×10^{-7}	0.26	4968
May	———	No release	———	———
June	20.3	6.5×10^{-7}	0.16	8044

*Release limit for ^{60}Co used for February. April and June release limit calculated for mixture of ^{60}Co and ^{51}Cr. All other releases used release limit for unknown mixture.

For the February, April and June releases, gamma ray spectroscopy revealed that essentially all the activity was due to either ^{60}Co or ^{51}Cr and ^{60}Co. In each of these cases the appropriate release limit value was used to calculate the fraction of the MPC released. For the identified radionuclides, the total releases during the reporting period were 38.8 microcuries of ^{60}Co and 18.9 microcuries of ^{51}Cr.

F. Radioactive Gaseous Releases

No significant quantity of any gaseous or particulate radioactive material with a half-life greater than eight days was released during the reporting period.

The average monthly concentration of Argon-41 was 6.1×10^{-8} $\mu Ci/cm^3$. This yielded a total of 2.57 Ci released in 1.50×10^9 cubic feet of air. The monthly releases are summarized in Table IV.

Table IV

Monthly Argon-41 Releases

	Concentration before dilution $\mu Ci/Cm^3$	Percent of MPC after dilution	Quantity mCi
July	9.2×10^{-8}	0.61	326
August	7.3×10^{-8}	0.49	258
September	3.5×10^{-8}	0.23	124
October	7.1×10^{-8}	0.47	251
November	6.4×10^{-8}	0.43	227
December	0.6×10^{-8}	0.04	21
January	8.0×10^{-8}	0.53	283
February	6.6×10^{-8}	0.44	234
March	5.4×10^{-8}	0.36	191
April	6.1×10^{-8}	0.41	216
May	7.8×10^{-8}	0.52	276
June	4.7×10^{-8}	0.31	166

G. Radioactive Solid Waste Disposal

Two shipments of solid waste were made to the Nuclear Engineering Company of Richland, Washington for disposal. A total of 0.728 Ci in a total volume of 278.5 cubic feet were packaged in 55 gallon drums for shipment. The majority of the radioactive waste was generated by campus facilities other than the Reactor and Nuclear Radiation Center. The shipments are tabulated below in Table V.

Table V

W.S.U. Solid Radioactive Waste Disposal

Date	Volume in Cubic Feet	Activity in Curies
9-12-79	105.0	0.181
6-20-80	173.5	0.547

H. Personnel and Visitor Radiation Exposures

The quarterly exposures of the reactor operating personnel are shown in Table VI below. A total of 966 persons visited the Center on tours. As determined from pocket dosimeters, the average individual exposure was 2.6 millirem with a maximum reading of 10 millirem.

Table VI

Reactor Personnel Exposures
(exposures in millirems, tabulated by quarters)

Name	J	JAS	OND	JFM	A*	Lifetime Exposure at beginning of year
Hawley	0	0	15	0	0	200
Neidiger	0	10	0	25	0	1593
Rosenberg	0	10	0	0	-	3732
Sikorski	0	0	0	0	0	3900
Wilson	0	0	0	0	0	3715

*May and June data to be provided when obtained

I. Reactor Facility Radiation Levels

The routine surveys of radiation levels in reactor operating areas indicate an average radiation level of 0.32 mRem/hr. The highest (average) level was 2.1 mRem/hr which occurred in the locked radiation source storage area. The lowest (average) level, 0.02 mRem/hr, was found in the reactor control rooms.

Routine surveys for removable contamination in reactor operating areas indicate an average value of 4.0×10^{-5} μCi/100 cm^2. The lowest (average) value of 5.5×10^{-6} μCi/100 cm^2 was found in the reactor control rooms. The highest (average) value, 1.9×10^{-4} μCi/100 cm^2, occurred on the platform where experimenters stand to insert or retrieve samples from the reactor.

The survey results indicate that radiation levels and amounts of removable contamination are very low and present no hazards to personnel or visitors.

J. Environmental Monitoring Programs

Initiated in 1974, the environmental monitoring program uses thermoluminescent dosimeters (TLD's) for locations in and around the reactor facility. The water samples taken in the vicinity of Washington State University are analyzed for gross beta-gamma activity.

The quarterly exposures near the Nuclear Radiation Center are listed in Table VII. No significant variation from past years' data is observed with the values from this year.

Table VII

Environmental Radiation Levels in the Vicinity of the W.S.U. Nuclear Reactor for 1979-80 Fiscal Year*

(exposure rates in μR/day)

JAS	OND	JFM	AMJ	Yearly Median
240	204	155	187	196

*From sampling stations located within 50-500 meters of the Nuclear Radiation Center

Quarterly exposure rates at readily accessible locations at the reactor facility are listed in Table VIII. As indicated by the results, there is no significant effect on the environmental radiation levels by reactor operation.

Table VIII

Exposure Rates Above Ambient Background per Megawatt Hour of Reactor Operation

(exposure rates in μR/MWH)

Location	JAS	OND	JFM	AMJ	Median
Entrance	8	38	72	47	42
Lower Loading Dock	20	15	11	40	18
Storage Shed	0	23	26	9	16
Pool Room Door	39	106	87	92	90
North Side of Bldg.	0	8	11	17	10
Beam Room Door	0	45	34	32	33

The gross beta-gamma activity of the water samples taken from locations in the vicinity of Washington State University are shown in Table IX. The results indicate that there are no effects correlated with the operation of the W.S.U. Nuclear Reactor.

Table IX

Water Sample Activities for 1979-80 Fiscal Year

Location	Number of Samples	Average Specific Activity, pCi/liter	Range of Values pCi/liter
Pullman Sewage Effluent	11	2.0	0.03 - 10.0
South Fork of Palouse River	11	1.3	0 - 7.3
Palouse River at Colfax	9	0.51	0 - 1.5
Snake River	9	0.80	0 - 3.0
Tap Water	9	1.9	0.27 - 6.2