

August 22, 2007

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 Technical Specifications for Facility License R-76 and the provisions of 10 CFR 50.59, paragraph (6), the attached Annual Report prepared by C. Corey Hines, Acting Reactor Supervisor of the WSU Facility, is hereby submitted. The report covers the period July 1, 2007 to June 30, 2008.

Sincerely,

Donald Wall

Donald Wall
Director

Enclosure

cc: C.C. Hines

**ANNUAL REPORT ON THE OPERATION OF THE
WASHINGTON STATE UNIVERSITY NUCLEAR RADIATION CENTER
TRIGA REACTOR**

Facility License R-76 for the Reporting Period of
July 1, 2007 to June 30, 2008

A. Narrative Summary of the Year's Operation

I. Operating Experience

The Washington State University Reactor has accumulated 1020.20 Megawatt hours on core 34-A during the reporting period. A total of 430 samples were irradiated, for a total of 11,786 user-hours. In addition, 26 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.

Two major upgrades to the facility were performed during the reporting period. The Area Radiation Monitoring System and Conductivity System were replaced under two 10 CFR 50.59 changes as approved by the WSU Reactor Safeguards Committee. All changes were performed according to appropriate procedures.

III. All surveillance tests and requirements were performed and completed within the prescribed time period.

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	195.22	348.38	288.87	324.62	1157.09
Megawatt Hours	183.44	327.42	270.99	238.35	1020.20
No of Sample Irradiations ¹	24	17	19	19	79
No. of Samples	248	107	42	35	432
No. of Iridium Cans Irradiated	16	25	27	26	94
No. of Silicon Containers Irradiated	7	6	7	2	22
User Hours	2340	3028	3815	2603	11786
No. Pulses > \$1.00	1	3	2	20	26

¹ This table has been modified for clarity. Numbers of Samples and Sample Irradiations do not include iridium and silicon data. Those data are listed in individual format. User hours denotes the total user hours, including iridium and silicon.

The cumulative energy output since criticality of the TRIGA core (1967) is 1215.5 Megawatt Days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 949.5 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 15 inadvertent SCRAMS are listed in Table II. No SCRAMS were due to a violation of the Limiting Safety Systems Set points.

Table II
Inadvertent SCRAMS

7/26/07	Operator manually selected linear channel scale to low, forcing scram.
12/03/07	Operator placed mode switch into "test" instead of "rundown".
12/05/07	Operator manually selected linear channel scale to low, forcing scram.
12/05/07	Operator manually selected linear channel scale to low, forcing scram.
12/10/07	Operator placed mode switch into "test" instead of "rundown".
1/24/08	Raise button stuck during blade manipulation at 1 MW, causing Pulse High Power scram. No limits exceeded.
2/07/08	Loss of building power.
2/07/08	Loss of building power.
2/07/08	Loss of building power.
2/07/08	Loss of building power.
2/14/07	Operator placed mode switch into "test" instead of "rundown".
3/27/08	Loss of building power.
3/27/08	Loss of building power.
3/27/08	Loss of building power.
4/09/08	Operator bumped period switch at 1 MW, initiating scram. No limits exceeded.

D. Major Maintenance

All routine planned maintenance items were completed within the reporting period. Two major upgrades were completed during this reporting period; the replacement of the analog area radiation monitors and the direct replacement of the pool water conductivity monitoring system.

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

The area radiation monitors and the pool water conductivity monitoring system were upgraded in March and May 2008, respectively. Approval for this change has been approved by the Reactor Safeguards Committee on July 21, 2008. The notice of the change has been submitted to the U.S. NRC. All upgrades were made in accordance with applicable procedures.

F. Radioactive Effluent Discharges

I. Radioactive Liquid Releases

A total of 0.12 μCi was released in 4534 gallons of liquid during the reporting period, as determined by calibrated HPGe detectors and associated software. A breakdown of the liquid releases is shown in Table III.

Table III
Radioactive Liquid Releases

Date	Volume Released (cu. feet)	Volume Released (gallons)	Activity (μCi)
5/19/08	606.8	4534	0.12

II. Radioactive Gaseous Release

During the reporting period, no significant quantity of gaseous or particulate material with a half-life greater than eight days was released. At no time did the argon-41 release exceed 20% of the effluent release limit. A total of 6.02 curies of argon-41 was released, with an average concentration of argon-41 of $9.12 \times 10^{-8} \mu\text{Ci/mL}$ of air, before dilution. The monthly releases are summarized in Table IV on Page 3.

Table IV
Monthly Argon-41 Releases

Month	Conc. Before Dilution, $\mu\text{Ci/mL}$	% Release Limit Before Dilution ¹	% DAC Limit Before Dilution ²	Quantity mCi^3
July 2007	2.26E-08	0.90	0.0031	124
August	1.51E-07	6.06	0.0202	833
September	9.81E-08	3.92	0.0131	540
October	9.81E-08	3.92	0.0131	540
November	1.07E-07	4.26	0.0142	586
December	9.43E-08	3.77	0.0126	519
January 2008	8.29E-08	3.31	0.0110	456
February	1.20E-07	4.81	0.0160	661
March	7.13E-08	2.85	0.0095	393
April	8.88E-08	3.55	0.0118	489
May	8.54E-08	3.42	0.0114	470
June	7.48E-08	2.99	0.0100	412

¹ Based on 10 CFR 20 effluent release limit of $1.0 \times 10^{-8} \text{ uCi/mL}$ for Ar-41 (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 $2.5 \times 10^{-6} \text{ uCi/cc}$. (20% of limit is $5.0 \times 10^{-7} \text{ uCi/mL}$).

² Based on 10 CFR 20 DAC limit of $3.0 \times 10^{-6} \text{ uCi/mL}$ for Ar-41 (Table 1, Col. 3) and a dilution factor of 4.0×10^{-3} for a before dilution DAC limit of $7.5 \times 10^{-4} \text{ uCi/mL}$.

³ Based on 4500 CFM effluent of ventilation system in AUTO mode of operation, total flow through effluent is $5.504 \times 10^{12} \text{ mL/month}$.

III. Radioactive Solid Waste Disposal

During the reporting period, the following solid waste was transferred to the WSU Radiation Safety Office for packaging and disposal:

- 0.11 millicuries in 42.68 cubic feet 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 4. The maximum quarterly exposure of a reactor staff member was 85 millirem, whole body.

A total of 3428 individual persons visited the Nuclear Radiation Center during the reporting period, of which 1336 entered a Restricted Area. All exposures as determined by digital pocket dosimeter were less than or equal to 1 millirem.

A total of 47 group tours, consisting of 945 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)¹

Badge No.	Jul-Aug-Sep 2007	Oct-Nov-Dec 2007	Jan-Feb-Mar 2008	Apr-May-June ² 2008
6296	18	77	37	6
7748	-	3	13	-
3504	-	-	11	-
7805	-	6	14	-
7588	1	49	61	15
7854	18	63	15	10
8141	- ³	3	85	29
7528	5	8	11	8

¹ The “-” denotes a dosimeter reading that is less than or equal to the background radiation level for that quarter.

² Data for the month of June was not received at the time of submittal.

³ Start date for employment was 11-17-07.

H. Reactor Facility Radiation and Contamination Levels

The routine area radiation surveys of the building in non-controlled access areas¹ (non-CAAs) had an average dose rate level of 0.55 mR/h, while controlled access areas had an average dose rate level of 0.89 mR/h. The highest average dose rate level in a CAA was 6.65 mR/h, which occurred in Room 2 East, behind a shielded storage area. The lowest average dose rate in a

¹ A non-controlled access 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.

CAA was 0.04 mR/h, which occurred in Room 201B, the Reactor Shop area. The average dose rate in the radiochemistry sample hoods (a non-CAA) was 1.95 mR/h. The highest average on site dose rate was 20 mR/h, which occurred in Room 2 East. This area is accessible only through a locked room, and is not accessible to the public.

Routine building surveys for removable contamination in non-controlled access areas had an average level of $3.95 \times 10^{-8} \mu\text{Ci}/\text{cm}^2$, while the average level in a CAA was $3.00 \times 10^{-8} \mu\text{Ci}/\text{cm}^2$. The highest average value in the CAAs was $4.93 \times 10^{-8} \mu\text{Ci}/\text{cm}^2$ which was located in the Pump Room for the Ion Exchange System, Room 101A. The lowest average value in the CAAs was $2.29 \times 10^{-8} \mu\text{Ci}/\text{cm}^2$ which was in Room 201 on the south side of the Reactor Pool Room. The average level of removable contamination in the radiochemistry hoods was $4.20 \times 10^{-8} \mu\text{Ci}/\text{cm}^2$.

I. Environmental Monitoring Program

The environmental monitoring program uses thermoluminescent dosimeters (TLD's) at locations both near and at distances around the reactor facility building. 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) are 0.243 mRem/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.

A large decorative granite structure, located in the center of the WSU campus, has been monitored for comparison to the dose rate values obtained in the environmental surveys for the areas that are in the vicinity of the Nuclear Radiation Center. The dose rate level values for the areas located greater than 25 meters of the WSUNRC, when compared to the central campus dose rate values, show no appreciable increase in ambient dose rate levels due to reactor operation.

Table VI
Environmental Radiation Levels in the Vicinity of the Nuclear Radiation Center¹
(Exposure in mRem/day)

Jul-Aug-Sep 2007	Oct-Nov-Dec 2007	Jan-Feb-Mar 2008	Apr-May-Jun 2008	Average
0.398	0.476	0.296	0.375	0.386
0.352 ²	0.481 ²	0.286 ²	0.356 ²	0.369 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 measured doses at locations adjacent to 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 Center¹
(Exposure in mRem/day)

Location	Jul-Aug-Sep 2007	Oct-Nov-Dec 2007	Jan-Feb-Mar 2008	Apr-May-Jun 2008	Average
East Loading Dock ²	0.333	0.442	0.297	0.333	0.351
Rad. Storage Shed	0.524	0.701	0.571	0.655	0.613
Reactor Room East Security Gate	0.333	0.468	0.297	0.345	0.361
Cooling Tower Fence	0.486	0.571	0.319	0.391	0.442
Liquid Waste Tank	0.400	0.442	0.297	0.368	0.377
Building Roof West		0.922	0.582		0.752
Building West Side	0.381	0.429	0.286	0.356	0.363
Reactor Room Exhaust Vent	0.381	0.455	0.297	0.345	0.369
Reactor Room West Vent ³	0.438	0.519	0.352	0.437	0.437
Pool Room East Vent	0.371	0.442	0.264	0.264	0.335
Building Roof East	0.381	0.429	0.286	0.379	0.369
South Bldg. Entrance	0.371	0.455	0.286	0.356	0.367

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

² Bold print locations indicate areas that are readily accessible by the public.

³ Pool Room West Vent. TLD on roof, directly above the reactor core.

* Note: Blank cells indicate that the dosimeter was missing for that time period.

Technical Specifications describing ALARA effluent releases in 3.12(2) specify annual radiation exposure due to reactor operation, at the closest off-site extended occupancy, shall not, on an annual basis, exceed the average local off-site background radiation by more than 20%. For the reporting period, the average total background radiation dose rate level for sampling points 25 meters or greater from the facility was 0.386 mR/day, while the average total radiation dose rate level at the closest extended occupied area 930 meters away was 0.376 mR/day, indicating no significant exposure level above natural background radiation.