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Nuclear Radiation Center

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August 29, 2001

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

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 Stephanie L. Sharp, Reactor Supervisor of the WSU facility, is hereby submitted. The report covers the period July 1, 2000to June 30, 2001

Sincerely,

Gerald E. Tripard
Director

GET/pw

Enclosure

cc: S.L. Sharp
American Nuclear Insurers
U.S. NRC, Document Control Desk

A020

ANNUAL REPORT ON THE OPERATION OF THE WASHINGTON STATE UNIVERSITY TRIGA REACTOR

Facility License R-76 for the Reporting Period of
July 1, 2000 to June 30, 2001

A. Narrative Summary of the Year's Operation

I. Operating Experience

The Washington State University Reactor has accumulated 1085 Megawatt hours on Core 33-X hours during the reporting period. A total of 669 irradiations for a total of 2684 samples were performed. In addition, 7 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	271.93	260.65	315.2	290.83	1138.61
Megawatt Hours	245.01	249.72	306	279.76	1085.20
No. of Irradiations	145	148	180	196	669
No. of Samples Irradiated	652	684	657	691	2684
No. Pulses > $1.00	0	3	0	4	7

The cumulative energy output since criticality of the TRIGA core since 1967 is 877 Megawatt Days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 611 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
7/12/00	High Power SCRAM. Raise Button Stuck in W/D Position. Max Power Calculated to be 121.4%.
7/23/00	High Power SCRAM. Raise Button Stuck in W/D Position. Switch filed down, cleaned and lubricated before re-start.
7/25/00	High Power SCRAM caused by jarring of console. No safety setting exceeded.
9/27/00	Short Period at 100% power. No other indication. No safety setting exceeded.
10/4/00	Short Period at 100% power. No other indication. No safety setting exceeded.
11/28/00	Short Period approaching 100% power. No other indication.
1/11/01	Short Period approaching 100% power. No other indication. Apparent voltage spike in Log-N channel.
3/5/01	Pulse rod, and Blades 1 and 4 SCRAMmed. Believed due to a power fluctuation. No other indication, no safety setting exceeded.

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

During this reporting period, several small changes to the facility have occurred. First of all, the BNCT facility controls have been partially installed to the requirements of our BNCT technical specifications. These included adding SCRAM buttons to both the interior and exterior of the treatment facility, adding door and key SCRAMs to the facility, as well as installing closed-circuit cameras in the beam areas. The facility collimator is now mostly complete, with lead and bismuth shielding installed in the beam, and four inches of lead placed on the roof of the treatment facility. In the coming year, a cone-shaped bismuth shield/collimator will be installed at the face of the epithermal column, with borated polyethylene surrounding it. The final step will be to cover the facility walls with neutron absorbing material.

One change has been made to the reactor pool. A 2" Aluminum plate was installed on the pool-side of the epithermal column, to replace a water gap between the core and the BNCT facility. It was estimated to have only a $0.50 reactivity worth with the reactor against the thermal column and in an optimal fuel configuration. Therefore, this installation was classified as an experiment and approved by the reactor safeguards committee.

F. Radioactive Effluent Discharges

1. 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 µCi	Release Concen. µCi /ml	Release Volume Liters	WSU Sewer Volume Liters	Total Dilute Volume Liters	Sewer Concen. µCi/ml	% MPC
8/30/00	0.0181	9.67e-10	660.2	480,000	480660.2	3.77e-11	0.19[1]
4/12/01	8.9564	4.76e-07	663.8	480,000	480663.8	1.8633e-8	93.2[1,2]

[1] Based on a release limit of $2.0x10^{-08}$ µCi /ml for unknown mixture, 10 CFR 20, Table 3.
[2] This release was analyzed using the GeLi system with a 500 mL marinelli beaker of discharge sample. The isotopes,
their respective concentrations, and %MPC for that nuclide are as follows:
Sc-46 1.74e-9 µCi /ml 0.002%, Mn-54 9.61e-8 µCi /ml 0.03%, Co-57 1.11e-7 µCi /ml 0.02%
Co-58 1.15e-2 µCi /ml 0.004%, Co-60 6.76e-9 µCi /ml 0.02%, Sb-124 4.76e-7 µCi /ml 0.68%

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 6.76 Curies of Argon-41 was released in $6x10^{13}$ cc of air, which yields an average monthly concentration of Argon-41 of $1.13x10^{-07}$ µCi /cc. The monthly releases are summarized in Table IV.

TABLE IV
Monthly Argon-41 Releases

Month	Conc. Before Dilution, µCi /ml	% Release Limit (1) Before Dilution	% DAC Limit (2) Before Dilution	Quantity mCi
Jul. (2000)	9.36e-8	3.74	0.0125	468
Aug.	1.07e-7	4.28	0.0143	535
Sep.	1.06e-7	4.24	0.0141	530
Oct.	1.39e-7	5.48	0.0185	695
Nov.	9.09e-8	3.64	0.0121	455
Dec.	9.66e-8	3.86	0.0129	483
Jan. (2001)	1.02e-7	4.08	0.0136	510
Feb.	1.01e-7	4.04	0.0135	505
Mar.	1.24e-7	4.96	0.0165	620
Apr.	1.33e-7	5.32	0.0177	665
May.	1.11e-7	4.44	0.0148	555
Jun.	1.47e-7	5.88	0.0196	735

(1) Based on 10 CFR 20 effluent release limit of 1.0×10^{-8} μCi /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} μCi/cc. (20% of limit is 5.0×10^{-7} μCi/ml).

(2) Based on 10 CFR 20 DAC limit of 3.0×10^{-6} μCi/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} μCi /ml.

3. Radioactive Solid Waste Disposal

During the reporting period, 70 cubic feet of non-compacted solid waste for a total of 0.34 millicuries of activity was transferred to the Campus Radiation Safety Office for packaging and disposal.

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 59 millirem, whole body.

A total of 1877 non-Nuclear Radiation Center staff or routine facility user individuals visited the Center during the reporting period, out of which 416 enter Restricted Areas. As determined by digital pocket dosimeter and an exposure recorded, the average individual exposure was <1.0 millirem.

A total of 34 group tours, consisting of 473 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
Quarterly Reactor and Experimenter Staff Exposure
(in millirem)

Badge No.	Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun
1	59	20	26	9
2	39	5	37	8
3	18	7	19	2
4	0	1	0	1
5	2	1	1	0

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 0.35 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.35 mR/Hr, as well. This figure does not include the pump and ion exchanger pits, or the storage caves. The highest average dose level in a routinely accessible reactor vital area was 0.77 mR/Hr., which occurred in Room 201, Reactor Pool Room, at the experimental benches. This reading is due to a source storage cask located on the bench. 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 0.51 mR/Hr. The highest average on site dose level was 15.45 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 5.40×10^{-06} $\mu Ci/100cm^2$, while the average level in the reactor vital areas was 2.10×10^{-05} $\mu Ci/100cm^2$. The highest average value in the reactor vital areas was 1.20×10^{-04} $\mu Ci/100cm^2$, 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 2.91×10^{-06} $\mu Ci/100cm^2$, which was in Room 2A, the source cave floor. The average level of removable contamination in the radiochemistry sample hoods was 9.10×10^{-05} $\mu Ci/100cm^2$.

(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 thermoluminecent 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 μRem/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 μRem /day)

Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun*	Average
161 (1)	126	179	143	152
661 (2)	652	Dosimeter missing	1000	667

(1) For sampling stations located 25 meters or greater from the Nuclear Radiation Center. Located in Excel File: Environmental Dosimeter Evaluation for the specified quarter.
(2) TLD attached to "Decorative" granite display on Compton Union Building Mall approximately 1300 meters from the Nuclear Radiation Center.
* Apr-May-Jun TLD's exposures not available at the time report was prepared. These are A-M-J 2000 results.

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 μR/day)

Location	Jul-Aug-Sep	Oct-Nov-Dec	Jan-Feb-Mar	Apr-May-Jun*	Average
E. Loading Dock (#2)	135	127	154	119	134
Rad. Storage Shed (#3)	157	220	333	165	219
Rx Rm W. Secr. Gate (#4)	247	212	269	340	267
Cooling Tower Fence (#5)	Missing	314	513	156	327
Liquid Waste Tank (#6)	169	153	167	156	161
Building Roof West (#7)	146	136	205	147	158
Fence S. Side (#8)	180	144	154	147	156
Building W. Side (#9)	180	161	192	165	175
Pool Rm Exh. Vent (#10)	124	110	167	101	125
Pool Room W. Vent (#11)	584	492	872	697	661 (2)
Pool Room E. Vent (#12)	370	331	551	431	421
Building Roof East (#37)	101	127	154	110	123
S. Bldg. Entrance (#40)	202	186	244	193	206

(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.

* Apr-May-Jun TLD's exposures not available at the time report was prepared. These are A-M-J 2000 results.

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 136 μR /day, while the average total radiation level at the closest extended occupied area 930 meters away was 152 μR /day. This yields a ratio of 11.8%, indicating no significant exposure level above natural background.