



Washington State University

Nuclear Radiation Center

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August 19, 1991

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, 1990 to June 30, 1991.

Sincerely,

*Gerald E. Tripard*

Gerald E. Tripard  
Director

Enclosure

cc: NRC, Region V, Office of Regional Administrator  
J.A. Neidiger  
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, 1990 to June 30, 1991

A. Narrative Summary of the Year's Operation

1. Operating Experience

The Washington State University Reactor has accumulated 356 Megawatt hours on Core 32-A during the reporting period. A total of 342 irradiations for a total of 4568 samples were performed. In addition, 4 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 and were within expected values.

B. Energy and Cumulative Output

The quarterly operations summaries are given in Table I below.

TABLE I  
Fiscal Year Summary of Reactor Operations

|                           | J-A-S | O-N-D | J-F-M | A-M-J | TOTALS |
|---------------------------|-------|-------|-------|-------|--------|
| Hours of Operation        | 101   | 85    | 94    | 96    | 376    |
| Megawatt Hours            | 94    | 84    | 94    | 84    | 356    |
| No. of Irradiations       | 95    | 91    | 92    | 64    | 342    |
| No. of Samples Irradiated | 1336  | 1286  | 1031  | 915   | 4568   |
| No. Pulses > \$1.00       | 0     | 1     | 0     | 3     | 4      |

The cumulative energy output since criticality of the TRIGA core since 1967 is 661 Megawatt Days. The mixed core of FLIP and Standard fuels installed in 1976 has accumulated 400 Megawatt Days.

C. Emergency Shutdowns and Inadvertent Scrams

There were no SCRAMS and no emergency shutdowns that occurred during the reporting period.

D. Major Maintenance

09/07/90 Replaced the 1 1/2 inch water inlet meter and the 2 inch discharge water meter on the liquid waste collection system.

All other major maintenance performed was routine planned maintenance items.

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

There were no changes, tests or experiments performed under 10 CFR 50.59 criteria during the reporting period.

F. Radioactive Effluent Discharges

1. Radioactive Liquid Releases

A total of 3.55 microcuries was released in 407,946 liters of liquid during the reporting period. This yields an average release concentration of liquid waste of  $8.70 \times 10^{-9}$  microcuries per milliliter. The monthly releases are listed in Table II below.

TABLE II  
Radioactive Liquid Releases

| Month       | Quantity,<br>uCi | Concentration,<br>uCi/ml | Percent MPC <sup>1</sup> | Volume,<br>Liters |
|-------------|------------------|--------------------------|--------------------------|-------------------|
| Jul. (1990) | 0.77             | $4.25 \times 10^{-8}$    | 42.5                     | 18,189            |
| Aug.        | 0.26             | $1.43 \times 10^{-8}$    | 14.3                     | 18,189            |
| Sep.        | 0.53             | $5.08 \times 10^{-9}$    | 5.1                      | 104,147           |
| Oct.        | NO RELEASE       |                          |                          |                   |
| Nov.        | 0.04             | $3.85 \times 10^{-9}$    | 3.9                      | 9775              |
| Dec.        | 0.34             | $9.03 \times 10^{-9}$    | 9.0                      | 37,533            |
| Jan. (1991) | NO RELEASE       |                          |                          |                   |
| Feb.        | 0.25             | $6.82 \times 10^{-9}$    | 6.8                      | 36,848            |
| Mar.        | 0.88             | $8.08 \times 10^{-9}$    | 8.1                      | 109,319           |
| Apr.        | 0.24             | $6.58 \times 10^{-9}$    | 6.6                      | 36,919            |
| May.        | 0.11             | $5.91 \times 10^{-9}$    | 5.9                      | 18,495            |
| Jun.        | 0.13             | $6.90 \times 10^{-9}$    | 6.9                      | 18,532            |

<sup>1</sup> Based on a release limit of  $1.00 \times 10^{-7}$  uCi/ml for unknown mixture found in Technical Specifications 6.10, paragraph 5, page 36.

## 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 release exceed 20% of MPC for Argon-41.

A total of 3.99 Curies of Argon-41 was released in  $6.70 \times 10^{13}$  cc of air, which yields an average monthly concentration of Argon-41 of  $5.96 \times 10^{-8}$  uCi/cc. The monthly releases are summarized in Table III below.

TABLE III  
Monthly Argon-41 Releases

| Month       | Concentration Before<br>Dilution, uCi/cc | Percent MPC <sup>1</sup><br>After Dilution | Quantity<br>mCi |
|-------------|--|--|-----------------|
| Jul. (1990) | $6.73 \times 10^{-8}$                    | 0.67                                       | 382             |
| Aug.        | $4.19 \times 10^{-8}$                    | 0.42                                       | 238             |
| Sep.        | $1.12 \times 10^{-7}$                    | 1.12                                       | 614             |
| Oct.        | $7.69 \times 10^{-8}$                    | 0.77                                       | 436             |
| Nov.        | $4.06 \times 10^{-8}$                    | 0.41                                       | 223             |
| Dec.        | $5.05 \times 10^{-8}$                    | 0.51                                       | 268             |
| Jan. (1991) | $4.35 \times 10^{-8}$                    | 0.44                                       | 247             |
| Feb.        | $6.71 \times 10^{-8}$                    | 0.67                                       | 344             |
| Mar.        | $5.98 \times 10^{-8}$                    | 0.60                                       | 339             |
| Apr.        | $5.01 \times 10^{-8}$                    | 0.50                                       | 275             |
| May         | $7.10 \times 10^{-8}$                    | 0.71                                       | 403             |
| Jun.        | $3.99 \times 10^{-8}$                    | 0.40                                       | 219             |

<sup>1</sup> Based on 10 CFR 20 limit of  $4.0 \times 10^{-8}$  uCi/cc (Table II, Col. I), and dilution factor of  $4.0 \times 10^{-3}$  (S.A.R. 6.4.2) for an after dilution limit of  $1.0 \times 10^{-5}$  uCi/cc. (20% of limit is  $2.0 \times 10^{-6}$  uCi/cc).

## 3. Radioactive Solid Waste Disposal

No solid waste generated by the Nuclear Radiation Center reactor was shipped off-site during the reporting period.

### 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 IV below. 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 1920 non-Nuclear Radiation Center staff or routine facility user individuals visited the Center during the reporting period, out of which 912 enter post-J Radiation Areas. As determined by digital pocket dosimeter and an exposure recorded, the average individual exposure was <0.1 millirem with a maximum exposure of 2 millirem.

A total of 30 group tours, consisting of 456 individuals, visited the Center during the reporting period. As determined by digital pocket dosimeter and an exposure recorded, the average group exposure was <0.1 millirem with a maximum of 0.1 millirem.

TABLE IV  
Average Quarterly Reactor and Experimenter Staff Exposure  
(in millirem)

| Jul-Aug-Sep | Oct-Nov-Dec | Jan-Feb-Mar | Apr-May-Jun <sup>1</sup> |
|-------------|-------------|-------------|--------------------------|
| 7.5         | 12.5        | 11.4        | 4.2                      |

<sup>1</sup> June's film badge results not available from the vendor at the time this report was prepared.

### H. Reactor Facility Radiation and Contamination Levels

The routine area radiation surveys of the building in non-reactor vital areas<sup>1</sup> had an average dose level of 0.02 mR/Hr., while routinely accessible reactor vital areas had an average dose level of 0.22 mR/Hr. The highest average dose level in a routinely accessible reactor vital area was 1.17 mR/Hr., which occurred in Room 201, North Pool Room. 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 0.04 mR/Hr. The average dose in the radiochemistry sample hoods was 0.05 mR/Hr. The highest average on site dose level was 82 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<sup>1</sup> had an average level of  $1.8 \times 10^{-6}$  uCi/100 cm<sup>2</sup>, while the average level in the reactor vital areas was  $1.2 \times 10^{-5}$  uCi/100 cm<sup>2</sup>. The highest average value in the reactor vital areas was  $47.2 \times 10^{-5}$  uCi/100 cm<sup>2</sup> 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  $1.1 \times 10^{-5}$  uCi/100 cm<sup>2</sup> which was in Room 201B, the Reactor Control Room floor. The average level of removable contamination in the radiochemistry sample hoods was  $3.2 \times 10^{-5}$  uCi/100 cm<sup>2</sup>.

<sup>1</sup> 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.

# 1. 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 V below. The average ambient gamma radiation levels for this area (80 mile radius) is 65 mRem/yr, (178 uR/day) as reported in the 27th Annual Report of the Environmental Radiation Program, Washington State Department of Social and Health Services.

The values observed indicate there is no significant effect on the environment radiation levels due to reactor operation.

TABLE V  
Environmental Radiation Levels in the  
Vicinity of the Nuclear Radiation Center<sup>1</sup>

(Exposure in uR/day)

| Jul-Aug-Sep | Oct-Nov-Dec | Jan-Feb-Mar | Apr-May-Jun <sup>2</sup> | Median |
|-------------|-------------|-------------|--------------------------|--------|
| 190         | 119         | 199         | -                        | 169    |

<sup>1</sup> For sampling stations located 50 meters or greater from the Nuclear Radiation Center.

<sup>2</sup> Apr-May-Jun TLD data not available from TLD vendor at the time this report was prepared.

Quarterly exposures at readily accessible locations at the reactor facility are listed in Table VI below. No significant effect on the environmental radiation levels by reactor operation was noted.

TABLE VI  
Environmental Radiation Levels Adjacent  
to the Nuclear Radiation Center<sup>1</sup>

(Exposure in uR/day)

| Location            | Jul-Aug-Sep | Oct-Nov-Dec | Jan-Feb-Mar | Apr-May-Jun <sup>2</sup> | Median |
|---------------------|-------------|-------------|-------------|--------------------------|--------|
| S. Bldg. Entrance   | 220         | 190         | 234         | -                        | 216    |
| E. Loading Dock     | 187         | 179         | 224         | -                        | 197    |
| Pool Rm. Vent Stack | 176         | 83          | 179         | -                        | 146    |
| Building W. Roof    | 198         | 179         | 194         | -                        | 190    |
| Rad. Storage Shed   | 237         | 238         | 284         | -                        | 273    |
| Building N. Side    | 231         | 179         | 493         | -                        | 301    |
| Beam Room W. Door   | 242         | 179         | 194         | -                        | 205    |
| Building W. Side    | 242         | 214         | 224         | -                        | 228    |
| Pool Room W. Roof   | 527         | 429         | 582         | -                        | 513    |
| Pool Room E. Roof   | 308         | 226         | 299         | -                        | 278    |

<sup>1</sup> For sampling stations located less than 50 meters of the Nuclear Radiation Center.

<sup>2</sup> Apr-May-Jun TLD data not available from TLD vendor at the time this report was prepared.

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 1st three quarters of the reporting period, the average total background radiation level for sampling points 400 meters or greater from the facility was 163 uR/day, while the average total radiation level at the closest extended occupied area 380 meters away was 172 uR/day. This yields a ratio of 5.50%, indicating no significant exposure level above natural background.