

*Center for Excellence in  
Nuclear Technology, Engineering, and Research*

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To whom it may concern:

Enclosed is the annual operating Report for the University of Utah TRIGA Nuclear Reactor, License No. R-126, Docket number 50-407, for the period of 1 July 1999 through 30 June 2000. This report fulfills the requirements of the TRIGA technical specifications (TTS) 6.10(5).

If there are any further questions or concerns regarding this report, please contact me at (801) 581-8499

Respectfully,

David M. Slaughter  
Reactor Administrator

**CENTER**  
*University of Utah*  
122 S. Central Campus Dr. Rm. 104  
Salt Lake City, Utah 84112-0561  
(801) 581-8499

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**The University of Utah TRIGA Reactor  
Annual Operating Report  
for the period  
1 July 1999 through 30 June 2000**

**A. NARRATIVE.**

**1. Operating Experience.**

The University of Utah Center for Excellence in Nuclear Technology, Engineering, and Research (CENTER) TRIGA Reactor, License No. R-126, Docket No. 50-407, was critical 102.549 hours and generated 17808.644 kilowatt-hours of thermal energy during this reporting year. The reactor was used for educational demonstrations, laboratory experiments, systems tests, power measurements and sample irradiations.

**2. Changes in Facility Design.**

The documents supporting a forthcoming application to upgrade licensed power from 100 kW to 1.1 MW, are being internally reviewed before submission to the NRC. No facilities changes have occurred.

**3. Surveillance Tests.**

Documentation of all surveillance activities is retained and stored by the facility.

**a. Control Rod Worths**

Table 1. Summary of control rod worth, SDM, and ER

Core Configuration	8/12/99	12/21/99	12/28/99	2/23/00
	#23	Experimental	#24	#24
	Dollars	Dollars	Dollars	Dollars
	(\$)	(\$)	(\$)	(\$)
Safety Rod	2.30	2.347	2.29	2.24
Shim-Safety Rod	1.57	1.56	1.56	1.52
Regulating Rod	0.25	0.213	0.25	0.26
Excess Reactivity	1.141	0.683	0.95	0.959
Shutdown Margin	0.679	1.09	0.855	0.821

**b. Control Rod Inspection.**

The Biennial Control Rod Inspection was performed during December 1999. Each control rod was found to be in good condition with no noticeable deterioration or corrosion having occurred since the last inspection. Rod drop times were measured on 8/12/99, 12/21/99, 12/28/99, and 2/23/00. All rod drop times were less than 1.0 seconds.

c. Reactor Power Level Instrumentation.

Calorimetric power calibrations were performed on 8/02/99, 8/03/99, 8/13/99, 1/04/00, and 2/27/00 with the following results:

Date	Measured % Power	Calculated Power Level
8/02/99	86.9 kW	89.456 kW
8/03/99	89.7 kW	89.66 kW
10/13/99	91.5 kW	86.21 kW
1/04/00	91.5 kW	90.4 kW
2/27/00	91.1 kW	88.276 kW

d. Fuel Inspection.

The Biennial Fuel Inspection was performed during December 1999. Each fuel element was visually inspected while keeping it submerged for shielding. No deterioration or excessive corrosion of in-core fuel elements was observed since the previous inspection. Pool water is sampled and analyzed periodically for evidence of fission product activity indicative of defective or deteriorating fuel. Analyses of pool water following full-power reactor operations lasting several hours have not shown any indication of fission product leakage.

e. Fuel Temperature Calibration.

Fuel temperature circuits were calibrated on 8/13/99 and 2/23/00. The circuits were calibrated to less than a 2°C error over the range 20°C to 400°C.

f. Reactor Safety Committee Audits.

Rian B. Smith audited the maintenance and operational activities of the facility and radiation safety for the period 1 Jul. 1999 through 31 Dec. 1999.

Rian B. Smith audited the maintenance and operational activities of the facility for the period 1 Jan. 2000 through 30 Jun. 2000.

K. Langely audited radiation safety and ALARA practices at the facility for the period 1 Jul. 1999 through 31 Dec. 1999.

Rian B. Smith audited radiation safety and ALARA practices at the facility for the period 1 Jan. 2000 through 30 Jun. 2000.

No significant deviations from normal operating practices were identified by these audits.

g. Environmental Surveys.

Rian B. Smith reported to the RSC a maximum total exposure of 59.0 millirem per quarter to environmental dosimeters located at various positions surrounding CENTER for the period 1 July 1999 through 30 June 2000. The average quarterly exposure for the six environmental monitoring stations was 36.28 millirem.

B. ENERGY OUTPUT.

The reactor was critical for 102.549 hours and produced 0.742 megawatt-days (17808.644 kilowatt-hours) of energy during this reporting period. Since initial criticality, the reactor has been operated for a total of 3003.330 hours with an accumulated total energy output of 7.889 megawatt-days (189342.3 kilowatt-hours).

C. EMERGENCY SHUTDOWNS AND INADVERTENT SCRAMS.

Quantity	Type	Cause	Action	Date
1	loss of linear power	insufficient compensation for experiment removal	restart	16 Feb. 2000

D. MAJOR MAINTENNANCE.

Console battery backup system stayed on battery supply and drained battery. The UPS system was replaced.

Fission counter reading erratically and abnormally large counts. Reactor was shut down and BNC connection replaced. Electronic parts replaced for fission counter cask.

CAM paper recorder needle was broken. Magnetic needle compartment replaced with one from another unit.

The % power channel was not tracking accurate power level. OP amp on the % power channel circuit board was changed.

High voltage power supply for CAM was not functioning. Replaced HV power supply with same model. HV power supply was sent for refurbishing. This HV power supply was replaced with the refurbished HV power supply.

Flow rate meter at console was reading 40+ GPM. The meter had defaulted to the high parameter setting. Meter was back to the parameters setting.

Ventilation motor system burned up. 5 Hp 3 phase motor for ventilation system replaced with motor of same technical specifications. The housing for the motor was modified to fit new motor unit.

R134A gas was recharged for the refrigerator system.

Stack monitor chart recorder was not advancing the paper. The chart recorder was replaced (model 288 Rustrack chart recorder).

Security system was not functioning properly (loss of continuity to the police dispatch). Technician from telecommunications was called to replace the phone line

(circuit # 69UCNA 2696).

Safety control rod drive mechanism did not automatically drive in when magnetic power was cut. The safety rod does drop properly. Lengthened the rod down fixture to activate the microswitch when the rod was lowered.

#### E. CHANGES, TESTS AND EXPERIMENTS PURSUANT TO 10 CFR 50.59.

A core change from #23 to #24 took place during December 1999. Rod drops were performed during core change over. These can be viewed in the Core Procedures Manual and the Log Manual.

As of the end of the reporting period, the current membership of the Reactor Safety Committee (RSC) as designated by the Licensee is as follows:

JoAnn Lighty, Chair  
Gary M. Sandquist, Secretary  
David M. Slaughter, Reactor Administrator  
James Thompson, RSO of University of Utah  
Melinda P. Krahenbuhl, reactor supervisor  
James M. Byrne  
Karen Langely  
Rian B. Smith

The RSC has reviewed and approved several CENTER procedures which were modified to update and correct perceived deficiencies. The CENTER staff continues to review and update facility documentation to assure compliance with all applicable regulations.

F. RADIOACTIVE EFFLUENTS.

1. Liquid Waste - Total Activity Released: 15.89  $\mu\text{Ci}$ .

A total volume of approximately 30 gallons of liquid effluent was released to the sanitary sewage system. The liquid effluent containing 15.89  $\mu\text{Ci}$  of tritium was generated during sample irradiation and subsequent processing. The additional 5 gallons of mop water from routine maintenance operations. Prior to release, analysis confirmed that the effluent contained no radioactivity in excess of naturally occurring radionuclides normally present in the potable water supply of this area.

2. Gaseous Waste - Total Estimated Activity Released: 221.72  $\mu\text{Ci}$ .

The TRIGA Reactor was operated for 102,549 hours at power levels up to approximately 90 kW. At this power level argon-41 production is substantially below MPC values for unrestricted areas. The minimum detectable concentration of Ar-41 for the stack monitor has been found to be one-third of 10 CFR 20 appendix B limits for release to unrestricted areas. The average annual calculated concentration of Ar-41 generated during operations is estimated at  $9.866 \times 10^{-10}$   $\mu\text{Ci}/\text{ml}$  which is less than 10 % of the MPC for this radionuclide. The total amount of Ar-41 released was estimated at 221.72  $\mu\text{Ci}$ . No phosphorus-32 was released from CENTER during this period. The total amount of all gaseous radioactivity released was estimated at 221.72  $\mu\text{Ci}$ . A monthly summary of gaseous releases is given in Table I.

Table I.

Summary of Monthly Gaseous Radioactive Effluent  
1 July 1999 through 30 June 2000

Month	Ar-41 ( $\mu\text{Ci}$ )	Estimated Release P-32 and all others	Total ( $\mu\text{Ci}$ )
July	7.71	0	7.71
August	45.72	0	45.72
September	13.84	0	13.84
October	46.98	0	46.98
November	19.60	0	19.60
December	26.71	0	26.71
January	20.04	0	20.04
February	16.04	0	16.04
March	9.36	0	9.36
April	8.80	0	8.80
May	6.92	0	6.92
June	0	0	0
Total Activity of gaseous effluent ( $\mu\text{Ci}$ ):		221.72 $\mu\text{Ci}$	

3. Solid Waste - Total Activity: none

Approximately 0 cubic meters of low-level materials were generated by the University of Utah facility. The types of materials generated include the following: debris removed from the reactor tank during cleaning/maintenance, materials from

handling irradiated samples and irradiated samples disposed of through Radiological Health Department.

#### G. RADIATION EXPOSURES.

Personnel with duties in the reactor laboratory on either a regular or occasional basis have been issued a OSL (since Nov. 1999, collected bimonthly) dosimeter by the University of Utah Radiological Health Department. The duty category and monitoring period of personnel are summarized below:

Name	Monitoring Period	Duty Category
David M. Slaughter	7/1/99-6/30/00	regular
Gary M. Sandquist	7/1/99-6/30/00	regular
Ross Schmidlein	7/1/99-6/30/00	regular
Melinda Krahenbuhl	7/1/99-6/30/00	regular
Dong-ok Choe	7/1/99-6/30/00	regular
Justin Wilde	7/1/99-6/30/00	regular
Christy Seiger-Webster	7/1/99-6/30/00	regular/terminated
Brenda Shelkey	7/1/99-6/30/00	regular
Stephannie Mecham	7/1/99-6/30/00	regular/terminated
Aja Marcheson	7/1/99-6/30/00	regular
Heidi Walk	7/1/99-6/30/00	regular
Michael LeBaron	7/1/99-6/30/00	regular
David Lignell	7/1/99-6/30/00	regular
Anthony Coulam	7/1/99-6/30/00	regular/terminated
Valerie Winberg	7/1/99-6/30/00	occasional/terminated

#### Measured Doses

7/1/99-6/30/00 Doses: <10 mrem average; 13 mrem highest measured.

#### Dose Equivalent Limit

Maximum Permissible Dose Equivalent = 5000 mrem/year (1250/quarter).  
Minimum Detectable Dose per Monthly Badge = 10 mrem.

Of the 362 visitors to the facility under the DOE Reactor Sharing Program for the reporting year, no visitor received a measurable dose. Therefore, the average maximum does are all within NRC guidelines. A summary of whole body exposures is presented in Table II.

Table II

Summary of Whole Body Exposures  
1 July 1999 through 30 June 2000

Estimated whole body exposure range  
(rem):

Number of individuals in each range:

No Measurable Dose	
Less than 0.10	15
0.10 to 0.25	0
0.25 to 0.50	0
0.50 to 0.75	0
0.75 to 1.00	0
1.00 to 2.00	0
2.00 to 3.00	0
3.00 to 4.00	0
4.00 to 5.00	0
Greater than 5 rem	0

#### H. LABORATORY SURVEYS

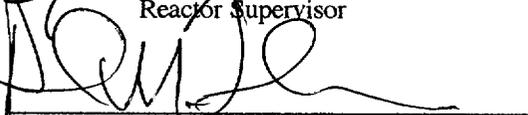
Monthly surveys of the facility were conducted by the University of Utah Radiological Health Department during the reporting period. Some of these surveys have identified minor localized removable contamination sources which were immediately cleaned. The surveys have not indicated any unusual radiation levels over previous years. Records of surveys are retained by the facility.

#### I. ENVIRONMENTAL STUDIES

Environmental monitoring conducted by the University of Utah Radiological Health Department indicated no unusual dose rates in the areas surrounding the Merrill Engineering Building, which houses the reactor facility.

Prepared by:  Date: 8/25/2000

Submitted by:  Date: 8/25/2000  
Reactor Supervisor

Approved by:  Date: 8/25/2000  
Reactor Administrator