THE UNIVERSITY OF UTAH

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To whom it may concern:

Enclosed please find 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 2017 through 30 June 2018. This report fulfills the requirements of the TRIGA Technical Specifications 6.7.1.

The report was generated on July 31st, 2018; however, updates have been made as dosimetry results and the Radiation Safety and ALARA audit have become available.

If there are any further questions or concerns regarding this report, please contact me at (801) 581-4188.

Respectfully,

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The University of Utah TRIGA Reactor (UUTR)

Annual Operating Report

for the period
1 July 2017 through 30 June 2018

Matthew Lund, UUTR Reactor Supervisor

A. NARRATIVE

1. Operating Experience

The University of Utah TRIGA Reactor (UUTR), License No. R-126, Docket No. 50-407, was critical for 57.3 hours and generated 2,448.269 kilowatt-hours of thermal energy during this reporting year. The reactor was used for educational demonstrations and training, laboratory experiments, reactor systems tests, reactor power measurements and sample irradiations.

2. Changes in Facility Design

No major changes to the facility occurred during this reporting period.

3. Surveillance Tests

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

a. Control Rod Worth

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

Core Configuration	#24-B	#24-B	#24-B
Date	8/10/17	3/28/18	6/07/18
	Worth ($)	Worth ($)	Worth ($)
Safety Rod	2.213	2.270	2.297
Shim Rod	1.473	1.510	1.503
Regulating Rod	.283	.287	.287
Excess Reactivity	.613	0.693	.663
Shutdown Margin	1.056	1.103	1.126

b. Control Rod Inspection

The biennial control rod inspection was performed during May of 2018. All controls rods are in good condition and clean, moving freely in housing. All control rod drives function correctly.

c. Reactor Power Level Instrumentation

Calorimetric power calibrations were performed on 8/3/17, 2/23/18, and 6/7/18 with the results shown in Table 2. All calibrations were within 5% of actual power, so no power channel adjustments were required. The additional calibration on 6/7/18 was completed after fuel inspection to verify power levels.

Table 2. Summary of calorimetric power calibrations

Date	Percent Power Indication	Linear Power Indication	Thermal Calculated Power Level
8/3/17	89.6	90.0	89.0
2/23/18	88.9	90.0	87.2
6/7/18	91.5	90.0	94.1

d. Fuel Inspection

The biennial fuel inspection was performed during May and June of 2018. Fuel elements were in good condition, matching condition from the previous inspection.

e. Fuel Temperature Calibration

Fuel temperature circuits were calibrated on 8/15/17 and 2/23/18. The circuits were calibrated to less than or equal to 2°C error over the range from 20 °C to 400 °C.

f. Reactor Safety Committee (RSC) Audits

Three RSC audits were completed during this reporting period. The data are shown in Table 3. No significant deviations from normal operating practices were identified by these audits.

Table 3. Audit summary

Audit	Period	Auditor
Operation and Maintenance	1 Jan. 2017 to 30 Jun. 2017	James M. Byrne
Radiation Safety and ALARA	1/1/2017 to 8/28/2018	Mary J. Handy
Operation and Maintenance	1 Jul. 2017 to 31 Dec. 2017	James M. Byrne

g. Environmental Surveys

Eight environmental monitors are located in the areas surrounding the UUTR. A maximum exposure of 43 mrem in a quarter to an environmental dosimeter located in the Building 80 was measured. Table 4 shows the average dose recorded in last five years.

Table 4. Summary of environmental monitoring around the UUTR

Year	Average quarterly readings for the 8 environmental monitors (mrem)
2017	31.78
2016	31.18
2015	32.06
2014	33.81
2013	33.88
2012	35.56
2011	35.13

B. ENERGY OUTPUT

The UUTR reactor was critical for 57.3 hours and produced 0.102 megawatt·days (2,448.269 kilowatt·hours) of energy during this reporting period. Since initial criticality, the reactor has been operated for a total of

4,032.581 hours with an accumulated total energy output of 9.518 megawatt·days (228,430.082 kilowatt·hours).

C. EMERGENCY SHUTDOWNS AND INADVERTENT SCRAMS:

There were five inadvertent SCRAMs that occurred during this period: 12/9/16, 1/10/17, 1/17/17, and two on 4/6/17, because of erratic indication when operating the linear power selector switch. Summary of the inadvertent scrams and unplanned shutdowns is given in Table 5.

Table 5. Summary of Inadvertent SCRAMS and Unplanned Shutdowns

Date	Run Number	Type	Cause	Action
9/7/17	1948	External	Security system changed state from inactive to active sending an external scram signal.	Reset security system and cleared any state changes.
10/19/17	1950	External	Irradiation sample was raised near tank arm detector, causing a high radiation alarm.	Sample was immediately lowered back into pool and allowed to decay. A standing order was issued to not pull samples over 1 mRem/hr without RS approval.
2/28/18	1963	Linear Power	Linear power indication oscillated when operating the reactor power selector switch	Reactor power selector switch examined
4/13/18	1975	Linear Power	Linear power indication oscillated when operating the reactor power selector switch	Reactor power selector switch examined
6/11/18	1982	Linear Power	Linear power indication oscillated when operating the reactor power selector switch	Reactor power selector switch examined

D. MAJOR MAINTENANCE

- The fission counter connectors were replaced.
- The pool tank was cleaned along, and the Thermal Irradiator (TI) was cleaned of dirt that had fallen into the TI, causing small contamination during neutron activation analysis.
- The shim rod down limit switch was examined. The connecting rod was replaced and a new limiter switch was ordered.

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

None.

F. REACTOR SAFETY COMMITTEE

As of the end of the reporting period, the current members of the RSC as designated by the Licensee are as follows:

James M. Byrne, Chair
Matthew Lund, Reactor Supervisor
Fred Monette, RSO of University of Utah
Michael Barber, Department Chair of Civil Engineering
Donald Wall
Benjamin Huffman
Ryan Schow
Greg Moffitt

The UNEP staff continues to review and update facility documentation to assure compliance with all applicable regulations.

G. RADIOACTIVE EFFLUENTS

1. Liquid Waste

Total activity released: none

2. Gaseous Waste

Total estimated activity released: 30.481 μCi.
The UUTR was operated for 57.3 hours at power levels up to approximately 90 kW. At this power level Ar-41 production is substantially below MPC values for unrestricted areas. The minimum detectable concentration of Ar-41 from the CAM system for the stack monitor has been found to be less than two-third of 10 CFR 20 appendix B limits for release to unrestricted areas. The average annual calculated concentration of Ar-41 generated during operation is estimated to be 1.35×10^{-10} μCi/ml that is approximately 0.0045 % of the DAC. The total amount of Ar-41 released was estimated to be 22.102 μCi. No phosphorus-32 was released from the UUTR and associated facilities during this period. The total amount of all gaseous radioactivity released was estimated to be 30.481μCi. A monthly summary of gaseous releases is given in Table 6. Total activity of gaseous effluent was therefore 30.481 μCi.

Table 6. Summary of Monthly Gaseous Radioactive Effluent

Month	Power (kWh)	Ar-41 (μCi)	Ar-41 (μCi/ml)	Estimated Release P-32 and all others	% of DAC
Jul 17	43.516	0.542	2.4096×10^{-12}	0	0.0001%
Aug 17	303.69	3.781	1.6816×10^{-11}	0	0.0006%
Sep 17	56.661	0.705	3.1375×10^{-12}	0	0.0001%
Oct 17	59.67	0.743	3.3041×10^{-12}	0	0.0001%
Nov 17	53.42	0.665	2.9581×10^{-12}	0	0.0001%

Dec 17	46.13	0.574	2.5544×10^{-12}	0	0.0001%
Jan 18	119.99	1.494	6.6443×10^{-12}	0	0.0002%
Feb 18	325.026	4.047	1.7998×10^{-11}	0	0.0006%
Mar 18	327.357	4.076	1.8127×10^{-11}	0	0.0006%
Apr 18	828.195	10.311	4.586×10^{-11}	0	0.0015%
May 18	0	0.000	0	0	0.0000%
Jun 18	284.614	3.543	1.576×10^{-11}	0	0.0005%
Total	**2448.269**	**30.481**	**1.3557E-10**	**0**	**0.0045%**

3. Solid Waste - Total activity: None
   No solid waste material was sent to the Radiation Safety for disposal during the period of 1 July 2017 through 30 June 2018.

H. PERSONNEL RADIATION EXPOSURES

UNEP Personnel

The University of Utah Radiation Safety has issued to all personnel with duties in the reactor laboratory on either a regular or occasional basis an OSL dosimeter. The duty category and monitoring period of personnel are summarized in Table 7. A summary of the whole-body exposures to the UNEP personnel is presented in Table 8.

Measured Doses

7/1/17-6/30/18 Doses: 6 mrem average; 14 mrem highest measured

Dose Equivalent Limit

Maximum Permissible Dose Equivalent = 5000 mrem/year (1250/quarter).
Minimum Detectable Dose per Monthly Badge = 1 mrem.

Visitors

775 individuals visited the reactor facility during the period 1 July 2017 to 30 June 2018. None of the visitors received a measurable dose.

Table 7. Summary of Monitored Personnel

Name	Monitoring Period	Duty Category
Albright, Lucas	07/01/17-6/30/18	Regular
Allred, Michael	07/01/17-12/31/17	Regular/Terminated
Burak, Adam	07/01/17-12/31/17	Regular/Terminated
Burnham, Steven	07/01/17-9/30/17	Regular/Terminated
Chu, David	02/01/18-6/30/18	Regular
Craynor, Elliott	07/01/17-6/30/18	Regular
Curtis, Jonathan	07/01/17-12/31/17	Regular/Terminated
Cutic, Avdo	07/01/17-12/31/17	Regular/Terminated
Faure, Quentin	07/01/17-6/30/18	Regular

Feist, Donovan	04/01/18-6/30/18	Regular
Foley, Amanda	07/01/17-6/30/18	Regular
Horvath, David	07/01/16-6/30/17	Regular
Jevremovic, Tatjana	07/01/17-12/31/17	Regular/Terminated
Kanno, Nicholas	07/01/17-12/31/17	Regular/Terminated
Kavouras, John	07/01/17-12/31/17	Regular/Terminated
Kim, Donghoon	07/01/17-6/30/18	Regular
Lintereur, Azaree	07/01/17-9/30/17	Regular/Terminated
Lund, Matthew	07/01/17-6/30/18	Regular
Novy, Rebecca	07/01/17-12/31/17	Regular/Terminated
Okabe, Parker	07/01/17-6/30/18	Regular
Palmer, Alan	07/01/17-12/31/17	Regular/Terminated
Pappas, Steven	02/01/18-6/30/18	Regular
Porter, JoCee	07/01/17-9/30/17	Regular/Terminated
Porter, Aaron	02/01/18-6/30/18	Regular
Reifsnyder, Alexander	02/01/18-6/30/18	Regular
Reinhart, Cameron	07/01/17-6/30/18	Regular/Terminated
Romero, Rachel	07/01/17-12/31/17	Regular/Terminated
Saenz, Brittney	07/01/17-6/30/18	Regular
Schow, Ryan C	07/01/17-12/31/17	Regular/Terminated
Takasugi, Cole	07/01/17-12/31/17	Regular/Terminated
Taylor, Bryan	02/01/18-6/30/18	Regular
Thomas, Bryce	07/01/17-12/31/17	Regular/Terminated
Thomas, Ryan	07/01/17-12/31/17	Regular/Terminated
Tuttle, Jacob	07/01/17-9/30/17	Regular/Terminated
Ulloa, Carlos	02/01/18-6/30/18	Regular
Winkle, Samantha	07/01/17-9/30/17	Regular/Terminated

Table 8. Summary of whole body exposures to the UNEP personnel

Estimated whole body exposure range (rem)	Number of individuals in each range
Less than 0.1	36
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

I. LABORATORY SURVEYS

Monthly surveys of the facility were conducted by the University of Utah Radiation Safety during the reporting period. The surveys have not indicated any unusual radiation levels over previous years. Records of surveys are retained by the facility.

J. ENVIRONMENTAL STUDIES

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

Prepared by: Matthew Lund, Reactor Supervisor Date: 7/31/2018

Updated by: Matthew Lund, Reactor Supervisor Date: 9/06/2018

Submitted by: Matthew Lund, Reactor Supervisor Date: 9/06/2018