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COLLEGE OF ENGINEERING | 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 2018 through 30 June 2019. This report fulfills the requirements of the TRIGA Technical Specifications 6.7.1.

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 2018 through 30 June 2019

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 57.212 hours and generated 2,622.591 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

None.

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 **Date**	#24-B 9/24/18	#24-B 2/27/19
	Worth ($)	**Worth ($)**
Safety Rod	2.270	2.257
Shim Rod	1.597	1.49
Regulating Rod	.287	.283
Excess Reactivity	.628	0.639
Shutdown Margin	1.186	1.134

b. Control Rod Inspection

The last biennial control rod inspection was performed during May of 2018, so no further inspections are required until May 2019. Drop time for control rods were tested and verified to be < 2s, during each semi-annual control rod calibrations.

c. Reactor Power Level Instrumentation

Calorimetric power calibrations were performed on 10/9/18, 2/27/19, and 3/15/19 with the results shown in Table 2. The calibration on 2/27/19 showed a 7.9% higher power level than normal, so the thermal power calibration was redone before any other reactor runs on 3/15/19 with a value of only 4.1% higher. Since the calibrations on 10/9/18 and 3/15/19 for the power channels were < 5% from the calculated power, no power channel adjustments were required.

Table 2. Summary of calorimetric power calibrations

Date	**Percent Power Indication**	**Linear Power Indication**	**Thermal Calculated Power Level**
10/9/18	93.1	90.0	92.507
2/27/19	92.2	90.0	97.911
3/15/19	92.2	90.3	94.102

d. Fuel Inspection

No fuel inspection was completed during this year, as the last biannual fuel inspection was performed during May and June of 2018.

e. Fuel Temperature Calibration

Fuel temperature channels were calibrated on 9/19/18 and 2/13/19. The channels 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. These audits identified no significant deviations from standard operating practices.

Table 3. Audit summary

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

g. Environmental Surveys

Eight environmental monitors are located in the areas surrounding the UUTR. Maximum exposure of 45 mrem in a quarter to an environmental dosimeter situated in Building 80 was measured. Table 4 shows the average dose recorded in the last five year.

Table 4. Summary of environmental monitoring around the UUTR

Year	Average quarterly readings for the eight environmental monitors (mrem)
2018	34.56
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 57.212 hours and produced 0.109 megawatt·days (2,622.591 kilowatt·hours) of energy during this reporting period. Since initial criticality, the reactor has been operated for a total of 4,089.793 hours with an accumulated total energy output of 9.627 megawatt·days (231,052.673 kilowatt·hours).

C. EMERGENCY SHUTDOWNS AND INADVERTENT SCRAMS:

Three inadvertent SCRAMs occurred during this period: 10/17/18, 3/20/19, and 3/21/19. 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
10/17/18	1987	Linear Power	Linear power indication oscillated when operating the reactor power selector switch	Reactor power selector switch examined
3/20/19	2009	External	The tank arm detector's connector was bumped during sample removal, causing a false high radiation alarm.	The connector and radiation alarm were verified for correct operation, and staff retrained to avoid agitating the connector during operations.
3/21/19	2010	Linear Power	Electrical signal noise appeared on the linear channel, resulting in a false SCRAM. The percent power, log power, and fuel temperature indicated a power of ~76kW, during the SCRAM.	The linear channel was tested and verified for correct operation during the next run. The noise was not reproducible. The new linear channel being installed will permanently fix the signal noise.

D. MAJOR MAINTENANCE

- The microswitch for the shim rod down was replaced, and the limit switches were adjusted to verify the shim rod drives in after the rod has dropped in a SCRAM.
- The temporary fission counter instrumentation was updated by adding a pre-amplifier to the system and redoing connections and cable routing to reduce noise.
- The Pneumatic Irradiator (PI) was not functioning due to a failed power supply and a broken rubber bumper at the bottom of the PI. The power supply was replaced and the bumper removed.
- The regulating rod's reverse motor bias potentiometer was adjusted to verify rod does not drift downwards after movement.
- The Continuous Air Monitor (CAM) noble gas detector signal cable failed. The cable and connectors were replaced.
- The facility is in the process of replacing the neutron power monitoring channels through the 10CFR50.59 process. The 50.59 process is being finalized as documentation is completed over the next few months for submission. The equipment has arrived and is being installed for testing separately from the existing systems, allowing facility staff to verify functionality.
- The new Area Radiation Monitors (ARMs) are being integrated into the console through the 10CFR50.59 process, which will be finalized in the next few months.
- The facility received the Department of Energy Research Reactor Infrastructure grant for 2018 to replace the reactor console, which is currently in the design phase with the manufacturer.

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. Solid Waste - Total activity: 95.3 mCi

Solid waste material was sent to the Radiation Safety Office (RSO) on campus for disposal during the period of 1 July 2017 through 30 June 2018. The waste includes mostly activated material (piping, plates, aluminum, gloves, etc...) collected over the life of the reactor with a total weight of 48.167 kg and a total activity of 95.3 mCi. The RSO office has sent several drums already for disposal with the rest stored in their facility, awaiting disposal in the next shipment.

3. Gaseous Waste - Total estimated activity released: 32.651 μCi.

The UUTR was operated for 57.212 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 1.45×10^{-10} μCi/ml that is approximately 0.0048 % of the DAC. The total amount of Ar-41 released was estimated to be 32.651 μCi. No phosphorus-32 was released from the UUTR and associated facilities during this period. A monthly summary of gaseous releases is given in Table 6. The total amount of all gaseous radioactivity released was estimated to be 32.651μCi.

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	0	0.000	0	0	0.0000%
Aug 17	0	0.000	0	0	0.0000%
Sep 17	0.39	0.005	2.1596×10^{-14}	0	0.0000%
Oct 17	40.741	0.507	2.256×10^{-12}	0	0.0001%
Nov 17	183.434	2.284	1.0157×10^{-11}	0	0.0003%
Dec 17	32.998	0.411	1.8272×10^{-12}	0	0.0001%
Jan 18	215.248	2.680	1.1919×10^{-11}	0	0.0004%
Feb 18	547.466	6.816	3.0315×10^{-11}	0	0.0010%
Mar 18	330.827	4.119	1.8319×10^{-11}	0	0.0006%
Apr 18	409.547	5.099	2.2678×10^{-11}	0	0.0008%
May 18	368.644	4.590	2.0413×10^{-11}	0	0.0007%
Jun 18	493.296	6.142	2.7316×10^{-11}	0	0.0009%
Total	**2622.591**	**32.651**	**1.4522×10^{-10}**	**0**	**0.0048%**

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 university began using Mirion Instadose dosimeters as of January 2019. 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

7/1/18-6/30/19 Doses: 32 mrem average; 270 mrem highest measured

Dose Equivalent Limit

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

Visitors

524 individuals visited the reactor facility during the period 1 July 2018 to 30 June 2019. None of the visitors received a measurable dose.

Table 7. Summary of Monitored Personnel

Name	Monitoring Period	Duty Category
Albright, Lucas	07/01/18-6/30/19	Regular
Bohanon, Reid	11/01/18-6/30/19	Regular
Cazales, Edward	11/01/18-6/30/19	Regular
Cole, Mary	10/01/18-12/31/18	Regular/Terminated
Chu, David	07/01/18-12/31/18	Regular/Terminated
Craynor, Elliott	07/01/18	Terminated
Faure, Quentin	07/01/18-6/30/19	Regular
Feist, Donovan	07/01/18-6/30/19	Regular
Fitzhugh, Richard	02/01/19-6/30/19	Regular
Foley, Amanda	07/01/18-6/30/19	Regular
Galbraith, Craig	10/01/18-12/31/18	
Horvath, David	07/01/18	Terminated
Kim, Donghoon	07/01/18	Regular/Terminated
Lund, Matthew	07/01/18-6/30/19	Regular
Mastren, Tara	11/01/18-6/30/19	Regular
Okabe, Parker	07/01/18	Terminated
Oliver, Corry	10/01/18-12/31/18	Regular/Terminated
Pappas, Steven	07/01/18-6/30/19	Regular
Porter, Aaron	07/01/18	Terminated
Quist, Teancum	10/01/18-6/30/19	Regular
Reifsnyder, Alexander	07/01/18-6/30/19	Regular
Saenz, Brittney	07/01/17-6/30/18	Regular
Stoddard, Michael	02/01/19-4/01/19	Regular/Terminated
Taylor, Bryan	07/01/18	Terminated
Tibbet, Bailey	10/01/18-12/31/18	Regular/Terminated
Ulloa, Carlos	07/01/18-6/30/19	Regular

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	24
0.10 to 0.25	1
0.25 to 0.50	1
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

The University of Utah Radiation Safety Office conducted monthly surveys of the facility during the reporting period. The studies have not indicated any unusual radiation levels over previous years. The facility retains records of surveys.

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: 7/29/2019

Submitted by: Matthew Lund, Reactor Supervisor — Date: 7/29/2019