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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 2015 through 30 June 2016. 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,

A handwritten signature in black ink, appearing to read 'R.C. Schow'.

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The University of Utah TRIGA Reactor (UUTR)

Annual Operating Report

**for the period
1 July 2015 through 30 June 2016**

Ryan C. Schow, UUTR Supervisor

A. NARRATIVE

1. Operating Experience

The University of Utah TRIGA Reactor (UUTR), License No. R-126, Docket No. 50-407, was critical for 13.234 hours and generated 179.386 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 Date | #24-B 2/10/16 | #24-B 6/16/16 |
|-------------------------|------------------|------------------|
| | Worth (\$) | Worth (\$) |
| Safety Rod | 2.277 | 2.227 |
| Shim Rod | 1.443 | 1.463 |
| Regulating Rod | 0.270 | 0.283 |
| Excess Reactivity | 0.6102 | 0.667 |
| Shutdown Margin | 1.103 | 1.079 |

b. Control Rod Inspection

The biennial control rod inspection was performed during May of 2016 when control rods were sequentially removed from the reactor core for visual inspection. Rod drop times were measured on 2/10/16 and 6/16/16. All rod drop times were less than 1.02 seconds.

c. Reactor Power Level Instrumentation

A calorimetric power calibration was performed on 2/18/16 with the results shown in Table 2. The calibration was completed at a lower power level of 50 kW due to replacement of ion-chambers and maintenance. Log power stopped responding during the test and the log power's inoperability has delayed the completion of a follow-up

calorimetric power calibration. When repairs are complete to the log power indication, another calorimetric power calibration will be performed.

Table 2. Summary of calorimetric power calibration

| Date | Measured % Power | Calculated Power Level |
|---------|------------------|------------------------|
| 2/18/16 | 41.1 | 54.2 |

The adjustment of power monitoring channels procedure was performed on 3/3/16 following the calorimetric results received on 2/18/16.

d. Fuel Inspection

The biennial fuel inspection was performed during April and May of 2016 when each fuel element was visually inspected while keeping it submerged in reactor tank water in assuring the required shielding. No deterioration or excessive corrosion of in-core fuel elements was observed. 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 the presence of fission products.

e. Fuel Temperature Calibration

Fuel temperature circuits were calibrated on 9/1/15 and 2/4/16. 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. 2015 to 30 Jun. 2015 | James M. Byrne |
| Radiation Safety and ALARA | 1 Jul. 2014 to 30 Jul. 2015 | Fred Monette Karen Langley Mary Handy |
| Operation and Maintenance | 1 Jul. 2015 to 31 Dec. 2015 | James M. Byrne |

g. Environmental Surveys

Nine environmental monitors are located in the areas surrounding the UUTR. A maximum exposure of 41 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) |
|------|--|
| 2015 | 32.06 |
| 2014 | 33.81 |
| 2013 | 33.88 |
| 2012 | 35.56 |
| 2011 | 35.13 |
| 2010 | 36.00 |

B. ENERGY OUTPUT

The UUTR reactor was critical for 13.234 hours and produced 0.007 megawatt-days (179.386 kilowatt-hours) of energy during this reporting period. Since initial criticality, the reactor has been operated for a total of 3882.695 hours with an accumulated total energy output of 9.342 megawatt-days (224206.581 kilowatt-hours).

C. EMERGENCY SHUTDOWNS AND INADVERTENT SCRAMS:

There was one inadvertent SCRAM that occurred during this period on 2/18/16 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 |
|----------|------------|--------------|---|--|
| 02/18/16 | 1894 | Linear Power | Linear power indication oscillated when operating the reactor power selector switch | Reactor power selector switch examined |

D. MAJOR MAINTENANCE

- The source range fission counter replacement was completed in February 2016.
- The reactor control console wiring and connections were cleaned and

organized which was completed in September 2015.

- Replacement of the % and log power ion-chambers was completed in February 2016.

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
 Tatjana Jevremovic, Director UNEP and UUTR
 Karen Langley, RSO of University of Utah
 Ryan Schow, Reactor Supervisor
 Donald Wall
 Rian Smith
 Benjamin Huffman

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: 2.233 μCi .

The UUTR was operated for 13,234 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 9.933×10^{-12} $\mu\text{Ci}/\text{ml}$ that is approximately 0.0003 % of the DAC. The total amount of Ar-41 released was estimated to be 2.233 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 2.233 μCi . A monthly summary of gaseous releases is given in Table 6. Total activity of gaseous effluent was therefore 2.233 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 15 | 0 | 0 | 0 | 0 | 0.000% |
| Aug 15 | 0 | 0 | 0 | 0 | 0.000% |
| Sep 15 | 0 | 0 | 0 | 0 | 0.000% |
| Oct 15 | 0 | 0 | 0 | 0 | 0.000% |
| Nov 15 | 0 | 0 | 0 | 0 | 0.000% |
| Dec 15 | 0 | 0 | 0 | 0 | 0.000% |
| Jan 16 | 0 | 0 | 0 | 0 | 0.000% |
| Feb 16 | 170.251 | 2.120 | 9.42742E-12 | 0 | 0.0003% |
| Mar 16 | 7.649 | 0.095 | 4.23553E-13 | 0 | 0.000% |
| Apr 16 | 1.206 | 0.015 | 6.67806E-14 | 0 | 0.000% |
| May 16 | 0 | 0 | 0 | 0 | 0.000% |
| Jun 16 | 0.28 | 0.003 | 1.55046E-14 | 0 | 0.000% |
| Total | 179.386 | 2.233 | 9.93325E-12 | 0 | 0.0003% |

3. Solid Waste - Total activity: None

No solid waste material was sent to the Radiological Health Department for disposal during the period of 1 July 2015 through 30 June 2016.

H. PERSONNEL RADIATION EXPOSURES

UNEP Personnel

The University of Utah Radiological Health Department 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

7/1/15-6/30/16 Doses: 2 mrem average; 8 mrem highest measured

Dose Equivalent Limit

Maximum Permissible Dose Equivalent = 5000 mrem/year (1250/quarter).

Minimum Detectable Dose per Monthly Badge = 1 mrem.

Visitors

Eight hundred and twenty-five (825) individuals visited the reactor facility during the period 1 July 2015 to 30 June 2016. None of the visitors received a measurable dose.

Table 7. Summary of Monitored Personnel

| Name | Monitoring Period | Duty Category |
|-------------------|-------------------|---------------|
| Albright, Lucas | 04/01/16-6/30/16 | Regular |
| Allred, Michael | 10/01/15-6/30/16 | Regular |
| Alroumi, Fawaz | 07/01/15-6/30/16 | Regular |
| Anderson, Jacqui | 07/01/15-6/30/16 | Regular |
| Bennett, Chelsea | 04/01/16-6/30/16 | Regular |
| Burak, Adam | 07/01/15-6/30/16 | Regular |
| Burnham, Steven | 07/01/15-6/30/16 | Regular |
| Chidester, Joshua | 07/01/15-6/30/16 | Regular |
| Cutic, Avdo | 07/01/15-6/30/16 | Regular |
| Doane, Samuel | 07/01/15-6/30/16 | Regular |
| Faure, Quentin | 04/01/16-6/30/16 | Regular |
| Fitzhugh, Richard | 08/01/15-6/30/16 | Regular |
| Flygare, Joshua | 07/01/15-6/30/16 | Regular |
| Foley, Amanda | 07/01/15-6/30/16 | Regular |
| Gee, Wimonphan | 07/01/15-6/30/16 | Regular |
| Griffin, Hayden | 08/01/15-6/30/16 | Regular |
| Han, Dahee | 07/01/15-6/30/16 | Regular |
| Hans, Zachary | 07/01/15-6/30/16 | Regular |

| | | |
|------------------------|----------------------|---------|
| Hatfield, Andrew | 10/01/15- 6/30/16 | Regular |
| Hawkins, Casey | 3/01/16- 6/30/16 | Regular |
| Hinrichs, Benny | 07/01/15- 6/30/16 | Regular |
| Horvath, David | 10/01/15- 6/30/16 | Regular |
| Jevremovic, Tatjana | 07/01/15- 6/30/16 | Regular |
| Kanno, Nicholas | 07/01/15- 6/30/16 | Regular |
| Kavouras, John | 07/01/15- 6/30/16 | Regular |
| Kim, Donghoon | 07/01/15- 6/30/16 | Regular |
| King, Travis | 07/01/15- 6/30/16 | Regular |
| Lai, Trent | 08/01/15- 6/30/16 | Regular |
| Lee, Sangkyu | 07/01/15- 6/30/16 | Regular |
| Levinthal, Joseph | 07/01/15- 6/30/16 | Regular |
| Lintereur, Azaree | 07/01/15- 6/30/16 | Regular |
| Lund, Matthew | 07/01/15- 6/30/16 | Regular |
| Lusk, Robert | 2/1/16- 6/30/16 | Regular |
| McDonald, Luther | 07/01/15- 6/30/16 | Regular |
| Minko, Aliaksei | 07/01/15- 6/30/16 | Regular |
| Morgan, David | 07/01/15- 6/30/16 | Regular |
| Murray, Nathan | 3/01/16- 6/30/16 | Regular |
| Novy, Rebecca | 07/01/15- 6/30/16 | Regular |

| | | |
|--------------------------------|-----------------------|--------------------|
| Okabe, Parker | 10/01/15- 6/30/16 | Regular |
| Olsen, Adam | 3/01/16- 6/30/16 | Regular |
| Porter, JoCee | 07/01/15- 6/30/16 | Regular |
| Rapich, Jason | 07/01/15- 6/30/16 | Regular |
| Reinhart, Cameron | 09/01/15- 6/30/16 | Regular |
| Saenz, Brittney | 10/01/15- 6/30/16 | Regular |
| Schow, Ryan C | 07/01/15- 6/30/16 | Regular |
| Schwerdt, Ian | 07/01/15- 6/30/16 | Regular |
| Tamplin, Michelle | 07/01/15- 6/30/16 | Regular |
| Waugh, Robert | 07/01/15- 6/30/16 | Regular |
| Weimer, Jonathan | 07/01/15- 6/30/16 | Regular |
| Wilding, Paul | 03/01/16- 6/30/16 | Regular |
| Wilson, Dylan | 07/01/15- 6/30/16 | Regular |
| Winkle, Samantha | 07/01/15- 6/30/16 | Regular |
| Adjei, Christian | 07/01/15- 9/30/15 | Regular/Terminated |
| Fairbanks, Thomas | 07/01/15- 9/30/15 | Regular/Terminated |
| Bahamonde Castro, Christina | 07/01/15- 10/31/15 | Regular/Terminated |
| Eklund, Mathew | 07/01/15- 10/31/15 | Regular/Terminated |
| Sisson, Richard | 07/01/15- 10/31/15 | Regular/Terminated |
| Duffin, Taylor | 07/01/15- 1/31/16 | 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 | 58 |
| 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 Radiological Health Department 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 Radiological Health Department indicated no unusual dose rates in the areas surrounding the Merrill Engineering Building, which houses the UUTR reactor facility.

Prepared by: Ryan Schow  Date: 7/28/2016
 Reactor Supervisor

Submitted by: Ryan Schow  Date: 7/28/2016
 Reactor Supervisor