USGS
science for a changing world
Department of the Interior
US Geological Survey
Box 25046 MS-974
Denver CO, 80225
January 9, 2017

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington DC 20555

Dear NRC staff,

Enclosed is the 2016 annual report for the U.S. Geological Survey TRIGA non-power reactor facility.

The facility docket number is 50-274.

Sincerely,

Brycen Roy
Reactor Supervisor

Enclosure

Copy to:
Geoffrey Wertz OWFN 12 D20

A020
NRR

U.S. GEOLOGICAL SURVEY TRIGA REACTOR

ANNUAL REPORT

JANUARY 1, 2016 - DECEMBER 31, 2016

NRC LICENSE No. R-113 DOCKET NO. 50-274

I. Personnel Changes:

Clayton Manning took over the Reactor Health Physicist position on March 30, 2016. Tim DeBey stepped down from the Reactor Supervisor position on July 23, 2016, and Brycen Roy was acting in that position until he was hired on September 15, 2016 as the replacement Reactor Supervisor.

II. Operating Experience

The Geological Survey TRIGA Reactor (GSTR) was in normal operation for the year 2016. No major facility changes were made during the year.

A synopsis of irradiations performed during the year is given below, listed by the organization submitting the samples to the reactor staff:

Organization	Number of Samples
USGS – INAA	237
USGS - Geochronology	789
USGS – other	16
Non-USGS	2594
Total	3636

A. Thermal power calibrations were performed in March and September, with adjustments made to the instrumentation as required.

B. During the report period, 179 daily checklists and 12 monthly checklists were completed in compliance with technical specifications requirements for surveillance of the reactor facility.

C. Tours were provided to individuals and groups during the year for a total visitor count of approximately 525.

III. Tabulation of Energy Generated

	MWh operated	Critical hours	Pulses
Jan	**31.719**	35h 18m	0
Feb	**25.276**	26h 26m	0
Mar	**59.197**	63h 31m	8
Apr	**85.700**	87h 27m	0
May	**36.100**	37h 55m	0
June	**54.494**	55h 57m	0
July	**37.572**	40h 24m	0
Aug	**43.140**	44h 47m	1
Sept	**29.643**	34h 48m	0
Oct	**40.199**	44h 03m	6
Nov	**9.120**	13h 57m	0
Dec	**44.589**	47h 20m	0
Totals	**496.749**	531h 53m	15

IV. Unscheduled Shutdowns

Twelve (12) unscheduled shutdowns occurred in 2016. These were:

Number	Date	Cause
1121	3/17/16	Failure of "Auto" mode controller; timeout scram
1122	3/18/16	DAS watchdog scram; cause could not be identified
1123	3/22/16	DAS watchdog scram; cause could not be identified
1124	4/6/16	DAS watchdog scram; cause could not be identified
1125	4/19/16	DAS watchdog scram; cause could not be identified
1126	5/25/16	DAS watchdog scram; cause could not be identified.
1127	6/16/16	DAS watchdog scram; cause could not be identified
1128	6/16/16	DAS watchdog scram; cause could not be identified
1129	6/17/16	DAS watchdog scram; cause could not be identified
1130	6/17/16	DAS watchdog scram; cause could not be identified
1131	7/1/16	NP1000 high power scram due to faulty signal cable connector
1132	7/5/16	DAS watchdog scram; cause could not be identified

V. Significant Maintenance Operations

1/16 Replaced inlet filter on HX inlet water pressure monitor sensor line.
1/16 Cleaned 8 nozzles on cooling tower.

5/16 Replaced air pressure regulator for transient rod air supply.
5/16 Replaced power switch for CAM air pump.
5/16 Replace ion exchange resin.
6/16 Replaced cooling tower "fill" and spray header.
6/16 Repaired signal cable for NP1000 detector.
7/16 Replaced "tee" connector for NPP1000 detector signal cable.
7/16 Replaced Sensoray board 2 in DAC computer.
7/16 Switched Sensoray boards 1 and 2 in DAC computer.
7/16 Pumped ~23 gallons of ground water from reactor tank annulus.
8/16 Performed DOP test of HEPA exhaust filters – SAT.
8/16 Replaced secondary system sump pump.
9/16 Replaced piping and fittings for secondary system sump pump.
12/16 Pumped ~28 gallons of ground water from reactor tank annulus.
12/16 Replaced both belts on reactor bay main exhaust fan.

VI. Summary of 10 CFR 50.59 changes

No 50.59 changes were made to the facility in CY 2016. One activity was screened for 50.59 applicability and it was evaluated to not require a full 50.59 evaluation or NRC approval.

VII. Radioactivity Releases

A. Listed below are the total amounts of radioactive gaseous effluents released to the environment beyond the effective control of the reactor facility

Table 1. Gaseous Effluents Released to the Environment in CY 2016

Month	**Argon-41** (Ci)	**R-113 License Allowable** (Ci)	**Tritium -HTO** (mCi) *	**10CFR20 Allowable** (mCi)
January	0.95217	5.833	0	124
February	0.35518	5.833	0.136	124
March	0.27149	5.833	0.107	124
April	1.0119	5.833	0.191	124
May	0.29592	5.833	0	124
June	0.76109	5.833	0.177	124
July	1.39031	5.833	0	124
August	1.70760	5.833	0	124
September	1.00000	5.833	0.584	124
October	2.43527	5.833	0	124
November	1.01546	5.833	0	124
December	1.2399	5.833	0.0748	124
Total	12.43629	70.00	0.688	1488
% of Allowable	17.7661%	----------	0.046%	----------

* **Note**: The tritium concentrations are estimates based on the amount of water lost by evaporation from the reactor multiplied by the concentration of tritium as HTO. Tritium sample analyses were performed by ALS Laboratories.

B. No liquid releases were made during the 2016 calendar year. Two 55-gallon drums of solid waste from the reactor facility were shipped to a waste broker in California for ultimate burial in Clive, Utah.

C. During the year Na-24 and Br-82 were detected on CAM filter analyses. Conservative estimated releases for these isotopes are in Table 2.

Table 2. Releases of Non-Gaseous Isotopes in CY 2016.

Isotope	µCi	µCi/ml	10 CFR 20 limit (uCi/ml)	% of limit
Na-24	1.4743E-3	1.982E-14	7.00E-09	2.832E-4
Br-82	1.8234E-3	2.452E-14	5.00E-09	4.904E-4

VIII. Radiation Monitoring

Our program to monitor and control radiation exposures included the four major elements below during the operating year.

1. Ten (10) gamma-sensitive area monitors, and one (1) neutron-sensitive area monitor, are located throughout the Nuclear Science Building. A remote readout panel is located in the reactor health physics office. High alarm set points range from 2 mR/hr to 50 mR/hr. High level alarms are very infrequent and due to sample movements. These monitors are calibration-checked annually.

2. One Continuous Air Monitor (CAM) samples air in the reactor bay. An equilibrium concentration of about 1.5×10^{-8} µCi/ml present for two minutes will result in an increase of about 500 cpm above background. Two alarm setpoints are a low-level alarm set at 5,000 cpm and a high level alarm set at 10,000 cpm. Reactor bay air is sampled during all reactor operations. The fixed particulate air filter is normally changed each week and counted on a HPGE gamma spectrometer. The charcoal filter, positioned behind the particulate air filter, is also normally changed and counted weekly. Filter data showed radioisotope concentrations less than allowable airborne concentration limits given in 10 CFR Part 20, Appendix B, Table 2 for all particulate radioisotopes produced by the reactor.

3. Contamination wipe surveys and portable instrument radiation surveys are performed at least once a month. The portable instruments are calibrated with a 3-Curie (initial activity) Cs-137 source traceable to NBS, and wipes are counted on a Gamma Products G5000W low-level counting system. The highest removable contamination found was during the May surveys, at 2612.4 pCi/100 cm^2 beta-gamma, located in the reactor bay on the end of the west table. The next highest contamination was found during the August surveys, at 930.3 pCi/100 cm^2 beta-

gamma, near the southwest lead cave. Each of these areas was subsequently decontaminated to levels below the removable contamination limit. No areas were greater than 12.2 pCi/100 cm^2 alpha contamination, which does not require decontamination as it is well below the limit of 90 pCi/100 cm^2 alpha.

The roof area over the reactor tank is roped off and posted as a radiation area (averaging 2.5 mR/hr) during 1 MW operations.

4. TLD dosimeters were used at seven outdoor environmental stations. Reactor facility visitors are issued self-reading electronic dosimeters. Reactor staff personnel are issued beta, gamma, albedo neutron badges.

Table 3. Personnel Monitoring Results (12/1/15 – 11/30/16)

Employee code	Whole Body (Rem) Deep Dose Equiv.	Whole Body (Rem) Shallow Dose Equiv.	Extremity (Rem)
E0888	0.231	0.285	0.698
E0707	0.272	0.317	0.531
E0908	0.057	0.057	0.189
E0715	0.080	0.080	0.102

Reactor visitors and visiting experimenters wore electronic pocket dosimeters that resulted in no individual's reading greater than 1.4 mr in a single visit or 1.5 mr cumulative annual dose.

Table 4. Environmental Dose Results (Oct 2015 through Sept 2016)

Location	**Dose Oct.- Dec.** (RAD)	**Dose Jan-Mar** (RAD)	**Dose Apr-June** (RAD)	**Dose July-Sept.** (RAD)	**Total** (RAD)
Control (Backgrond)	0.062	0.057	0.063	0.056	0.238
Main Exhaust	0.150	0.045	0.054	0.027	0.276
West Vehicle Gate	0.059	0.021	0.011	0.014	0.105
West Room 151 Gate	0.073	0.061	0.061	0.053	0.248
Cooling Tower	0.000	0.000	0.000	0.000	0.000
SE Light Pole	0.000	0.000	0.000	0.000	0.000
SW Light Pole	0.011	0.000	0.000	0.000	0.011
Rx Fence Loading Dock	0.068	0.035	0.039	0.042	0.184
Tunnel	0.018	0.028	0.025	0.019	0.090

Note: Above totals have the background subtracted (see control badge). All TLDs were supplied and analyzed by Mirion Technologies.

X. Environmental Monitoring

Very small releases of two non-gaseous isotopes were detected on the CAM filters during the year. These two isotopes (Na-24 and Br-82) were discharged through the normal air exhaust above the roof of the reactor bay. The amounts released are shown in Table 2. Routine biennial environmental soil and water samples were taken in the summer of 2016 and will be taken again in 2018. Analyses of the 2016 samples showed no isotopes that were produced by the reactor facility.