USGS
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Department of the Interior
US Geological Survey
Box 25046 MS-974
Denver CO, 80225
January 31, 2019

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

Dear NRC staff,

Enclosed is the 2018 annual report for the U.S. Geological Survey TRIGA non-power reactor facility.

The facility docket number is 50-274.

Sincerely,

Christopher Farwell

Christopher Farwell
Acting Reactor Supervisor

Enclosure

Copy to:
Geoffrey Wertz OWFN 12 D20

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NRR

U.S. GEOLOGICAL SURVEY TRIGA REACTOR

ANNUAL REPORT

JANUARY 1, 2018 - DECEMBER 31, 2018

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

I. Personnel Changes:

On October 26, 2019, Brycen Roy was temporarily assigned to another position within the USGS. The new acting Reactor Supervisor is Christopher Farwell.

II. Operating Experience

The Geological Survey TRIGA Reactor (GSTR) was in normal operation from January 1 through October 17, 2018. On October 17, 2018 the max power level was administratively restricted to 880 kW to ensure compliance with our accepted operating core configuration. On October 26, 2018, the USGS director made the decision to administratively stop reactor operations to conduct a review of our technical procedures. 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	261
USGS - Geochronology	499
USGS – other	6
Non-USGS	1956
Total	2722

A. A thermal power calibration was performed in September, with adjustments made to the instrumentation as required.

B. During the report period, 166 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 419.

D. One fuel movement was performed during the year for the purpose of increasing reactivity and performing the 60-month fuel element inspection.

III. Tabulation of Energy Generated

	MWh operated	Critical hours	Pulses
Jan	**17.646**	19h 59m	0
Feb	**40.272**	42h 17m	0
Mar	**58.986**	71h 08m	0
Apr	**31.566**	33h 20m	0
May	**25.515**	27h 24m	0
June	**36.202**	37h 59m	0
July	**36.765**	40h 41m	0
Aug	**49.517**	51h 12m	0
Sept	**28.090**	32h 23m	0
Oct	**38.331**	45h 25m	0
Nov	**00.000**	00h 00m	0
Dec	**00.000**	00h 00m	0
Totals	**362.887**	401h 48m	0

IV. Unscheduled Shutdowns

Three (3) unscheduled shutdowns occurred in 2018. These were:

Number	Date	Cause
1138	03/12/18	CSC Computer was bumped in its drawer by operator, initiating a System Scram
1139	05/04/18	System Scram due to unknown cause
1140	06/13/18	NM-1000 timeout; unknown cause

NOTE: It was discovered during CY18 that the total number of unscheduled scrams was incorrect. The latest scram, number 1140, is actually the facility's 1143rd scram. Thus, the next unscheduled scram will be number 1144; scram numbers 1141 and 1142 will be skipped.

V. Significant Maintenance Operations

01/08/2018 Reg rod down limit switch replaced with spare. Drop test time ok; drive up/down time unchanged
06/21/2018 Replaced CAM alarm bell mechanism with new alarm bell mechanism.
8/20/2018 – 9/10/2018 The secondary cooling system water tank was excavated and replaced with a new tank; a few water lines running to this water tank were also replaced as needed during this operation.
08/30/2018 DOP tested Rx Bay emergency exhaust & Rm 151 hood exhaust HEPA filters. Rx bay filter >99.99% efficient; Rm 151 hood filter >99.99% efficient.
09/07/2018 Replaced CAM air pump motor with like motor.
10/22/2018 Adjusted low pressure setpoint on transient rod air supply from 50 psi to 65 psi.
10/22/2018 Performed annual surveillance on TR Drive IAW Procedure 28. Appearance and function OK; lubrication adequate; drop time <1 s.

VI. Summary of 10 CFR 50.59 changes

No 50.59 changes were made to the facility in CY 2018. One activity was screened for 50.59 applicability and it was evaluated not to 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 2018

Month	Argon-41 (Ci)	R-113 License Allowable (Ci)	Tritium -HTO (mCi) *	10CFR20 Allowable (mCi)
January	0.0117	5.833	0.113	124
February	0.0623	5.833	0.060	124
March	0.0662	5.833	0.095	124
April	0.0786	5.833	0.000	124
May	0.0273	5.833	0.146	124
June	0.0497	5.833	0.000	124
July	0.0840	5.833	0.000	124
August	0.0822	5.833	0.114	124
September	0.0607	5.833	0.105	124
October	0.0353	5.833	0.000	124
November	0.0000	5.833	0.124	124
December	0.0000	5.833	0.000	124

Month	Argon-41 (Ci)	R-113 License Allowable (Ci)	Tritium -HTO (mCi) *	10CFR20 Allowable (mCi)
Total	0.5580	70.000	0.757	1488
% of Allowable	0.797%	----------	0.051%	----------

* **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 2018 calendar year.

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 2018.

Isotope	µCi	µCi/ml	10 CFR 20 limit (uCi/ml)	% of limit
Na-24	1.474E-3	1.032E-13	7.00E-09	1.474E-3
Br-82	1.155E+0	4.012E-11	5.00E-09	8.024E-1

D. The facility exported 2 55-gallon drums of low-level radioactive waste to a broker in California on July 30 for management and eventual disposal in Utah.

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 January surveys, at 1311 pCi/100 cm^2 beta-gamma, located in Rm 151 at the foot of the fume hood used for sample transfers. Gamma spectroscopy revealed this contamination to be Au-198. Four days prior to this survey, a transfer of Au-198 in the form of gold chloride took place in the transfer hood in Rm 151. To facilitate a greater transfer efficiency from the irradiation capsule to the shipping container, water was sprayed into the capsule from a spray bottle several feet away. It is likely that during this spraying, some water splashed out of the capsule. Due to the very small area that was contaminated, and the small distance from the contaminated area to the hood, it is highly probable that only a tiny drop of water escaped the hood. No personnel contamination resulted from this contamination. Dose rates post- transfer were relatively low and did not necessitate posting of a high radiation area. After two iterations of cleaning and swiping, no more contamination was detected. Due to the stability of the gold chloride compound, it is estimated that none of the material was released to the environment.
The next highest contamination was found during the October surveys, at 1426 pCi/100 cm^2 beta-gamma, on the floor near the back table in the Reactor Bay. This contamination likely occurred when a rod for a central thimble sample dripped some contaminated water onto the floor. This area was subsequently decontaminated to levels below the removable contamination limit, and no personnel contamination nor environmental release occurred as a result. No areas were greater than 12.0 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. (NOTE: Neutron exposure was less than the minimum reportable doses for the badges throughout this time frame)

Table 3. Personnel Monitoring Results (12/1/17 – 11/30/18)

Employee code	Whole Body (Rem) Deep Dose Equiv.	Whole Body (Rem) Shallow Dose Equiv.	Extremity (Rem)
E0707	0.715	0.819	1.188
E0908	0.387	0.405	0.851
E0715	0.304	0.318	0.481

Air sampling performed during high-activity sample transfers (from irradiation container to shipping container) inside the Rm 151 fume hood showed that no bioassay program is required for the reactor staff for these operations. Although a bioassay program is not required, air sampling will still be conducted during future

high-activity transfers in order to assess radionuclide concentrations and dose to employees.

Reactor visitors and visiting experimenters wore electronic pocket dosimeters which showed that no individual's reading greater than 1.30 mRem in a single visit or as a cumulative annual dose.

Table 4. Environmental Dose Results (Oct 2017 through Sept 2018)

Location	Dose Oct.- Dec. (RAD)	Dose Jan-Mar (RAD)	Dose Apr-June (RAD)	Dose July-Sept. (RAD)	Total (RAD)
Control (Background)	0.067	0.064	0.068	0.056	0.255
Main Exhaust	0.061	0.069	0.043	0.063	0.236
West Vehicle Gate	0.012	0.012	0.000	0.011	0.035
West Room 151 Gate	0.080	0.067	0.043	0.033	0.223
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	0.000	0.000	0.000	0.000	0.000
Rx Fence Loading Dock	0.027	0.029	0.030	0.027	0.113
Tunnel	0.017	0.017	0.018	0.029	0.081

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

IX. 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.

Biennial soil samples were collected in August and analyzed on HPGe detectors for reactor-produced isotopes. 31 Soil samples and 5 water samples were collected from the area surrounding the GSTR. None of these samples identified any reactor-produced isotopes.

X. Fuel Inspection results

During the 60-month fuel element inspection five aluminum-clad fuel elements did not pass the go/no-go gauge. These elements were taken out of service and put in

storage. The other fuel elements passed the go/no-go gauge and the elongation measurement requirements.

The facility received 19 lightly used fuel from Idaho National Labs. Those fuel elements were inspected upon receipt. One of those elements was found to not pass to the go/no-go gauge and has been put into storage. The other 18 fuel elements passed the fuel inspection process.