



Department of the Interior
US Geological Survey
Box 25046 MS-974
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January 12, 2016

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

Dear NRC staff,

Enclosed is the 2015 annual report for the U.S. Geological Survey TRIGA non-power reactor facility.

The facility docket number is 50-274.

Sincerely,

A handwritten signature in cursive script that reads 'Timothy DeBey'.

Timothy M. DeBey
Reactor Supervisor

Enclosure

Copy to:
Geoffrey Wertz OWFN 12 D20

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NRC

U.S. GEOLOGICAL SURVEY TRIGA REACTOR

ANNUAL REPORT

JANUARY 1, 2015 - DECEMBER 31, 2015

NRC LICENSE No. R-113

DOCKET NO. 50-274

I. Personnel Changes:

Alex Buehrle terminated his employment at the reactor facility on 2/20/2015.
Clayton Manning was hired as a full-time employee at the reactor facility on 7/13/2015.

II. Operating Experience

The Geological Survey TRIGA Reactor (GSTR) was in normal operation for the year 2015. 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:

<u>Organization</u>	<u>Number of Samples</u>
USGS – INAA	537
USGS - Geochronology	1423
USGS – other	60
Non-USGS	<u>3025</u>
Total	5045

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

B. During the report period, 197 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 550.

III. Tabulation of Energy Generated

	<u>MWh operated</u>	<u>Critical hours</u>	<u>Pulses</u>
<u>Jan</u>	73.644	77h 33m	0
<u>Feb</u>	75.597	77h 30m	0
<u>Mar</u>	51.947	54h 35m	0
<u>Apr</u>	39.933	41h 47m	0
<u>May</u>	55.963	65h 33m	0
<u>June</u>	27.498	30h 34m	0
<u>July</u>	61.758	66h 04m	0
<u>Aug</u>	59.480	63h 53m	0
<u>Sept</u>	11.583	16h 56m	0
<u>Oct</u>	79.479	86h 04m	4
<u>Nov</u>	63.520	70h 00m	0
<u>Dec</u>	92.533	97h 44m	0
<u>Totals</u>	692.935	748h 13m	4

IV. Unscheduled Shutdowns

No unscheduled shutdowns occurred in 2015.

V. Significant Maintenance Operations

- 1/15 Vacuumed bottom of tank and other horizontal surfaces in tank
- 1/15 Replaced CAM detector with new LND detector
- 2/15 Replaced west belt on normal exhaust fan for reactor bay
- 2/15 CSC computer power supply failed; replaced unit with Thermaltake 650W
- 3/15 Replaced Action Pak modules with Universal Signal Conditioners for: power bar graphs #1 and #2, temp test, time delay, magnet voltage and magnet ground
- 3/15 Replaced Magnehelic air flow gauge on CAM with Photohelic 3008MR gauge
- 4/15 Moved CAM DC power supply, signal conditioners, and Ludlum 375 from standard wall socket to AC power from large UPS in reactor bay
- 5/15 Replaced prefilter in emergency exhaust duct
- 5/15 Replaced batteries in RAMs 4, 7, and 14
- 5/15 Replaced battery in UPS for Panther unit
- 5/15 Replaced all batteries in large UPS in reactor bay
- 5/15 Replaced window on swipe counter proportional detector
- 5/15 Replaced hard drive on Ar-41 monitor computer; installed Genie 2000
- 5/15 Replaced battery in Ludlum 375 that is part of the CAM
- 5/15 Replaced "drive down" limit switch on Reg Rod drive

- 6/15 Replaced ion exchange resin and replaced gasket at top of ion exchange tank
- 6/15 Cleaned ~8 nozzles and replaced 2 cracked nozzles on cooling tower
- 6/15 Replaced "T" connectors on HV & input for NPP1000 with "inline" connectors
- 7/15 Replaced Shim 1 "drive down" limit switch
- 7/15 Replaced sump pump in secondary system sump. New pump is Flotec Professional Model E75VLT with motor: ¾ HP, 115V, 80 GPM flow with 25 ft immersion height
- 8/15 Replaced ion exchange resin in Rm 151 DI water system
- 8/15 Added low pressure switch and LED indicator to secondary makeup water line
- 9/15 Replaced PB4 circuit board for OP3 with spare PB4 board from OP4 position in DAC; reused all solid state relay modules
- 11/15 Added blowdown line to clear debris in cooling tower header drain line
- 12/15 Replaced in-tank light on west side of reactor tank

VI. Summary of 10 CFR 50.59 changes

No 50.59 changes were made to the facility in CY 2014. Four activities were screened for 50.59 applicability and all were 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 2015

Month	Argon-41 (Ci)	R-113 License Allowable (Ci)	Tritium -HTO (mCi) *	10CFR20 Allowable (mCi)
January	1.282	5.833	0.12	124
February	1.277	5.833	0.11	124
March	1.166	5.833	0.0	124
April	0.775	5.833	0.13	124
May	0.966	5.833	0.0	124
June	0.408	5.833	0.10	124
July	0.705	5.833	0.00	124
August	0.901	5.833	0.10	124
September	0.051	5.833	0.0	124
October	0.914	5.833	0.0	124
November	0.898	5.833	0.13	124
December	0.989	5.833	0.14	124
Total	10.332	70.00	0.83	1488
% of Allowable	14.760%	-----	0.056%	-----

*** 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 2015 calendar year. One 55-gallon drum of solid waste from the reactor facility was shipped to a waste broker in California for ultimate burial in Clive, Utah.

C. Throughout the year Na-24, Mn-54, Co-60, Cu-64, Br-82, I-133, Cs-137, and Re-186 were observed on the CAM filter analyses. Conservative estimated releases for these isotopes are in Table 2.

Table 2. Releases of Other Isotopes in CY 2015.

Isotope	µCi	µCi/ml	10 CFR 20 limit (uCi/ml)	% of limit
Na-24	1.78E-03	1.20E-16	7.00E-09	1.71E-06
Mn-54	1.11E-05	7.46E-19	1.00E-09	7.46E-08
Co-60	1.56E-05	1.05E-18	5.00E-11	2.10E-06
Cu-64	6.23E-03	4.16E-16	3.00E-08	1.39E-06
Br-82	7.05E-03	4.74E-16	5.00E-09	9.48E-06
I-133*	3.83E-05	2.57E-18	1.00E-09	2.57E-07
Cs-137*	6.29E-05	4.23E-18	2.00E-10	2.12E-06
Re-186	6.13E-03	4.12E-16	2.00E-09	2.06E-05

*Note that these two isotopes are fission products. However, during the time period that these were detected (mid-August, 2015), the Denver, CO area was experiencing significant smoke in the atmosphere from large wildfires both in the Pacific Northwest part of the U.S. and the northwest part of Colorado. Smoke advisories were in effect in Denver and the GSTR CAM filters were accumulating significant smoke particles along with material that was made airborne through the fires. There were none of the "traditional" fission products seen that would have indicated a fuel element leak at the GSTR. After the smoke cleared, these fission products were no longer detected.

VIII. Radiation Monitoring

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

1. Nineteen gamma-sensitive area monitors 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.

2. One Continuous Air Monitor (CAM) does sampling of the air in the reactor bay. An equilibrium concentration of about 1.5×10^{-8} $\mu\text{Ci/ml}$ present for two minutes will result in an increase of about 500 cpm above background. The alarm setpoints are a low-level alarm set at 5000 cpm and the high level alarm set at 10000 cpm. Reactor bay air is sampled during all reactor operations. The fixed particulate air filter is changed each week and counted on a HPGE gamma spectrometer counting system. The charcoal filter, fitted behind the particulate air filter, is also changed and counted weekly. In all instances, sample data were less than allowable airborne concentrations 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 582.3 pCi/100 cm² beta-gamma, located in the reactor bay on the floor between the demineralizer pump and the west table. This area was successfully decontaminated below MDA. The next highest removable contamination found was 350.7 pCi/100 cm² beta-gamma in the reactor bay on the center of the westernmost table; this did not require decontamination. No areas were greater than 11.7 pCi/100 cm² alpha contamination, which does not require decontamination.

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 (12/1/14 – 11/30/15)

Employee code	Whole Body (Rem) Deep Dose Equiv.	Whole Body (Rem) Shallow Dose Equiv.	Extremity (Rem)
E0888	0.276	0.280	0.475
E0607	0.038	0.038	0.126
E0707	0.255	0.256	0.637
E0908	0.084	0.086	0.314
E0615	0.000	0.000	0.000
E0715	0.025	0.025	0.000

Reactor visitors and occasional experimenters wore electronic pocket dosimeters that resulted in no individual's reading greater than 1.3 mrem per a visit and no cumulative total annual dose greater than 4.6 mrem.

Table 4. Environmental Dose Results (Oct 2014 through Sept 2015)

Location	Dose Oct.- Dec. (RAD)	Dose Jan-Mar (RAD)	Dose Apr-June (RAD)	Dose July-Sept. (RAD)	Total (RAD)
Exhaust Stack	0.055	0.044	0.000	0.043	0.142
Cooling Tower Fence	0.000	0.000	0.000	0.000	0.000
West Vehicle Gate	0.000	0.033	0.022	0.013	0.068
West Room 151 Gate	0.076	0.070	0.059	0.054	0.259
Southwest Light Pole	0.000	0.000	0.000	0.000	0.000
Control badge (background)	0.054	0.048	0.063	0.057	0.222
Southeast Light Pole	0.000	0.000	0.000	0.000	0.000
Rx Fence Loading Dock	0.086	0.102	0.065	0.050	0.303

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

X. Environmental Monitoring

There were several isotopes detected on the CAM filters throughout the year resulting in very small releases of non-gaseous isotopes throughout the year. The isotopes of Na-24, Mn-54, Co-60, Cu-64, Br-82, I-133, Cs-137, and Re-186 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 2014 and will be taken again in 2016.