



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555-0001

December 23, 2019

Mr. Robert Horton, Reactor Administrator
Department of the Interior
U.S. Geological Survey
P.O. Box 25046, MS 911
Denver, CO 80225

SUBJECT: UNITED STATES GEOLOGICAL SURVEY – U.S. NUCLEAR REGULATORY
COMMISSION ROUTINE INSPECTION REPORT NO. 50-274/2019-201

Dear Mr. Horton:

From December 2-5, 2019, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at your U.S. Geological Survey TRIGA (Training, Research, Isotopes, General Atomics) Research Reactor facility. The enclosed report documents the inspection results, which were discussed on December 5, 2019, with you, Mr. Chris Farwell, Interim Reactor Supervisor, and Mr. Clayton Manning, Reactor Health Physicist.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, observed various activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Should you have any questions concerning this inspection, please contact Craig Bassett at (240) 535-1842 or by electronic mail at Craig.Bassett@nrc.gov.

Sincerely,

/RA/

Anthony J. Mendiola, Chief
Non-Power Production and Utilization
Facility Oversight Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-274
License No. R-113

Enclosure:
As stated

cc: See next page

U.S. Geological Survey

Docket No. 50-274

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Test, Research and Training
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SUBJECT: UNITED STATES GEOLOGICAL SURVEY – U.S. NUCLEAR REGULATORY
COMMISSION ROUTINE INSPECTION REPORT NO. 50-274/2019-201
DATED: DECEMBER 23, 2019

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No. 50-274

License No. R-113

Report No. 50-274/2019-201

Licensee: United States Geological Survey

Facility: U.S. Geological Survey TRIGA Reactor

Location: Building 15, Denver Federal Center
Denver, Colorado

Dates: December 2-5, 2019

Inspectors: Craig Bassett
Mike Takacs

Approved by: Anthony J. Mendiola, Chief
Non-Power Production and Utilization Facility
Oversight Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

United States Geological Survey
U.S. Geological Survey TRIGA Reactor
Inspection Report No. 50-274/2019-201

The primary focus of this routine, announced inspection was the on-site review of selected aspects of the U.S. Geological Survey (USGS, or the licensee's) Class II research and test reactor safety program including: (1) organization and staffing, (2) operations logs and records, (3) procedures, (4) requalification training, (5) surveillance and limiting conditions for operation (LCO), (6) experiments, (7) radiation protection, (8) environmental monitoring, (9) design changes, (10) committees, audits and reviews, (11) emergency planning, (12) maintenance logs and records, (13) fuel handling logs and records, and (14) transportation of radioactive materials since the last U.S. Nuclear Regulatory Commission (NRC) inspection of these areas. The licensee's program was acceptably directed toward the protection of public health and safety and generally in compliance with NRC requirements.

Organization and Staffing

- The organizational structure and staffing were consistent with the requirements specified in Section 6.1 of the facility technical specifications (TSs).

Operations Logs and Records

- Reactor operations and logs were acceptable and completed in accordance with procedural and TS requirements.

Procedures

- The procedural control and implementation program was acceptably controlled and maintained and met TS requirements.

Requalification Training

- The requirements of the Operator Requalification Program were being met; it was being acceptably implemented; and, the program was up to date.
- Medical examinations were being completed biennially as required.

Surveillance and Limiting Conditions for Operation

- The licensee's program for completing surveillance checks and tests and verifying LCO satisfied TS requirements.

Experiments

- Conduct and control of experiments and irradiations met the requirements specified in TS Section 6.5, the applicable experiment authorizations, and procedures.

Radiation Protection

- Periodic surveys were completed and documented as required by procedure.
- Postings, notices, and signs met regulatory requirements.
- Personnel dosimetry was being worn as required and recorded doses were well within the NRC's regulatory limits.
- Radiation survey and monitoring equipment was being maintained and calibrated as required.
- The Radiation Protection and as low as reasonably achievable (ALARA) Programs met regulatory requirements.
- The radiation protection training program was acceptable.

Effluents and Environmental Monitoring

- Effluent monitoring was in accordance with license and regulatory requirements and releases were within the specified regulatory and TS limits.
- The environmental protection program met NRC requirements.

Design Changes

- The licensee's design change protocol was being followed and design changes would generally be conducted in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Changes, test and experiments."

Committees, Audits and Reviews

- Audits and reviews conducted by the Reactor Operations Committee (ROC) were in accordance with the requirements specified in TS Section 6.2 and Section 3 of the Reactor Operations Manual.

Emergency Planning

- The facility Emergency Plan (E-Plan) was being reviewed by the ROC as required.
- Emergency response equipment was being maintained and alarms were tested at the required periodicity.
- Annual evacuation drills and biennial emergency drills were being conducted as required by the E-Plan.
- Emergency preparedness training for staff and first responders was being completed as required.

Maintenance Logs and Records

- The licensee's maintenance program was being implemented as required by facility procedures.

Fuel Handling

- Fuel handling activities and documentation were as required by the TSs and facility procedures.

Transportation of Radioactive Materials

- Shipments of radioactive material made under the reactor license were generally in compliance with NRC and Department of Transportation (DOT) regulations.
- One Non-Cited Violation was noted for failure to ship radioactive tracer material in accordance with 49 CFR 173.431 and 433 requirements.

REPORT DETAILS

Summary of Facility Status

As a result of past problems, the USGS TRIGA research and test reactor, licensed to operate at a maximum steady-state thermal power of 1 megawatt, was currently conducting limited operations in support of class work for the Colorado School of Mines, to complete required surveillance and maintenance work, and to allow the operators to complete their required hours of operation and maintain their qualifications. The research reactor had been placed under an administrative operational limit of 880 kilowatts (kW) as well. During the inspection the reactor was operated to support ongoing classroom work and surveillance activities.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure [IP] 69001, Section 02.01)

The inspector reviewed selected aspects of the following regarding the licensee's organization and staffing to ensure that the requirements of Section 6.1 of the facility TSs, implemented as Appendix A to the Facility Operating License, No. R-113, dated October 14, 2016, were being met:

- Current staff qualifications
- Staffing requirements for safe operation of the facility
- Organizational structure for the USGS TRIGA Reactor facility
- Reactor Operations Manual (ROM), Section 3, "Nuclear Center Organization," latest revision dated March 2017
- Geological Survey TRIGA Reactor (GSTR) Quarterly (Operations) Reports for each quarter between April 1, 2018, through June 30, 2019
- USGS TRIGA Reactor Annual Report for January 1, 2017, through December 31, 2017, submitted to the NRC on January 11, 2018
- USGS TRIGA Reactor Annual Report for January 1, 2018, through December 31, 2018, submitted January 31, 2019
- ROC meeting minutes for meetings held from October 2017 to April 2019
- American National Standards Institute/American Nuclear Society (ANSI/ANS) 15.4, "Selection and Training of Personnel for Research Reactors"

b. Observations and Findings

The organizational structure and staff responsibilities had not changed since the last NRC inspection of the facility (refer to NRC Inspection Report Number (No.) 50-274/2018-202). The facility remained under the direct control of the Reactor Supervisor (RS) and he was responsible to the Reactor Administrator for safe operation and maintenance of the reactor and its associated equipment.

The organization and staff responsibilities were as specified in, and required by, Section 6.1 of the TS, Section 3 of the ROM, and Figure 3.1 in the ROM. Section 3.4.1 of the ROM stated that the training and qualification requirements contained in ANSI/ANS-15.4 were the minimum for GSTR facility personnel. The

inspector confirmed that the reactor staff met ANSI/ANS-15.4 education, training, and experience requirements.

The inspector noted that staffing levels had changed somewhat since the previous inspection. One person, who had worked at the facility as the RS, had left. The current operations staff was now made up of the Interim RS and the Reactor Health Physicist for the GSTR. The staff members were both senior reactor operators (SROs) and worked full-time at the facility.

c. Conclusion

The licensee's organization and shift staffing were in compliance with the facility TS Section 6.1, and ROM Section 3.

2. Operations Logs and Records

a. Inspection Scope (IP 69001, Section 02.02)

The inspector reviewed selected aspects of the following to verify operation of the reactor in accordance with TS Sections 3, 4, 5 and 6:

- Daily TRIGA Prestart Test data sheet printouts for 2018 to date
- ROM, Section 5, "Operating Procedures," Revision (Rev.) 5, dated March 2017
- Reactor Operations Logbooks Nos. 176 – 177, dated June 25, 2018, to the present
- Staffing for operations as required by Section 5.2 of the ROM, Rev. 5
- Selected USGS TRIGA Reactor Facility Start-Up Checklists, Rev. 15, from the 2018 to the present
- Selected USGS TRIGA Reactor Facility Shutdown Checklists, Rev. 16, from 2018 to the present
- Selected USGS TRIGA Reactor Facility Monthly Checklists, Rev. 14, from 2018 to the present
- GSTR Quarterly (Operations) Reports for each quarter between April 1, 2018, through June 30, 2019
- ROC meeting minutes for meetings held from April 2018 to April 2019
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector reviewed the operations logs from June 2018 through the present. The inspector also reviewed selected Daily Start-Up and Shutdown Checklists and Monthly Checklists. From the records reviewed the inspector determined that reactor operations were carried out in accordance with written procedures as required by TS Section 6.4. Information on the operational status of the facility was appropriately recorded in logbooks or on checklists as required by ROM Section 5. Scrams were identified in the logs and records, and were reported and resolved as required before the resumption of operations. Through interviews with operators and review of the logs, the inspector confirmed that shift staffing met the minimum

requirements of at least two reactor staff members on duty whenever the reactor was operating as required by ROM Section 5.2.4.

The inspector noted that the licensee took action on October 26, 2018, to limit operation of the GSTR (until further notice) for the purpose of maintaining: (1) operator proficiency, (2) surveillances required by TS, and (3) student training.

c. Conclusion

Reactor operations and logs were acceptable and in accordance with procedural and TS requirements.

3. Procedures

a. Inspection Scope (IP 69001, Section 02.03)

To ensure that safety standards and written instructions for those activities specified in TS Section 6.4 were in effect, the inspector reviewed selected aspects of the following:

- Selected GSTR procedures
- Procedural implementation by the reactor staff
- Records of changes and temporary changes to procedures
- Various ROM Sections including: No. 4, "Administrative Procedures," No. 5, "Operating Procedures," which contained the various GSTR Procedures, and No. 8, "Radiation Protection Program"
- ROC meeting minutes for meetings held from April 2018 to April 2019
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector reviewed ROM Sections 4 and 8, and selected GSTR procedures contained in ROM Section 5. These ROM Sections and GSTR procedures provided guidance for administrative, operational, and health physics (HP) functions of the facility. The inspector confirmed that written procedures were available for those tasks and items required by TS Section 6.4. The licensee controlled changes to procedures and the ROC conducted the review and approval process as required. The inspector noted that the GSTR procedures were reviewed biennially as required by the ROM.

After reviewing the 2018 and 2019 training records and interviewing staff members, the inspector determined that the training of personnel on procedures was adequate. During tours of the facility, the inspector observed that personnel performed facility operations and tasks in accordance with applicable procedures.

c. Conclusion

The procedural control and implementation program were acceptably conducted and maintained and met TS requirements.

4. Requalification Training

a. Inspection Scope (IP 69001, Section 02.04)

To verify that the licensee was complying with the requirements of their NRC-approved Operator Requalification Program and 10 CFR Part 55, "Operators' Licenses," the inspector reviewed selected aspects of:

- Operator competence evaluation and written examination records for 2018, and to the present
- Physical examination records documented on NRC Form 396 records
- Individual operator training records documented on "Geological Survey TRIGA Reactor (GSTR) Reactor Operator Requalification On the Job Training," forms for the periods from December 2018 to the present
- Appendix 3-1 (to ROM, Section 3), entitled "U.S. Geological Survey TRIGA Reactor Operator Requalification Program," latest Rev. dated April 2014 which included the "GSTR Fitness for Duty Policy for Licensed Reactor Operators," dated April 2010

b. Observations and Findings

There were two licensed SROs at the facility. The inspector reviewed the operators' training records and confirmed they were being maintained as required. The records showed that the operators were knowledgeable of the appropriate subject material required by the program as demonstrated by successful completion of annual written examinations. Individual requalification records also showed that each operator demonstrated operational competence which was affirmed by the RS as required by the requalification program. The inspector further confirmed that all the operators had completed the required reactivity manipulations and the quarterly hours of operation required by the program. Requalification training lectures were documented for both operators.

The inspector noted that the operators were also receiving biennial medical examinations as required by 10 CFR Part 55, Subpart C.

c. Conclusion

The requirements of the Operator Requalification Program were being met and the program was being acceptably implemented. Medical examinations were being completed biennially as required.

5. Surveillance and Limiting Conditions for Operation

a. Inspection Scope (IP 69001, Section 02.05)

To verify that the surveillance program was being conducted as required in TS Sections 3 and 4, the inspector reviewed selected aspects of the following:

- Reactor Activity Calendar maintained by the RS
- Surveillance, calibration, and test data sheets and related records
- Reactor Operations Logbooks Nos. 176 – 177, dated June 25, 2018, to present
- Selected USGS TRIGA Reactor Facility Start-Up Checklists, Rev. 15 from 2018 to the present
- Selected USGS TRIGA Reactor Facility Shutdown Checklists, Rev. 16, from 2018 to the present
- Selected USGS TRIGA Reactor Facility Monthly Checklists, Rev. 14, from 2018 to the present
- GSTR Quarterly (Operations) Reports for each quarter between April 2018 to June 2019
- ROC meeting minutes for meetings held from April 2018 to April 2019
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector reviewed selected records of TSs required checks, tests, and LCO verifications performed since April 2018. These included the daily checklists that provided documentation of control rod scram, withdraw prevent, interlock functions, and weekly conductivity tests, as well as monthly surveillance checks of the reactor ventilation system, building alarms, radiological safety, and reactor water system. The inspector observed three TS required surveillance activities performed by one of the SROs which included: (1) a channel check of the reactor tank bulk water temperature alarm setpoint, (2) the reactor tank water conductivity check, and (3) the channel test of a continuous air monitor. Other periodic surveillances and verifications were reviewed including power calibrations, control rod inspections, and fuel elements inspections. The review showed that the periodic checks, tests, and LCO verifications for TS required surveillances were completed as required. The results of these activities were within prescribed TS limits and procedure parameters and in agreement with the previous surveillance results.

The various surveillance checks, inspections, and verifications reviewed were being tracked through the Daily Checklists, Monthly Checklists, and equipment-specific surveillance forms. Documentation of completion of these activities was maintained in the appropriate checklists or on forms and in the Operations or Fuel Logbooks. This system was found to provide adequate control of the reactor operational tests and checks, and LCO verifications. Good correlation was noted between the console logs, checklists and other logbooks.

c. Conclusion

The licensee's program for surveillance checks and LCO verifications satisfied TS requirements.

6. Experiments

a. Inspection Scope (IP 69001, Section 02.06)

The inspector reviewed selected aspects of the following to verify that experiments were conducted in compliance with TS Sections 3 and 4, and ROM, Section 4, and were reviewed and approved as required by TS Section 6.5:

- Selected Experiment Authorizations, logs, and records
- Reactor Operations Logbooks Nos. 176 – 177, dated June 25, 2018, to the present
- Experiment program requirements contained in ROM Sections 4.5 through 4.8
- GSTR Experiment Authorization Forms including Parts I, II, and III for Experiment Nos. L-119, L-124, C-35, C-55, C-61, P-13, O-1, O-18, and O-26
- Selected GSTR Radioisotope Request and Receipt Forms which had been completed during June 2016 through the present
- ROC meeting minutes for meetings held from April 2018 to April 2019
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The RS categorized experiments at the GSTR as either Class I or Class II experiments. Class I experiments were those that had been performed previously or were minor modifications to previous experiments. They were classified and approved by the RS. Class II experiments were new experiments or major modifications of previously existing ones. These were reviewed and approved by the ROC. All experiments that were currently used at the facility were also required to be reviewed on an annual basis by the RS.

The inspector reviewed various Class I Experiment Authorization Forms. The authorization forms listed a description of the experiment, the experiment class, limiting conditions for reactor operations, personnel authorized to deliver and/or pick up samples, and the license number of the authorized recipient. All the experiments had the proper classification as required. The annual review was late this year due to the limitations placed on reactor operations.

Through the review of current experiment authorizations, radioisotope request and receipt (RR&R) forms, and related reactor logbook entries, the inspector confirmed that experiments were typically installed, performed, and removed as outlined in the approved experiment authorizations. The inspector also verified that the various RR&R forms were used to list the radioisotopes produced during the irradiation and the disposition thereof. The inspector determined that the resulting radioisotopes were appropriately controlled and held for decay or transferred as required. This information was appropriately documented on the RR&R forms.

c. Conclusion

The control and performance of experiments were acceptable and in accordance with the applicable Experiment Authorizations and TS Section 6.5 requirements.

7. Radiation Protection

a. Inspection Scope (IP 69001, Section 02.07)

The inspector reviewed selected aspects of the following to verify compliance with 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigation" and 10 CFR Part 20, "Standards for Protection against Radiation," and TS Section 3.7 requirements:

- Radiological signs and posting in various areas of the facility
- Training records for GSTR staff and various support personnel
- HP Quarterly Reports for 2018 through 2019 to date
- USGS TRIGA Reactor Quarterly Reports for 2018 through 2019 to date
- USGS TRIGA Reactor Monthly Checklists for the past 2 years
- GSTR Annual Audit of Radiation Exposures and Radioactive Material Releases for 2018 and 2019
- Routine periodic survey and monitoring records for the past 2 years documented on radiological survey maps
- Maintenance and calibration records of radiation monitoring equipment for the past 2 years documented in the instrument calibration log
- GSTR Radiation Protection Program as outlined in ROM, Chapter 8, "Radiation Protection Program," latest revision dated October 2018, including: Section 8.1, "Radiation Protection Policy;" Section 8.2, "Health Physics Training;" Section 8.3, "Radioactive Material Control;" Section 8.4, "Radiation Monitoring;" Section 8.5, "Instrumentation;" Section 8.6, "Records;" Section 8.7, "Emergency Response and Exposure Guidelines;" Section 8.8, "Declared Pregnant Woman Guidelines;" and, Section 8.9, "Planned Special Exposures"
- Various ROM GSTR Procedures including: Procedure No. 15, "Pocket Dosimeter Drift Check Procedure;" Procedure No. 16, "Pocket Dosimeter Calibration Procedure;" and, Procedure No. 20, "Procedure for Radiation Instrument Calibrations"
- The ALARA Program outlined in ROM Chapter 8, dated November 22, 2011, and recent ALARA reviews
- GSTR 2017 Annual Audit of Radiation Exposure and Radioactive Material completed by the RS and dated January 11, 2018
- GSTR 2018 Annual Audit of Radiation Exposure and Radioactive Material completed by the RS and dated February 22, 2019
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

(1) Surveys

Selected start-up and monthly radiation and/or contamination surveys were reviewed by the inspector. The surveys had been completed by

staff members as required. Any contamination detected in concentrations above established action levels was noted and the area or item was decontaminated. Results of the surveys were documented and posted so that facility personnel would be knowledgeable of the radiological conditions that existed in the controlled areas of the facility.

(2) Postings and Notices

Radiological signs were posted at the entrances to controlled areas. Caution signs, postings, and controls for radiologically controlled areas were as required in 10 CFR Part 20, Subpart J. Other postings at the facility showed the industrial hygiene hazards that were present in the areas as well.

Copies of NRC Form 3, "Notice to Employees," noted at the facility were the latest version, as required by 10 CFR 19.11, "Postings of notices to workers," and were posted in various areas throughout the facility. These locations included the bulletin boards in the hallways by each entrance to the facility protected area and in the hallway by the facility calibration range. Copies of other notices to workers were posted in appropriate areas in the facility as well.

(3) Dosimetry

The inspector determined that the licensee used thermoluminescent dosimeters (TLDs) for whole body monitoring of beta and gamma radiation exposure with an additional component to measure neutron radiation. The licensee used TLD finger rings for extremity monitoring. The dosimetry was supplied and processed by a National Voluntary Laboratory Accreditation Program accredited vendor (currently Mirion Technologies [GDS] Inc.). An examination of the TLD results, indicating exposure to radiation at the facility for the past 2 years, showed that the highest occupational doses, as well as doses to the public, were well within 10 CFR Part 20 limits.

(4) Radiation Monitoring Equipment

Examination of selected radiation monitoring meters indicated that the instruments had the acceptable up-to-date calibration sticker attached. The instrument calibration records indicated that calibration of portable survey meters was typically completed by licensee staff personnel. However, some instruments, including the neutron detection instruments, were shipped to vendors for calibration. Calibration frequency met procedural requirements and records were maintained as required. Area radiation monitors and stack monitors were also being calibrated as required.

(5) Radiation Protection and ALARA Programs

The licensee's Radiation Protection and ALARA Programs were established and described in ROM Chapter 8 and through associated

GSTR procedures that had been reviewed and approved. The programs contained instructions concerning organization, training, monitoring, personnel responsibilities, audits, record keeping, and reports. The ALARA Program provided guidance for keeping doses ALARA and was consistent with the guidance in 10 CFR Part 20.

The inspector also determined that the licensee had conducted an annual review of the Radiation Protection Program for 2017 and 2018 in accordance with 10 CFR 20.1101, "Radiation protection programs," paragraph (c). This had been completed by the RS. In addition, annual audits of the ALARA Program had been conducted by USGS Radiation Safety Committee.

The licensee did not have or require a respiratory protection program.

(6) **Radiation Protection Training**

The inspector reviewed the radiation worker (Rad Worker) training given to staff members, to those who are not on staff but who are authorized to use the experimental facilities of the reactor, and to support personnel. Initial Rad Worker training was given to everyone before they started work in the facility. Refresher training for reactor staff was given every 2 years; everyone else received refresher training every 3 years. The inspector noted that the last refresher training had been conducted on May 21, 2019.

The initial and refresher training covered the topics specified in 10 CFR Part 19 as required. Training records showed that personnel were acceptably trained in radiation protection practices. The training program was acceptable.

c. **Conclusion**

The inspector determined that the Radiation Protection and ALARA Programs, as implemented by the licensee, were in accordance with regulatory requirements. Specifically, (1) periodic surveys were completed and documented acceptably to permit evaluation of the radiation hazards present; (2) notices and postings met regulatory requirements; (3) personnel dosimetry was being worn as required and recorded doses were well within the NRC's regulatory limits; (4) radiation survey and monitoring equipment was being maintained and calibrated as required; and (5) the radiation protection training program was acceptable.

8. Effluents and Environmental Monitoring

a. **Inspection Scope (IP 69001, Section 02.07)**

To determine that the licensee was complying with the requirements of 10 CFR Part 20 and TS Section 3.7, the inspector reviewed selected aspects of:

- GSTR "Argon-41 [Ar-41] Record" logbook
- Environmental monitoring release records

- GSTR “Environmental TLD” results logbook GSTR “H-3 in Reactor Water” logbook tracking gross alpha and beta activity in reactor water and cooling water
- Various ROM GSTR Procedures including: Procedure No. 17, “Procedure for Determining Argon-41 Release;” Procedure No. 20, “Procedure for Radiation Instrument Calibrations;” and, Procedure No. 22, “Procedure for Analysis of Stack Gas Radionuclides”
- Calibration records for the Ar-41 monitor (stack), area monitors, and the continuous air monitor for the past 2 years
- The two most recent USGS TRIGA Reactor Annual Reports
- The two most recent GSTR Annual Audits of Radiation Exposure and Radioactive Material completed by the RS

b. Observations and Findings

On-site and off-site gamma radiation monitoring was completed using the reactor facility stack effluent monitor, various environmental monitoring TLDs, and area monitors in accordance with the applicable procedures. Data indicated that there were no measurable doses above any regulatory limits. Biennial environmental soil and water samples were taken in December 2018 and analyzed. No reactor-produced isotopes were identified in the samples.

The inspector determined that gaseous releases continued to be monitored and calculated as required, were acceptably documented, and were within the annual dose constraint of 10 millirem stipulated in 10 CFR 20.1101(d), 10 CFR Part 20, Appendix B concentrations, and TS limits. Environmental Protection Agency COMPLY and CAP88-PC code calculations also indicated that the facility was in compliance with effluent emissions.

The program for the monitoring, storage, and/or transfer of radioactive liquid and solids was consistent with applicable regulatory requirements. No liquid discharges had been made during 2017 and 2018. Solid radioactive material was monitored and released when below acceptable limits or was shipped to a waste processing facility for disposal. The principles of ALARA were acceptably implemented to minimize radioactive releases. Monitoring equipment was acceptably maintained and calibrated. Records were current and acceptably maintained.

c. Conclusion

Effluent monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and TS limits.

9. Design Changes

a. Inspection Scope (IP 69001, Section 02.08)

To verify that the licensee had met the design change requirements of 10 CFR 50.59 and TS Section 6.2, the inspector reviewed selected aspects of:

- GSTR Experimental Authorization Forms
- Facility design change (10 CFR 50.59) records for the past 2 years
- ROC meeting minutes for meetings held from April 2018 to April 2019
- ROM Administrative Procedure, Section 4.5, "Experimental Review and Approval," dated March 2017
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector determined that design changes at the GSTR were initiated by a facility staff review followed by a ROC review and subsequent approval of the changes. The inspector determined that all staff members were familiar with the design change procedure.

A follow-up on a previously identified unresolved item (URI) will be discussed in Section 15 of this report. This URI concerned the adequacy of the licensee's 10 CFR 50.59 review of the movement of lightly used fuel elements acquired from Department of Energy (DOE) and placing some of those elements in the core.

c. Conclusion

The licensee's design change program was being followed and design changes would generally be conducted in accordance with 10 CFR 50.59.

10. **Committees, Audits and Reviews**

a. Inspection Scope (IP 69001, Section 02.09)

To verify that the licensee had established and conducted reviews and audits as required by TS Section 6.2, the inspector reviewed selected aspects of:

- Safety records review and audit reports for the past 2 years
- Responses to the safety reviews and audit reports for the past 2 years
- ROC meeting minutes for meetings held from April 2018 to April 2019
- ROM, Section 3, "Nuclear Center Organization," latest revision dated March 2017, detailing ROC jurisdiction, structure, quorum, meetings, and responsibilities
- ROM, Section 4, "Administrative Procedures," latest revision dated March 2017, containing ROC charter, outlined in the USGS Manual, 308.44, "Reactor Operations Committee," dated February 5, 1999
- ROC Operational Audits dated April 5, 2016, March 27, 2017, and April 27, 2018
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The ROC was meeting semiannually as required and committee membership satisfied TS Section 6.2.1, ROC charter, and ROM Section 3.8 requirements. Review of the meeting minutes from April 2018 through April 2019 indicated that

the committee provided guidance, direction, and oversight for the reactor and ensured suitable and safe reactor operations.

The ROC minutes and audit records showed that safety reviews and individual audits had been completed at the required frequency for the functional areas specified by TS Sections 6.2.3 and 6.2.4. The inspector noted that audit topics included reactor operations, maintenance and operations logs, facility procedures, the operator requalification program, fuel movement, the radiation protection program, emergency preparedness, and the physical security plan. The inspector reviewed the results of the audits that had been completed and determined that the audit findings, and licensee actions taken in response to the findings, were acceptable.

c. Conclusion

Audits and reviews conducted by the ROC were in accordance with the requirements specified in TS Section 6.2 and Section 3 of the ROM.

11. **Emergency Planning**

a. Inspection Scope (IP 69001, Section 02.10)

To verify compliance with the facility E-Plan entitled, "Emergency Plan for the U.S. Geological Survey TRIGA Reactor Facility," Rev. 16, dated October 2017, the inspector reviewed selected aspects of:

- Emergency drills and critiques for 2018 and 2019
- GSTR Emergency Call List, last updated April 2019
- One offsite support agreement letter and related information
- Emergency response facilities, supplies, equipment, and instrumentation
- Emergency Plan implementing procedures contained in ROM Section 7, "Emergency Procedures," revision dated October 2017
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector verified that the E-Plan in use at the facility was the same as the version most recently submitted to the NRC. The E-Plan was audited and reviewed at least biennially (typically done annually) by the ROC as required by TS Section 6.2.4. The implementing procedures were reviewed and revised as needed.

The inspector verified that annual evacuation drills, and biennial emergency exercises were being conducted as required. Critiques were held following the drills and exercises and strengths, as well as areas for improvement, were identified and discussed. The inspector also determined that the emergency equipment and portable detection instrumentation listed in the emergency procedures were available and being tested and maintained as required by the E-Plan and various GSTR procedures.

The inspector reviewed the letter of agreement (LOA) that had been established with the offsite medical support organization, St. Anthony Hospital. The LOA was required to be updated biennially. The most recent version was dated June 17, 2019, and it indicated that the hospital would assist in the decontamination and treatment of radiologically contaminated patients. The inspectors toured the Hospital Decontamination Facility and found it to be very well organized and thoroughly supplied. The inspectors also interviewed the Hospital Emergency Preparedness Coordinator and found this individual to be very knowledgeable on the facility's response capabilities to a radiological emergency at the GSTR facility.

Through reviews of training records and interviews with GSTR personnel, the inspector confirmed that emergency response review and training was completed as required by the E-Plan and the Operator Requalification Plan. Emergency responders were knowledgeable of the proper actions to take in case of an emergency. Fire Department personnel were being trained biennially as required by the plan.

The E-Plan also required the reactor staff personnel to contact the local DOE Radiological Assistance Program team and verify their contact information. This was being done as required. In addition, the facility emergency call list was required to be reviewed and updated at least biennially. The call list had been updated in March 2019.

c. Conclusion

The inspector concluded that the emergency preparedness program was conducted in accordance with the E-Plan. Specifically: (1) the E-Plan and implementing procedures were being reviewed biennially as required, (2) emergency response equipment was being maintained and alarms were being tested as required, (3) an LOA with an offsite support organization was being maintained, (4) drills were being conducted as required, and (5) emergency preparedness training was being completed.

12. Maintenance Logs and Records

a. Inspection Scope (IP 69001, Section 02.11)

To verify that the maintenance program was being conducted as required in TS Sections 3, 4 and 5, the inspector reviewed selected aspects of:

- Various facility maintenance procedures
- USGS TRIGA Reactor Maintenance Log
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector reviewed selected maintenance guidance documents and records, including the maintenance log. This log was used effectively to document detailed maintenance activities completed on specific items of equipment including the primary and secondary pumps, exhaust fans, the cooling tower, and

electronic equipment. The records reviewed indicated that routine and preventive maintenance was controlled, conducted, and documented in the maintenance or operations log consistent with licensee procedures. Verifications and operational systems checks were performed to ensure system operability before an item of equipment or a system was returned to service. Unscheduled maintenance or repairs were reviewed to determine if the situation required a 10 CFR 50.59 evaluation. The inspector observed the SRO successfully perform the monthly maintenance on a continuous air monitor.

c. Conclusion

The licensee's maintenance program was being implemented as required by GSTR procedures.

13. Fuel Handling

a. Inspection Scope (IP 69001, Section 02.12)

To verify that reactor fuel was handled, moved, inspected, and stored in compliance with TS Sections 4.1, 5.3, and 5.4, the inspector reviewed selected aspects of the following:

- Fuel movement and examination records
- Fuel handling equipment and instrumentation
- Fuel Element Location Board maintained in the Reactor Room
- GSTR Fuel Books containing the various USGS TRIGA Reactor Fuel Element History sheets for all the elements at the facility, Fuel Movement sheets, and Fuel Inspection forms and information
- Reactor Operations Logbooks Nos. 176 – 177, dated June 2018 to the present
- Various GSTR Procedures including: No. 4, "Procedure for Fuel Loading and Unloading;" No. 8, "Procedure for Measuring Fuel Elements;" No. 9, "Procedure for Locating Fuel Element Cladding Failure;" and, No. 25, "Procedure for Visual Verification of (1) Aluminum-Clad Fuel Element Locations and (2) number of Fuel Elements in Reactor Core"
- GSTR Quarterly (Operations) Reports for each quarter between April 2018 to June 2019
- ROC meeting minutes for meetings held from April 2018 to April 2019
- The two most recent USGS TRIGA Reactor Annual Reports

b. Observations and Findings

The inspector reviewed fuel handling at the facility and found that the appropriate fuel logs and inspection records were being maintained. It was noted that fuel movements were planned and a written sequence developed prior to completing the actual transfers and were documented in the console logbook and appropriate fuel logbook. Log entries were as specified in the facility procedures and fuel inspection met TS Section 4.1 requirements. Through review of the fuel movement and inspection records and interviews with operations staff, the inspector verified that fuel was moved and controlled according to established

procedure. The inspector verified that the fuel was being inspected every 5 years as required. The inspector also verified that fuel was being stored in the locations indicated by licensee records and as required in TS Sections 5.3 and 5.4.

c. Conclusion

Fuel handling activities and the documentation thereof were acceptable and in accordance with procedural and TS requirements.

14. Transportation of Radioactive Materials

a. Inspection Scope (IP 86740)

To verify compliance with regulatory and procedural requirements for the transfer or shipment of licensed radioactive material, the inspectors reviewed the following:

- HP Logbook
- Training records of staff members responsible for shipping and receiving licensed radioactive material
- ROM GSTR Procedure No. 23, "Procedure for Receipt of Radioactive Material Shipments"
- ROM GSTR Procedure No. 29, "Procedure for Fuel Unloading Operations at the USGS TRIGA Facility"
- Letter from the licensee to the NRC dated June 29, 2018, documenting a self-reported violation of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," requirements
- Letter from the licensee to the NRC dated August 9, 2018, with the subject: "Request for Approval for Use of Alternative A2 Value for Isotope Br-80m under Appendix A to 10 CFR 71"
- Letter from the licensee to the DOT dated August 9, 2018, with the subject: "Request for Approval for Use of Alternative A₂ Value for Isotope Br-80m under 49 CFR § 173.433"
- Letter from the DOT to the licensee dated October 3, 2018, approving the licensee's request to use an alternate A₂ value for Bromine-80m

b. Observations and Findings

(1) Routine Transportation Activities

The inspector verified that those facility personnel designated as "shippers" had received training covering the various requirements of the DOT and the International Air Transport Association and that the training was current.

Through records review and discussions with licensee personnel, the inspector determined that the licensee had shipped various types of radioactive material during the past 2 years. The records indicated that the types and quantities of the radioisotopes involved were calculated and dose rates measured as required. The radioactive material shipment

records reviewed by the inspectors had been completed in accordance with DOT and NRC regulations except as noted below.

(2) Self-Identified Violation of DOT and NRC Regulations

49 CFR 173.431(a) requires that, "Except for LSA material and SCO, a Type A package may not contain a quantity of Class 7 (radioactive) materials greater than A_1 for special for Class 7 (radioactive) material or A_2 for normal form Class 7 (radioactive) material as listed in § 173.435, or, for Class 7 (radioactive) materials not listed in §173.435, as determined in accordance with § 173.433."

49 CFR 173.433(d) requires that, "Mixtures of radionuclides whose identities and respective activities are known must conform to the following conditions:" and subpart (5) states "Alternatively, the A_2 value for mixtures of normal form material may be determined as follows:

$$A_2 \text{ for mixture} = \frac{1}{\sum_i \frac{f(i)}{A_2(i)}}$$

Where:

$f(i)$ is the fraction of activity for normal form radionuclide i in the mixture; and

$A_2(i)$ is the appropriate A_2 value for radionuclide i ."

49 CFR 173.433(g) requires that, "For mixtures of radionuclides, the radionuclides (n) that must be shown on shipping papers and labels in accordance with §§172.203 and 172.403 of this subchapter, respectively, must be determined on the basis of the following formula:

$$\sum_{i=1}^n \frac{a_{(i)}}{A_{(i)}} \geq 0.95 \sum_{i=1}^{n+m} \frac{a_{(i)}}{A_{(i)}}$$

Where:

$n + m$ represents all the radionuclides in the mixture;

m are the radionuclides that do not need to be considered;

$a_{(i)}$ is the activity of radionuclide i in the mixture; and

$A_{(i)}$ is the A_1 or A_2 value, as appropriate for radionuclide i ."

During the inspection, the licensee informed the inspectors of a problem they had identified during their review of their radioactive material shipping program. When they first began making and shipping Bromine-82 (Br-82) tracer material in the 2011 timeframe, they were aware that three additional isotopes were also produced. These isotopes were Br-82 metastable (Br-82m), Br-80m, and Br-80. Calculations were apparently performed during that period to identify what isotopes would need to be listed on the shipping label to comply with the regulations in

49 CFR 173.433. It appears that the determination was made at that time that Br-82 accounted for greater than 95 percent (95%) of the hazard according to the formula provided in 49 CFR 173.433(g) and therefore was the only isotope that needed to be listed on the shipping papers and label.

Last year, during their review of the radioactive material shipping program, they re-checked the calculations for all tracers they produced and shipped and discovered that the calculations performed previously (in ~2011) were incorrect. They discovered that, during the past 3 years, Br-80m should also have been included along with Br-82 on the majority of the shipping labels in violation of 49 CFR 173.433(g). They also calculated the total quantity of material allowed to be transported in a Type A package for the mixture of Br-80m and Br-82 and found that, on a very few occasions in the past three years the sum of the nuclides was greater than 1 which was a violation of 49 CFR 173.431 and 173.433(d)(2).

As a result of these problems, the licensee took various corrective actions. The licensee provided the inspectors with copies of letters documenting these violations that they had identified and what they had done to resolve the issue. On June 29, 2018, they submitted a letter to the NRC documenting the violations. Later, on August 9, 2018, the licensee submitted letters to the NRC and the DOT requesting approval to use an alternative A_2 value for the isotope Br-80m. By letter dated October 3, 2018, the DOT approved the licensee's request for an alternate A_2 value for Br-80m which would resolve the problem.

The licensee was informed that this non-willful, licensee-identified and corrected violation would be treated as a Non-Cited Violation (NCV), consistent with Section 2.3.2 of the NRC Enforcement Policy (NCV 50-274/2019-201-01). This NCV will be considered closed.

However, because the NRC has not yet granted approval for the use of an alternate A_2 value for shipping Br-80m as required by 10 CFR Part 71, this issue, namely the licensee's request for approval to use an alternative A_2 value to ship radioactive tracer material (Br-80m), will be identified as an Inspector Follow-up Item (IFI 50-274/2019-202).

c. Conclusion

Radioactive material was generally being shipped in accordance with the applicable NRC and DOT regulations. One NCV was noted for failure to ship radioactive tracer material in accordance with 49 CFR 173.431 and 173.433 requirements.

15. Follow-up on Previously Identified Issues

a. Inspection Scope (IP 92701)

The inspector reviewed the following URI with the licensee:

- 50-274/2018-202-01 – URI – Review the adequacy of the licensee's 10 CFR 50.59 review concerning movement of the lightly used fuel acquired from DOE and placing some of the elements into the core.

b. Observations and Findings

During an inspection in 2018, the inspector reviewed the design change program at the facility. The design change review process included a "screening" review to determine if a 10 CFR 50.59 evaluation was necessary. From the review of the changes made at the facility at that time, as well as through interviews with licensee personnel, the inspector determined that a 10 CFR 50.59 design change screening had been completed for each. According to the licensee, all the changes had "screened-out" and did not require an evaluation using the criteria listed in 10 CFR 50.59(c)(1) and (2). The NRC inspector noted from past experience that items that typically do not screen-out include: (1) changes to the facility as described in the safety analysis report (SAR), (2) changes to procedures governing safety-related equipment as described in the SAR, and (3) conduct of tests or experiments not described in the SAR.

Upon reviewing one 10 CFR 50.59 design change, the inspector noted that it involved relocating fuel elements within the reactor core and adding additional fuel elements to the reactor core. The licensee completed a screening form for the proposed change which indicated that the fuel movement and addition to the core "screened-out" and thus did not require any further evaluation in accordance with the criteria of 10 CFR 50.59. The licensee's screening review indicated that the primary document used for the review was the safety evaluation report (SER) that had been written by the NRC to support the 2016 USGS license renewal review. The licensee indicated that they had completed a separate Monte Carlo N-Particle Transport (MCNP) code calculation before replacing some of the fuel elements in the core with "lightly used" elements acquired from the DOE Idaho National Laboratory. Despite doing their own MCNP calculations, the licensee relied on the information and conclusions in the SER in reaching their conclusion that no further evaluations were needed before loading the lightly used fuel into their core. The NRC inspector was not clear how a proposed facility change (i.e., core reconfiguration) that "screened-out" would need to be supported by new or additional MCNP analyses.

Furthermore, the inspector observed that the ROC did not agree with the 10 CFR 50.59 screening concerning this issue and indicated that the licensee's SAR did not align with the NRC SER. Also, the ROC (and the NRC inspector) had questions about the thermo-hydraulic analysis for the limiting core configuration. Because of all these issues, the NRC questioned whether the licensee's screening of the fuel movement and addition constituted a sufficient review on their part and found that further evaluation was needed to completely characterize the effectiveness of the licensee's design control process. The

licensee was informed that this issue would be considered an URI which would require further consideration and review.

During this inspection, the inspector discussed this issue with the licensee and reviewed various associated documents. It was noted that facility management had placed an administrative limit of 880 kW on reactor operations so that the licensee did not exceed 14.0 kW peak power in any single element. This was a power level listed in the SAR. Also, the ROC had indicated that the licensee should perform an NRC-accepted thermal-hydraulics analysis of the core (or have one performed) and then, using that data, submit a license amendment request to the NRC to amend the currently approved SAR. The licensee indicated that this was the course of action that was planned. This issue remains open.

c. Conclusion

The issue of the adequacy of the 10 CFR 50.59 process was discussed but not yet resolved. This issue remains open.

16. Exit Interview

At the conclusion of the inspection, the inspector reviewed the inspection results with members of licensee management on December 5, 2019. The licensee acknowledged the findings presented and did not identify as proprietary any of the material provided to or reviewed by the inspector during the inspection.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

C. Farwell	Reactor Supervisor and Senior Reactor Operator
R. Horton	Reactor Administrator
C. Manning	Reactor Health Physicist and Senior Reactor Operator

Other Personnel

D. Young	Operations Supervisor, Mega Center Dispatch, Denver Federal Center
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INSPECTION PROCEDURE (IP) USED

IP 69001	Class II Research and Test Reactors
IP 86740	Transportation of Radioactive Material
IP 92710	Follow-up on Previously Identified Items

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-274/2019-201-01	NCV	Failure to ship radioactive tracer material (Br-80m) in accordance with 49 CFR 173.431 and 173.433 requirements.
50-274/2019-202-01	IFI	Follow-up on the licensee's request for approval to use an alternative A ₂ value to ship radioactive tracer material (Br-80m) in accordance with 49 CFR 173.431 and 173.433 requirements.

Discussed

50-274/2018-202-01	URI	Review the adequacy of the licensee's 10 CFR 50.59 review concerning movement of the lightly used fuel acquired from DOE and placing some of the elements into the core.
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Closed

50-274/2019-201-01	NCV	Failure to ship radioactive tracer material (Br-80m) in accordance with 49 CFR 173.431 and 173.433 requirements.
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PARTIAL LIST OF ACRONYMS USED

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ALARA	As Low As Reasonably Achievable
ANSI/ANS	American National Standards Institute/American Nuclear Society
AR-41	Argon-41
Br	Bromine
DOE	Department of Energy
DOT	Department of Transportation
E-Plan	Emergency Plan
GSTR	Geological Survey TRIGA Reactor
HP	Health Physics
IFI	Inspector Follow-up Item
IP	Inspection Procedure
kW	Kilowatts
LCO	Limiting Conditions for Operation
LOA	Letter of Agreement
MCNP	Monte Carlo N-Particle Transport (code)
NCV	Non-Cited Violation
No(s).	Number(s)
NRC	U.S. Nuclear Regulatory Commission
Rev.	Revision
ROC	Reactor Operations Committee
ROM	Reactor Operations Manual
RR&R	Radioisotope Request and Receipt (form)
RS	Reactor Supervisor
SAR	Safety Analysis Report
SER	Safety Evaluation Report
SRO	Senior Reactor Operator
TLDs	Thermoluminescent Dosimeters
TS	Technical Specification
URI	Unresolved Item
USGS	United States Geological Survey