



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION IV
1600 EAST LAMAR BOULEVARD
ARLINGTON, TEXAS 76011-4511

September 6, 2019

Ms. Charlotte Engstrom, Vice President
and General Counsel
General Atomics
P.O. Box 85608
San Diego, CA 92186-9784

SUBJECT: GENERAL ATOMICS - NRC INSPECTION REPORT 050-00089/2019-001;
050-00163/2019-001

Dear Ms. Engstrom:

This letter refers to the U.S. Nuclear Regulatory Commission's (NRC's) inspection conducted from August 5-8, 2019, at your General Atomics facility in San Diego, California. This 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. Within these areas, the inspection consisted of selected examination of procedures and representative records, observations of activities, independent radiological measurements, and interviews with personnel.

The inspection included a review of decommissioning activities being conducted at the Mark I and F reactor facility. An NRC confirmatory radiological survey was conducted at the reactor facility as part of the inspection. A preliminary exit briefing was held with Michael Grogan, Senior Director, Licensing, Safety and Nuclear Compliance, and other members of your staff on August 8, 2019. The NRC inspector provided updated information with Paul Pater, Health Physics Manager, and other members of your staff, by teleconference call on August 20, 2019. A final exit briefing will be provided to your staff when the results of the confirmatory survey are available.

The enclosed report presents the results of this inspection, except for the results of the confirmatory survey. The confirmatory survey results will be presented to you under separate correspondence at a later date. In summary, the inspector determined that General Atomics was conducting site activities in accordance with license and regulatory requirements. No violations were identified, and no response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Agency Rules of Practice and Procedure," a copy of this letter, its enclosure, and your response, if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy or proprietary information so that it can be made available to the Public without redaction.

Should you have any questions concerning this inspection, please contact Dr. Robert Evans, Senior Health Physicist, at 817-200-1234 or the undersigned at 817-200-1156.

Sincerely,

/RA/

Heather J. Gepford, PhD, CHP, Chief
Materials Licensing and Decommissioning
Branch
Division of Nuclear Materials Safety

Docket Nos.: 050-00089; 050-00163
License Nos.: R-38; R-67

Enclosure:
NRC Inspection Report 050-00089/2019-001;
050-00163/2019-001

cc:
P. Pater, General Atomics
G. Perez, California Department of Public
Health

**U.S. NUCLEAR REGULATORY COMMISSION
Region IV**

Docket Nos.: 050-00089; 050-00163

License Nos.: R-38; R-67

Report Nos.: 050-00089/2019-001; 050-00163/2019-001

Licensee: General Atomics

Facility: Torrey Pines Mesa Site
TRIGA Reactor Facility

Location: 3550 General Atomics Court
San Diego, California 92121

Inspection Dates: August 5-8, 2019

Inspector: Robert J. Evans, PhD, PE, CHP, Senior Health Physicist
Materials Licensing and Decommissioning Branch
Division of Nuclear Materials Safety

Approved By: Heather J. Gepford, PhD, CHP, Chief
Materials Licensing and Decommissioning Branch
Division of Nuclear Materials Safety

Attachment: Supplemental Inspection Information

Enclosure

EXECUTIVE SUMMARY

General Atomics
NRC Inspection Report 050-00089/2019-001; 050-00163/2019-001

This U.S. Nuclear Regulatory Commission (NRC) inspection was a routine, announced inspection of licensed activities being conducted at the General Atomics TRIGA Reactor Facility in San Diego, California. In summary, the licensee conducted decommissioning activities in accordance with license and regulatory requirements.

Research and Test Reactor Decommissioning

- The licensee maintained site staffing in accordance with license, quality assurance, and decommissioning plan requirements. Sufficient staff was available for the work in progress. (Section 1.2.a)
- The licensee conducted site decommissioning in accordance with the NRC-approved decommissioning plan. The licensee and its contractors developed comprehensive work instructions, and the work was conducted in accordance with these procedural requirements. (Section 1.2.b)
- The licensee implemented its radiation protection program in accordance with license and regulatory requirements. The licensee monitored workers for occupational exposures, and no individual exceeded the regulatory limit. (Section 1.2.c)
- The licensee implemented its effluent control and environmental monitoring programs in accordance with license and regulatory requirements. The licensee collected all required samples and reported the results as required by the license. No sample result exceeded any procedural action level or regulatory limit. (Section 1.2.d)
- Since the last inspection, the licensee conducted and documented a technical review to remove the building ventilation systems from service. The technical review was conducted to ensure that the proposed change complied with regulatory and license requirements for changes in equipment operability. (Section 1.2.e)
- The licensee implemented its audit and review programs in accordance with license and regulatory requirements. The licensee continued to submit annual reports to the NRC that included the information required by the two reactor licenses. (Section 1.2.f)
- The licensee developed and implemented an emergency plan as required by the decommissioning plan. (Section 1.2.g)
- The licensee conducted transportation activities in accordance with U.S. Department of Transportation regulations. (Section 1.2.h)

Decommissioning Inspection Procedure For Materials Licensees

- The licensee developed a final status survey plan that met the intent of the 1999 decommissioning plan, as supplemented, and the licensee was implementing the final

status survey program in accordance with the instructions provided in the final status survey plan. (Section 2.2.a)

- The preliminary confirmatory survey results indicate that additional remediation may be necessary in selected areas of the reactor facility. (Section 2.2.b)

Report Details

Site Status

The licensee constructed the Mark I reactor in 1957 and began operating the reactor in May 1958. The reactor was originally licensed to operate at a power level of 10 kilowatts thermal power, but the reactor was later upgraded to 250 kilowatts. The Mark I reactor was permanently shut down in 1997. The NRC amended the Mark I reactor License R-38 in October 1997 to a possession-only license.

The licensee constructed and began operating the Mark F reactor in 1960. This reactor was rated at 1,500 kilowatts of steady state thermal power. This reactor was permanently shut down in early 1995. In March 1995, the NRC amended the Mark F reactor License R-67 to a possession-only license. The fuel from both reactors was shipped offsite in 1980-1981 and 2010 to a storage facility in Idaho.

The NRC revised the Mark I and F licenses in August 1999, authorizing the licensee to decommission the reactor facility in accordance with instructions provided in the General Atomics TRIGA Reactor Facility Decommissioning Plan (DP) dated July 1999.

Since the previous NRC inspection, conducted in October 2018 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML18319A137), the licensee's contractor completed the decommissioning of the two reactor pits. The licensee also remediated the reactor facility, including removal of the building ventilation equipment. The licensee shipped all radioactive wastes offsite for disposal. The shipped material included soil, building rubble, contaminated equipment, and contaminated trash. By early May 2019, the licensee essentially completed the decommissioning of the reactor facility.

At the time of the onsite inspection, the licensee was conducting final status surveys of the reactor facility. Upon completion of the final status survey, the licensee plans to submit the results of the survey to the NRC for review and approval. The licensee plans to use the information provided in the final status survey report, in part, to support a request to terminate the two reactor licenses.

1 Research and Test Reactor Decommissioning (Inspection Procedure 69013)

1.1 Inspection Scope

The purpose of this inspection was to determine if dismantlement and decontamination activities were being conducted safely and in accordance with regulatory requirements, licensee commitments, and the NRC-approved DP.

1.2 Observations and Findings

a. Organization and Staffing

The staffing requirements are described in the technical specifications for the two reactor licenses (ML13312A797 and ML14063A627), the licensee's quality assurance program document, and the NRC-approved DP. The inspector compared the current organization to license requirements. The inspector determined the licensee's organizational structure was staffed with qualified individuals in accordance with license,

quality assurance, and DP requirements. The licensee had enough staff for the work in progress.

Since the previous inspection, the former director, licensing, safety and nuclear compliance, retired from the company. The licensee filled the open position with another individual who provided management-level oversight of the health physics program. All other positions on the organization chart were filled with qualified individuals who were present during previous inspections.

b. Work Controls

The licensee is authorized to conduct decommissioning activities in accordance with the NRC-approved DP dated July 1999. The inspector discussed the status of decommissioning with licensee representatives and toured the Mark I and Mark F reactor facility to observe work in progress.

The Mark I reactor pit is approximately 6.5 feet wide and 20 feet deep. The pit walls are approximately 8-9 inches thick. During August-September 2018, the licensee's contractor installed 24 micropiles in a circular pattern around the Mark I pit. The micropiles are approximately 26 feet long and were installed at an angle relative to the pit walls. After completion of the 5-week cure time, in November 2018, the contractor installed hooks in the pit walls. Chains were used to attach the micropiles to the hooks. The purpose of the support system was to stabilize the upper portion of the Mark I biological shield prior to excavation of the lower portion of the structure wall.

The licensee's contractor started to decommission the Mark I pit in December 2018. The contractor removed the concrete floor, the activated portion of the lower wall, and any activated soil underneath the floor or behind the lower wall. As part of the decommissioning activity, the contractor installed four columns under the remaining biological shield wall for structural support. The contaminated material removed from the reactor pit was placed into containers for eventual shipment for disposal. The decommissioning work in the Mark I pit was completed by early-March 2019.

The Mark F reactor pit is approximately 10 feet wide and 26 feet deep. The pit is connected to an "L" shaped fuel storage canal that is 4 feet wide and 17 feet long. In 2015, the contractor removed the epoxy and gunite material from the walls and floor of the Mark F pit. Concrete core samples were collected at that time, in part, to determine how much concrete material needed to be removed from the walls and floor during future decommissioning work. After a delay in work activities, the contractor removed the steel liner from the pit in September 2018. After removal of the steel liner, the contractor started to remove sections of activated concrete from the pit. The concrete removal work was completed in December 2018. The waste material was placed into industrial package IP-1 boxes for shipment for disposal.

Starting in January 2019, the licensee began cleaning out the miscellaneous material from the reactor facility as part of decommissioning. This work included removal of the fume hood from the Mark F reactor room. Radiological characterization surveys were conducted in this area in February 2019 to confirm that the room was ready for final status surveys. Building cleanout activities continued into May 2019.

In late-April 2019, the licensee removed the two reactor facility ventilation systems from service. This activity was the last major decommissioning activity to be conducted in the reactor facility. The licensee completed all decommissioning activities by early May 2019. The licensee also shipped the remaining radioactive waste from the site in March and June 2019. Any future decommissioning activities are expected to consist of limited remediation of areas identified with elevated radioactivity during characterization and final status surveys. This limited decommissioning work is expected to be conducted using portable ventilation and monitoring equipment.

The licensee developed a work plan for the remediation of the two reactor pits. Radiological Work Authorization W/A 600-18 was developed and approved by the licensee in June 2018. This document included work instructions, radiological controls, as low as is reasonably achievable (ALARA) goals, and emergency plan. The primary hazard was accidental falls, and the licensee and its contractor implemented stringent fall protection requirements. The inspector toured the areas where work had been completed and compared the work to the instructions provided in the work plan. The inspector concluded that the work had been completed in accordance with work plan requirements.

The inspector reviewed the licensee's updates to the work plan since the previous inspection. The work plan changes included the addition of shipment procedures and extension of the work plan expiration date. At the time of the inspection, the work plan was scheduled to expire in September 2019, with the expectation that all decommissioning work would be completed by that date.

In conclusion, the inspector confirmed that the licensee conducted site decommissioning in accordance with the DP. The licensee and its contractors conducted the work in accordance with approved procedures.

c. Health Physics/Radiation Protection

The inspector reviewed the licensee's radiation protection program to ensure compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20 and license requirements.

The inspector reviewed the licensee's occupational exposure records for 2018-2019 to ensure that no individual exceeded the limits specified in 10 CFR 20.1201. The licensee monitored workers for external exposures only. Based on the type of work being conducted and the results of air sampling, the licensee suspended internal exposure dose assessments and bioassay sampling as allowed by 10 CFR 20.1502.

The licensee monitored 39 workers for external radiation exposure who were authorized to work at the reactor facility in 2018. For 2018, the highest total effective dose equivalent exposure was 4 millirem with a regulatory limit of 5,000 millirem per year as specified in 10 CFR 20.1201. For the first half of 2019, the highest total effective dose equivalent for an individual was 4 millirem. Overall, occupational exposures were lower than previous years due to a reduction in the radioactive source term present at the reactor facility.

The technical specifications for each reactor license require the licensee to implement a radiation monitoring system including continuous area radiation monitoring, airborne

radiation monitoring, and annual calibration of equipment. The inspector reviewed representative records for 2018-2019 and interviewed the staff responsible for maintaining the radiation monitoring system in service. The records indicated that the licensee continued to operate and maintain the equipment. No air sample results exceeded the procedural action levels, and no valid high radiation monitoring alarms were received during the inspection period. The licensee maintained records demonstrating that the radiation monitoring system components were calibrated and functionally checked for operability on a routine basis, as required by site procedures and technical specifications.

The licensee collected routine and non-routine air samples using portable equipment to support decommissioning work in progress. The inspector reviewed a representative sample of these records and confirmed that airborne contamination levels were maintained below the respective procedural action levels. The inspector noted that air sample results were at or near background levels during the decommissioning of the two reactor pits. A licensee representative indicated that the low sample results were due to the concrete drilling work being conducted under wet conditions, which limited the potential for airborne contamination.

The licensee's staff conducted routine contamination monitoring of areas containing radioactive material. Routine monitoring included weekly swipe surveys for removable contamination (conducted weekly but required monthly) and measurement of ambient gamma radiation levels. The inspector reviewed representative records of sampling conducted since the last inspection. No areas within the building exceeded the procedural action levels for removable contamination or ambient gamma radiation levels. As noted in the next section of this inspection report, the licensee also measured the gamma radiation levels at the reactor facility fence line, and no location along the fence line exceeded the 2 millirem per hour limit specified in 10 CFR 20.1301(a)(2) for unrestricted areas.

The inspector reviewed the licensee's maintenance and calibration program for radiation detection instrumentation. The inspector noted that instruments in use were calibrated and had been source checked as required. Also, instruments in use were capable of detecting radiation of the type and at the levels expected for the location of usage. The inspector determined that the licensee's instrument calibration program was in compliance with license requirements.

The training requirements are specified in Section 2.5 of the DP. The inspector verified that the licensee had established and implemented a training and qualification program for all personnel involved in decommissioning activities. Specifically, the licensee maintained a decommissioning training matrix which tracked employee training. The licensee's training program included annual refresher training, work authorization and work permit review, and updated procedure reviews as necessary.

The inspector conducted independent ambient gamma radiation surveys during site tours. The inspector measured the ambient gamma radiation levels using a Ludlum Model 2401-S survey meter calibrated to cesium-137 (NRC 079765, Serial Number 182780, calibration due date of 11/5/19). The inspector surveyed tools and equipment that the licensee planned to release from the building for unrestricted use. With a background of 7 microrentgen per hour ($\mu\text{R/hr}$), the survey results were at

background levels, indicating that the tools and equipment could be released for unrestricted use.

d. Effluent Control and Environmental Monitoring

The inspector reviewed the licensee's effluent control and environmental monitoring programs to verify compliance with regulatory and license requirements. In accordance with the NRC-approved DP, the licensee is required to sample reactor building ventilation system exhausts, environmental airborne effluents, and potentially contaminated liquids. The technical specifications require the licensee to maintain records of gaseous and liquid radioactive effluents and environmental monitoring surveys. The technical specifications also require the licensee to summarize the radioactive effluents released and describe any environmental surveys performed outside of the facility in the annual reports.

The licensee presented the results of the effluent and environmental programs in the annual reports for the two reactor licenses. The inspector reviewed the annual reports for 2018 during the inspection (ADAMS Accession No. ML19079A246). The licensee sampled the reactor facility gaseous effluents for mixed fission products and iodine. No sample result exceeded the action levels specified in the applicable health physics procedure. The licensee permanently discontinued stack sampling in May 2019, after removing the two reactor ventilation systems from service.

In addition to the two reactor stack samplers, the licensee conducted stack sampling at three other locations on site. These samples were collected in accordance with the licensee's special nuclear material License SNM-696, which was terminated in May 2019 (ADAMS Accession No. ML19115A322). The sample results for all locations were well below the procedural alert level.

The licensee's records indicated that no radionuclide releases were discharged into the main site sanitary sewer system in 2018; although, the licensee sampled the sewage daily to monitor the discharges of its property tenants. No sewage sample exceeded the gross alpha or beta action levels specified in site procedures.

The licensee monitored the ambient gamma radiation levels using 33 passive area dosimeters located inside and outside the reactor building. The inspector reviewed the environmental dosimeter records for 2018-2019. The nearest tenant exposure was measured at 22 millirem per year. The highest measurement inside the reactor facility was 46 millirem per year. The highest reactor facility yard measurement was 95 millirem for the first two quarters of 2019. This elevated yard measurement was attributed to the storage of radioactive wastes in the yard. These wastes have since been shipped offsite. All environmental dosimeter measurements for 2018 were less than the NRC's public dose limit of 100 millirem per year.

The licensee conducted monthly ambient gamma radiation surveys along the reactor facility fence. The inspector reviewed selected records for 2018-2019. The most recent survey results ranged from 12-17 $\mu\text{R/hr}$, results that were essentially at background levels. All survey results for 2018-2019 were well below the regulatory limits for posting as radiation areas (5,000 $\mu\text{R/hr}$) and for dose rates in unrestricted areas (2,000 $\mu\text{R/hr}$).

In February 2019, the licensee experienced a rain event that resulted in approximately eight inches of water in the Mark F reactor pit. The licensee's records indicated the water was sampled and released into the yard adjacent to the building.

The licensee's Compliance and Radiation Safety Working Group conducted public dose assessments. The public dose assessment for 2018 was completed in April 2019. The review estimated that the maximum dose to a member of the public was less than 32 millirem per year as compared to a regulatory limit of 100 millirem per year. Most of the assessed dose was based on environmental dosimeter measurements near the nearest resident location. A small fraction of the dose was attributed to airborne effluents.

e. Change Control

The inspector reviewed recent changes to the decommissioning program. The most significant change involved the licensee's decision to remove the building ventilation systems permanently from service. The technical specifications for both reactors provide instructions for operation of the ventilation systems until all decommissioning activities have been completed in the reactor facility.

In April 2019, the licensee formally reviewed the Mark I and Mark F reactor technical specifications for operability of the plant ventilation systems during the final stages of decommissioning. The licensee concluded that it could remove the permanent plant equipment from service, as long as it continued to operate portable ventilation systems as needed to support future decommissioning activities. The licensee concluded that there were no unreviewed safety questions for the proposed building modification that required a detailed technical review as required by 10 CFR 50.59. The inspector concluded that the licensee appropriately assessed the change prior to implementation.

The Mark I and Mark F reactor facility ventilation systems were permanently removed from service during late-April 2019. In addition, the licensee permanently removed the air sampling stations on the roof of the reactor facility after the ventilation exhaust ductwork had been removed and sealed shut.

The inspector reviewed the documentation that was used by the licensee to manage the work. The work package included a radiation work permit to control worker exposures to radioactive material. General area air sampling was conducted to monitor worker exposure to airborne radioactivity. The work plan provided step-by-step instructions for removing the ventilation equipment from service. Based on interviews with site staff, the work was conducted without incident and with limited worker exposures to radioactive material.

At the time of the inspection, no decommissioning activities were in progress and essentially all decommissioning work had been completed. Portable ventilation equipment was available if decommissioning activities were to recommence, such as resumption of core drilling or building surface remediation work. During the onsite inspection, the licensee used portable ventilation and protective tents during one concrete sampling event in the Mark F reactor pit, in compliance with technical specification requirements.

f. Audits and Reviews

The inspector reviewed the licensee's programs and procedures for audits and reviews for compliance with license requirements.

The technical specifications describe the requirements of the Criticality and Radiation Safety Committee. The committee is required to meet at least annually to review facility changes, records, performance, occurrences, and incidents. The committee also conducted annual As Low As Reasonably Achievable (ALARA) reviews. The licensee subsequently renamed this committee as the Compliance and Radiation Safety Working Group. The inspector reviewed the most recent Working Group's annual audit summary.

The Working Group's audit and ALARA review for 2017-2018 was issued in April 2019. The records indicated that the Working Group reviewed reactor facility dismantlement and decommissioning activities in May 2018, prior to active remediation of the two reactor pits by the licensee's contractor. No concerns or findings were identified by the auditor.

The annual Working Group meeting was conducted in August 2018. The meeting topics included a status update of reactor facility decommissioning activities. The Working Group decided to conduct a supplemental audit of decommissioning activities, because the May 2018 audit was conducted during the contract negotiation phase. This supplemental audit was conducted in May 2019. The auditor concluded that remediation activities conducted since the previous audit were well planned and executed. No issues or findings were reported by the auditor.

The licensee is required by the DP to implement a quality assurance program. No quality assurance audits were conducted since the last inspection, but the licensee planned to audit the radiation protection program starting in late-August 2019.

The licensee conducted annual radiation protection program reviews as required by 10 CFR 20.1101(c). Each annual review included selected radiation protection program areas. The last annual review was conducted in March 2019. This review concentrated on records, required health physics activities, sealed source leak tests, and the nuclear material accountability program. The auditor did not identify any non-compliances or findings.

The technical specifications for each license require the licensee to submit annual reports to the NRC. The inspector reviewed the licensee's annual reactor reports. The reports summarized decommissioning activities, radiation safety results, and environmental monitoring results for the previous year. The inspector reviewed the annual reports for 2018, submitted to the NRC by letter dated March 18, 2019 (ADAMS Accession No. ML19079A246). The inspector confirmed that the licensee submitted the reports to the NRC in a timely manner, and the reports included the information required by the licenses.

g. Emergency Planning

Section 7 of the NRC-approved DP required the licensee to have an emergency plan in place during decommissioning activities. The licensee developed an emergency procedure for the reactor facility. The 2016 procedure was included in Radiological

Work Authorization W/A 600-18. The procedure included instructions for a medical incident, fire, security event, earthquake, structural damage, and radiological releases. At the time of the inspection, the primary hazards at the site were industrial injuries such as slips, trips, and falls. The potential for a radiological event was limited since most of the radioactive material had been removed from the site.

The licensee conducted and documented monthly emergency equipment inspections. The inspected equipment included fire extinguishers, first aid kits, and emergency lights. The licensee was also required to train site staff to respond to emergencies. The licensee established and maintained a training matrix of all workers that included emergency response team training.

h. Solid Radioactive Waste Management and Transportation

The licensee continued to maintain a Low Level Waste Certification Plan for shipment of waste to the U.S. Department of Energy disposal site in Nevada. The Department of Energy conducted annual audits to confirm whether the licensee's waste certification program was effective and complied with program requirements. The most recent audit was conducted in February 2019. The auditor identified one minor observation involving the shipper's instructions. Based on the results of the audit, the Department of Energy continued to allow the licensee to ship authorized waste streams to the Nevada National Security Site for disposal.

The licensee and its contractor completed two shipment campaigns since the last inspection. The inspector reviewed the licensee's documentation of these shipments and discussed the shipment details with site staff.

The first shipment campaign occurred in March 2019. The licensee's contractor shipped 24 drums of soil and sludge material to a processor in Tennessee for ultimate disposal. The waste material contained small quantities of europium-152, cobalt-60, and radium-226. Based on the low concentrations of radioactive material in the waste material, the shipments were not subject to Department of Transportation requirements. Formal radiation surveys were not required, but the licensee conducted radiological surveys and documented the measurements in a logbook.

The second shipment campaign occurred in June 2019. The licensee shipped 18 industrial package IP-1 steel boxes in four truck shipments to Nevada for disposal. The material was shipped in accordance with Department of Transportation requirements as radioactive material. The shipped radionuclides included europium-152, cobalt-60, nickel-63, iron-55, and strontium-90. The shipments were exclusive use shipments. The licensee's staff used checklists to ensure proper documentation of the shipments.

The licensee used scaling factors to quantify the non-gamma emitting radionuclides in the shipments such as iron-55, nickel-63, strontium-90, thorium, and uranium based on the quantities of gamma-emitting radionuclides such as cobalt-60 and cesium-137. The inspector questioned the licensee's staff about the technical analysis used to develop the scaling factors. At the time of the inspection, the licensee's staff could not easily locate the documentation of these calculations, but the staff agreed to locate the technical analysis and add it to the shipping paper packages for future reference.

The licensee maintained a matrix of training requirements for site workers. The matrix included the training requirements for workers who packaged and shipped radioactive material. The inspector noted that the licensee's staff who conducted transportation activities were being trained, and their training was documented on the training matrix.

The inspector concluded that the licensee conducted shipments in accordance with transportation regulations. The inspector also confirmed that the licensee had implemented a training program to ensure that applicable employees attended function specific-training.

1.3 Conclusions

The licensee maintained site staffing in accordance with license, quality assurance, and DP requirements. Sufficient staff was available for the work in progress.

The licensee conducted site decommissioning in accordance with the NRC-approved DP. The licensee and its contractors developed comprehensive work instructions, and the work was conducted in accordance with these procedural requirements.

The licensee implemented its radiation protection program in accordance with license and regulatory requirements. The licensee monitored workers for occupational exposures, and no individual exceeded the regulatory limit.

The licensee implemented its effluent control and environmental monitoring programs in accordance with license and regulatory requirements. The licensee collected all required samples and reported the results as required by the license. No sample result exceeded any procedural action level or regulatory limit.

Since the last inspection, the licensee conducted and documented a technical review to remove the building ventilation systems from service. The technical review was conducted to ensure that the proposed change complied with regulatory and license requirements for changes in equipment operability.

The licensee implemented its audit and review programs in accordance with license and regulatory requirements. The licensee continued to submit annual reports to the NRC that included the information required by the two reactor licenses.

The licensee developed and implemented an emergency plan as required by the DP.

The licensee conducted transportation activities in accordance with U.S. Department of Transportation regulations.

2 **Inspection of Remedial and Final Surveys at Permanently Shutdown Reactors (Inspection Procedure 83801)**

2.1 Inspection Scope

The scope of this inspection was to verify that: (1) the reactor facility was decontaminated to acceptable residual radioactivity levels as specified in the NRC-approved decommissioning plan, (2) the licensee implemented its NRC-approved final status survey program, and (3) the licensee's final status survey results were

acceptable. The inspection included a review of selected final status survey packages for compliance with DP requirements, observations of final status surveys in progress, and performance of an independent confirmatory survey.

2.2 Observations and Findings

a. Review of Final Status Survey Program

The final status survey program requirements are provided in Section 4 of the NRC-approved DP dated July 1999. The DP provided release criteria for surfaces but not volumetric material such as soil and concrete. By letters dated December 18, 2015, and August 15, 2016 (ADAMS Accession Nos. ML15362A506 and ML16242A319), the licensee requested approval of volumetric release criteria for the reactor facility. The licensee requested release criteria similar to the criteria that the NRC had previously approved for the special nuclear material license SNM-696. By letter dated February 1, 2017 (ADAMS Accession No. ML16285A300), the NRC approved the licensee's request. The licensee used the new criteria to estimate the amount of volumetric material that would have to be removed during decommissioning of the two reactor pits. The licensee also used the new criteria as part of the final status survey project.

In addition to approval of volumetric release criteria, the licensee's 2015-2016 submittals and the NRC's 2017 reply changed the survey methodology that the licensee will use during the final status survey. The licensee committed to use the guidance provided in NUREG-1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)." The licensee developed a final status survey plan (FSSP) that included portions of the 1999 DP, as revised by the 2015-2017 letters. The licensee submitted the FSSP to the NRC by email dated July 16, 2019 (ADAMS Accession No. ML19247C586). The inspector concluded that the FSSP provided instructions that were consistent with MARSSIM guidance.

The inspector discussed a possible weakness of the survey plan with licensee staff involving building drains. By procedure, the licensee was required to swipe survey drains for removable contamination, to determine whether the drain in question could be released. During the NRC's confirmatory survey (described below), one drain was observed to have fixed contamination that would not have been identified by swipe sampling for removable contamination. Although there were only a limited number of drains in the reactor facility, the licensee's representatives agreed to reconsider its procedure for final surveying building drains.

The inspector reviewed the licensee's implementation of the FSSP during the inspection. At the time of the inspection, the final status survey had been completed in Survey Units 8 and 9 (mezzanine level rooms) and was in progress in Survey Unit 5 (Mark F reactor room). The inspector confirmed that the licensee's representatives were implementing the survey in accordance with FSSP instructions.

The inspector reviewed a representative final status survey package for comparison to FSSP requirements. The documentation included worker instructions, instrumentation requirements, survey requirements, and documentation requirements. The inspector noted that the number of sample measurements was greater than the minimum number of sample points needed for the survey unit, indicating that the licensee was using conservatism in the implementation of its final status survey. The survey package was

well designed and was developed in accordance with the instructions provided in the survey plan. None of the survey results exceeded the associated surface derived concentration guideline levels.

The inspector observed that the survey meters being used for the final status survey had been calibration checked just prior to the start of the survey. The instrumentation in use during the inspection were being functionally checked for operability as required by the FSSP.

b. Performance of Confirmatory Survey

The NRC conducted confirmatory surveys of select areas within the reactor facility. A confirmatory survey is a radiological survey conducted by the NRC, or its contractor, to verify the results of the licensee's final status survey. Staff from Oak Ridge Associated Universities, Oak Ridge Institute for Science and Education conducted the survey on behalf of the NRC.

Prior to the survey, the NRC's contractor developed a confirmatory survey plan using information provided in the 1999 DP, 2015-2017 letters (described above), and the licensee's FSSP. The confirmatory survey plan was submitted to the NRC by email dated August 2, 2019 (ADAMS Accession No. ML19247C549).

The confirmatory survey consisted of a combination of indoor and outdoor surface scans, fixed-point measurements of surface contamination levels, and collection of swipe, soil, and concrete samples for offsite analysis. The preliminary survey results were presented to the licensee at the end of the onsite inspection. The preliminary results identified areas of elevated activities, greater than the associated surface derived concentration guideline levels, in various locations including the Mark F canal. The preliminary results indicate that limited remediation may be necessary in certain locations. The swipe, soil, and concrete samples will be analyzed offsite by the contractor. The final confirmatory survey results will be presented to the licensee under separate correspondence at a later date.

2.3 Conclusions

The licensee developed a FSSP that met the intent of the 1999 DP, as supplemented, and the licensee was implementing the final status survey program in accordance with the instructions provided in the FSSP.

The preliminary confirmatory survey results indicate that additional remediation may be necessary in selected areas of the reactor facility.

3 Exit Meeting Summary

The inspector presented the preliminary inspection results to the licensee's staff at the end of the onsite inspection on August 8, 2019. The inspector provided updated confirmatory survey information in a teleconference call with the licensee's staff on August 20, 2019. A final exit briefing will be provided to the licensee's staff when the results of the confirmatory survey are available. During the inspection, the licensee did not identify any information reviewed by the inspector as proprietary.

SUPPLEMENTAL INSPECTION INFORMATION

Partial List of Persons Contacted

Licensee

E. Drees, Nuclear Engineer
K. Gavlik, Vice President, Radiological Services, Philotechnics, Ltd.
J. Greenwood, Manager, TRIGA Reactors
M. Grogan, Senior Director, Licensing, Safety and Nuclear Compliance
C. Hughes, Radiation Control Technician, Philotechnics, Ltd.
R. Klasen, Senior Staff Technician
P. Pater, Manager, Health Physics
J. Razvi, Chair, Compliance and Radiation Safety Working Group
R. Trimble, Health Physicist

Oak Ridge Associated Universities

E. Bailey, Health Physicist/Project Manager
K. Engel, Health Physicist
A. Kirthlink, Health Physicist
S. Pittman, Health Physicist

Inspection Procedures (IPs) Used

IP 69013	Research and Test Reactor Decommissioning
IP 87104	Decommissioning Inspection Procedure for Materials Licensees

Items Opened, Closed and Discussed

Opened

None

Closed

None

Discussed

None

List of Acronyms Used

ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As is Reasonably Achievable
CFR	<i>Code of Federal Regulations</i>
DP	Decommissioning Plan
FSSP	Final Status Survey Plan
IP	Inspection Procedure
μR/hr	microrentgen per hour
NRC	U.S. Nuclear Regulatory Commission
SNM	special nuclear material