TEXAS A&M UNIVERSITY

RADIATION PROTECTION PROGRAM: 2021 REVIEW

Environmental Health and Safety

Radiological Safety

June 2022

Table of Contents

INTRODUCTION

This document provides a review of the Radiation Protection Program for Texas A&M University over the 2021 calendar year. Topics covered include an overview of the Protection Program scope and organization, followed by a review of several specific elements. Components which are vital to the strength of the program, such as training and maintenance of As Low As Reasonably Achievable (ALARA) practices, are appraised. In addition to these items, a review of routine practices, such as waste disposal, internal and external audits and inspections, and changes to the program, are discussed.

TEXAS A&M UNIVERSITY LICENSES AND REGISTRATIONS

Texas A&M University holds several federal and state licenses and registrations, which authorize the use of byproduct radioactive materials, source materials, special nuclear materials, and radiation-producing devices (both ionizing and non-ionizing). In accordance with state and federal regulations (25 TAC §289.202 (e) (3) and 10 CFR 20.1101(c), respectively) this report reviews the activities conducted under the licenses and registrations for the calendar year 2021. An overview of the various licenses maintained by Texas A&M University is provided in Table 1.

Table 1 – Texas A&M University Licenses and Registrations

License No.	Issuing Agency	Expiration Date	Description
42-09082-09	United States Nuclear Regulatory Commission (USNRC)	October 31, 2033	Radioactive Materials License, Use aboard JOIDES (SEDCO/BP 471) and any other TAMU research ship
L00448	Texas Department of State Health Services (TDSHS)	September 30, 2029	Radioactive Materials License, TAMU, College Station, Bryan, Houston, Galveston and Dallas
L05683	Texas Department of State Health Services (TDSHS)	August 31, 2024	Radioactive Materials License, TAMU College Station, Bryan, University Services Bldg., Riverside Campus, Prairie View A&M, Beeville, Bushland, Dallas, Lubbock, Overton, Plainview, Uvalde, Vernon and Weslaco
L06561	Texas Department of State Health Services (TDSHS)	July 31, 2023	Radioactive Material License, Texas A&M University Cyclotron Institute
R00304	Texas Department of State Health Services (TDSHS)	September 30, 2023	Certificate of Registration (RPD), TAMU, Riverside Campus, Lufkin, TAES-Beeville, Prairie View A&M and Galveston
R14497	Texas Department of State Health Services (TDSHS)	February 28, 2026	Certificate of Registration (RPD), JOIDES (D/V SEDCO/BP-471 aka JOIDES Resolution)
Z00116	Texas Department of State Health Services (TDSHS)	April 30, 2029	Certificate of Registration (Laser), TAMU

42-09082-09

The U.S. Nuclear Regulatory Commission issues this license. It authorizes the University to use selected radionuclides at temporary job sites at sea aboard TAMU and other research vessels. No amendments were submitted in 2021. The license expires on October 31, 2033.

L00448

The Texas Department of State Health Services (TDSHS) issues this broad-scope license. This license authorizes the use of radioactive materials at the following sites.
Texas A&M University- College Station, Bryan, Galveston, Institute of Biosciences and Technology-Houston, and Texas A&M College of Dentistry-Dallas. Three amendments were completed during 2021: amendment 157, increasing the activity limits for Z > 84 materials and addition of the Dallas Health Science Center site; amendment 158, updating the decommissioning funding plan; and amendment 159, incorporating an approved plan for storing unused sources for greater than 24 months. The license expires on September 30, 2029.

L05683

The Texas Department of State Health Services issues this specific license. This license authorizes the use radioactive materials at designated remote sites inside Texas. The license include Prairie View A&M University, Texas A&M Agrilife sites at Beeville, Lubbock, Plainview, Uvalde, Overton,Vernon, Weslaco, Bushland, and Dallas. Unlike the broadscope license L00448, license L05683 is relatively specific with regard to the radioactive materials that may be possessed, as well as the individuals authorized to use the materials. Two amendments were completed in 2021. Amendment 44 updated the site RSO for Beeville; Amendment 45 was issued for removal of Site 017 (Bryan, North Harvey Mitchell Pkwy, Suite 500). The license expires on August 31, 2024.

L06561

The Texas Department of State Health Services issues this specific license. It authorizes Texas A&M University Cyclotron Institute to produce radioactive material for research and development. Unlike the broad-scope license L00448, this license is relatively specific with regard to the radionuclides that can be produced using the cyclotron and the individuals authorized to possess and use those radionuclides. No amendments were completed in 2021. The license expires on July 31, 2023.

R00304

This registration is issued by The Texas Department of State Health Services and authorizes the University to possess and use radiation producing devices on the College Station Campus, with remote sites at RELLIS, Beeville, Prairie View A&M University, Galveston, Stephenville, Huntsville, Kirbyville, HSC-Bryan campus, Kingsville and NESC. An amendment to correct the total number of units in Site 004 was requested in December 2021. The registration expires on September 30, 2023.

R14497

This registration, issued by The Texas Department of State Health Services, authorizes the University to possess and use minimal threat and other industrial X-ray units aboard The JOIDES research vessel. No amendments were completed in 2021. The registration expires on February 28, 2026.

Z00116

This registration, issued by The Texas Department of State Health Services and authorizes the possession and use of Class III B and Class IV lasers at the College Station Campus, Bryan, Galveston, Kingsville, Institute of Biosciences and Technology (IBT)- Houston and Prairie View A&M University. One amendment was completed in 2021 for the submission of outdoor laser firing procedures for research and development. The registration was renewed and the expiration date is April 30, 2029.

RADIOLOGICAL SAFETY PROGRAM ORGANIZATION

Radiological Safety Committee

The Radiological Safety Committee (RSC) advises the Texas A&M University administration on matters related to radiological safety and recommends policies and procedures it deems appropriate to ensure an adequate radiological safety program. The RSC consists of at least six voting members, including the Chair, appointed by the Vice President for Finance and Operations; plus three Ex Officio (non-voting) members as outlined below. The RSC acts as an advisory body to ensure that radioactive materials are safely used in accordance with "As Low As Reasonably Achievable (ALARA)" principles. The RSC also conducts a series of annual audits in which the entire program is reviewed over a period of three years. The RSC met three times during the 2021 calendar year.

Members	**Department**
John Ford, Ph.D., Chair	Nuclear Engineering
Jonathan Sczepanski, Ph.D.	Chemistry
Joseph Reibenspies, Ph.D.	Chemistry
Thomas Welsh, Ph.D.	Animal Science
Kris Hagel, Ph.D.	Cyclotron Institute
Waruna Kulatilaka, Ph.D.	Mechanical Engineering
Jay Griffin, DVM	Large Animal Clinical Sciences
Bryan Tomlin, Ph.D.	Center for Chemical Characterization
Craig Marianno, Ph.D.	Nuclear Engineering
Ursula Winzer-Serhan, Ph.D.	Neurosciences & Experimental Therapeutics
Christopher M. Meyer *Ex-Officio*	Office of Safety and Security
Latha Vasudevan, Ph.D., CHP, *Ex-Officio*	Radiological Safety Officer
Christina Robertson, CIH, CSP, *Ex-Officio*	Environmental Health and Safety

Radiological Safety Staff

The Radiological Safety Staff (RSS) consists of individuals employed by Environmental Health and Safety, under direction of the Radiological Safety Officer (RSO). In 2021, the RSS consisted of the RSO; One Senior Health Physicist /Assistant RSO; One Senior Health Physicist; Two Health Physicists; One Assistant Health Physicist III; Two Assistant Health Physicists II; Two Assistant Health Physicists I; a Senior Office Associate, and 5-6 student technicians. A part time program aide position for supporting scanning and storing documents in Laserfiche repository was vacant.

RADIOLOGICAL SAFETY PROGRAM ELEMENTS

Overview of Permits

Texas A&M Radiological Safety maintains three different kinds of radiation permits: Radioactive Material (RAM) permits, Radiation Producing Device (RPD) permits, and Laser permits. The NRC and TDSHS licenses are blanket licenses for the entire university. To adequately maintain oversight, Radiological Safety issues permits, or sub-licenses, to principal investigators authorizing them to possess and use specific quantities of RAM or specific devices. As of December 2021, there were a total of 106 RAM permits, 73 RPD permits possessing a total of 143 RPDs, and 101 laser permits possessing a total of 415 laser units.

Radiological Safety Training

During 2021, several types of training were offered by EHS. There were a total of 24 live virtual training sessions offered; 12 for General Radiation Safety Initial training and 12 for Veterinary Hospital Radiation Safety Initial training. A total of 509 people were trained in virtual sessions; an additional 3,867 people were trained via online training modules. EHS offers General Radiation Safety and Veterinary Radiation Safety class room training as well as online refresher training, online General Radiation Producing Device (RPD) training, and online General Laser Safety training. A summary of training provided by the Radiological Safety Staff in 2021 is displayed in Table 2.

Instrument Calibration

Radiological Safety provides response check services for instrumentation used by labs. Radiological Safety also facilitates the shipping and paperwork for instruments requiring calibration by outside entities. In 2021, 63 portable survey instruments were sent to the manufacturer for calibration, and 96 instruments were provided functional response checks by RSS and verified to be operational with an acceptable efficiency.

Sealed Sources & Leak Tests

Radiological Safety provides leak test services to authorized users with certified sealed sources. Leak tests are performed quarterly. These services are also provided, as a courtesy, to users possessing sources authorized under a general license. In 2021, leak tests were performed for 86 sealed sources (13 of which are neutron soil moisture gauges), and 21 generally licensed sources.

Table 2– Summary of training provided by RSS in 2021

Training Type	Number of Times Offered in 2021	Number of Individuals Attended Training
General Radiation Safety Initial (Zoom-only in 2021)	12	196
Veterinary Radiation Safety Initial (Zoom-only in 2021)	12	313
General Laser Safety (Online)	--	1,046
General Radiation Producing Device -RPD (Online)	--	405
Electron Beam Facility RPD Training (Online)	--	34
General Radiation Safety Refresher (Online)	--	397
Transportation Training for Moisture Gauge Users (Online)	--	87
Veterinary Hospital General Radiation Safety Laser, and RPD Refresher (Online)	--	225
Veterinary Radiation Producing Device -Vet RPD (Online)	--	249
Other (Radiation Safety Awareness for Vet, MRI Safety, etc.)	--	1,424
Total	**24**	**4,376**

Special Nuclear Material

Special Nuclear Materials (SNM) that are possessed by the University should be accounted for and verified on an annual basis. The RSS performs inventory verifications and prepares reports as required by 10 CFR 74 and the Nuclear Material Management and Safeguards System (NMMSS). These NMMSS reports were filed for the period 12/1/2020-11/30/2021 and were reconciled on January 5, 2022.

Review of External Dosimetry Data

This section addresses external dosimetry for the calendar year 2021. Through the end of 2021, 1550 individuals were monitored for external occupational radiation exposure. Of those monitored, 736 people (about 47%), had no reportable whole-body deep dose equivalent (DDE) above background. Of the remaining 814 individuals, six received doses exceeding 10% of the whole-body annual limit, or 500 mrem. These individuals received doses of 575, 590, 628, 636, 1934, and 2000 mrem. The remainder received doses ranging from 1 mrem to 500 mrem. The cumulative dose for all individuals monitored for the entire year was 23.1 person-rem. The average deep dose equivalent for those who received a measurable dose was approximately 15 mrem. A summary of these data is provided in Table 3 and Figure 1. The average DDE values shown in this table are deep dose equivalent averaged over individuals receiving a non-zero dose. Personnel were also monitored for whole-body shallow dose equivalent (or "skin dose," SDE), dose equivalent to the lens of the eye (LDE).The highest DDE reported in 2021 was 2000 mrem, SDE of 2017 mrem, and LDE of 2019 mrem. In addition to whole body dosimeters, some users were issued extremity dosimeters to measure dose to the hand, when applicable. The highest extremity equivalent noted for 2021 was 2284 mrem.

The individuals with the highest dose reported work in Nuclear Medicine and diagnostic radiology at the Veterinary Teaching Hospital. Diagnostic and interventional procedures, such as X-ray, computed tomography, and fluoroscopy are common in the Veterinary Teaching Hospital, and account for the majority of dose received on campus.

For those individuals who received total effective dose equivalent of 100 rem or higher, an annual dose report was provided as per TAC 289.203(d). All occupational dose reports are on permanent file at Texas A&M University Environmental Health and Safety.

Table 3 - Summary of whole-body dose (DDE) by subaccount number

Department or Group	Number Measured	Number w/ Measured Dose	Cumulative DDE (mrem)	Avg. DDE (mrem)	Max. DDE (mrem)
4th year students	681	12	404	34	195
Athletics	2	2	2	1	1
Student Health Center	4	0	0	0	0
Bio	1	0	0	0	0
CCCA	3	0	0	0	0
Cyclotron Institute	681	12	404	34	195
E-beam	6	5	33	7	8
EHS	33	17	242	14	107
GI	22	9	68	8	28
Human Clinical	2	2	6	3	4
IBT	1	0	0	0	0
Joides Research Vessel	7	1	1	1	1
LA/Med Surg	24	13	86	7	41
LA/Res Int	26	25	368	15	86
Monthly	38	35	7535	215	2000
Nuc Eng	40	17	394	23	88
Office of the State Chemist	2	0	0	0	0
RELLIS	1	0	0	0	0
SA/Fac Med	16	15	654	44	133
SA/Res Int	68	68	1972	29	127
SA/Spec	21	21	693	33	109
School of Public Health	5	0	0	0	0
Staff/Anes	18	16	1204	75	636
Staff/LA ICU	15	11	76	7	33
Staff/LA Med	19	18	604	34	305
Staff/LA OR	21	19	448	24	190
Staff/Misc	7	6	119	20	34
Staff/RAD	3	3	85	28	50
Staff/SA Cardio	2	2	67	34	47
Staff/SA Dental	1	1	10	10	10
Staff/SA ER	31	31	1249	40	171
Staff/SA Int Med	7	6	142	24	38
Staff/SA Neuro	5	4	44	11	24
Staff/SA Onco	11	10	185	19	31
Staff/SA OR	26	25	604	24	99
Staff/SA Ortho	9	7	165	24	40
Staff/SA SX	6	6	103	17	37
Staff/SA Zoo Med	5	1	1	1	1

TAES	1	0	0	0	0
TAES2	3	0	0	0	0
TIPS	15	1	1	1	1

*M : "Minimal" indicates no measurable dose above background.

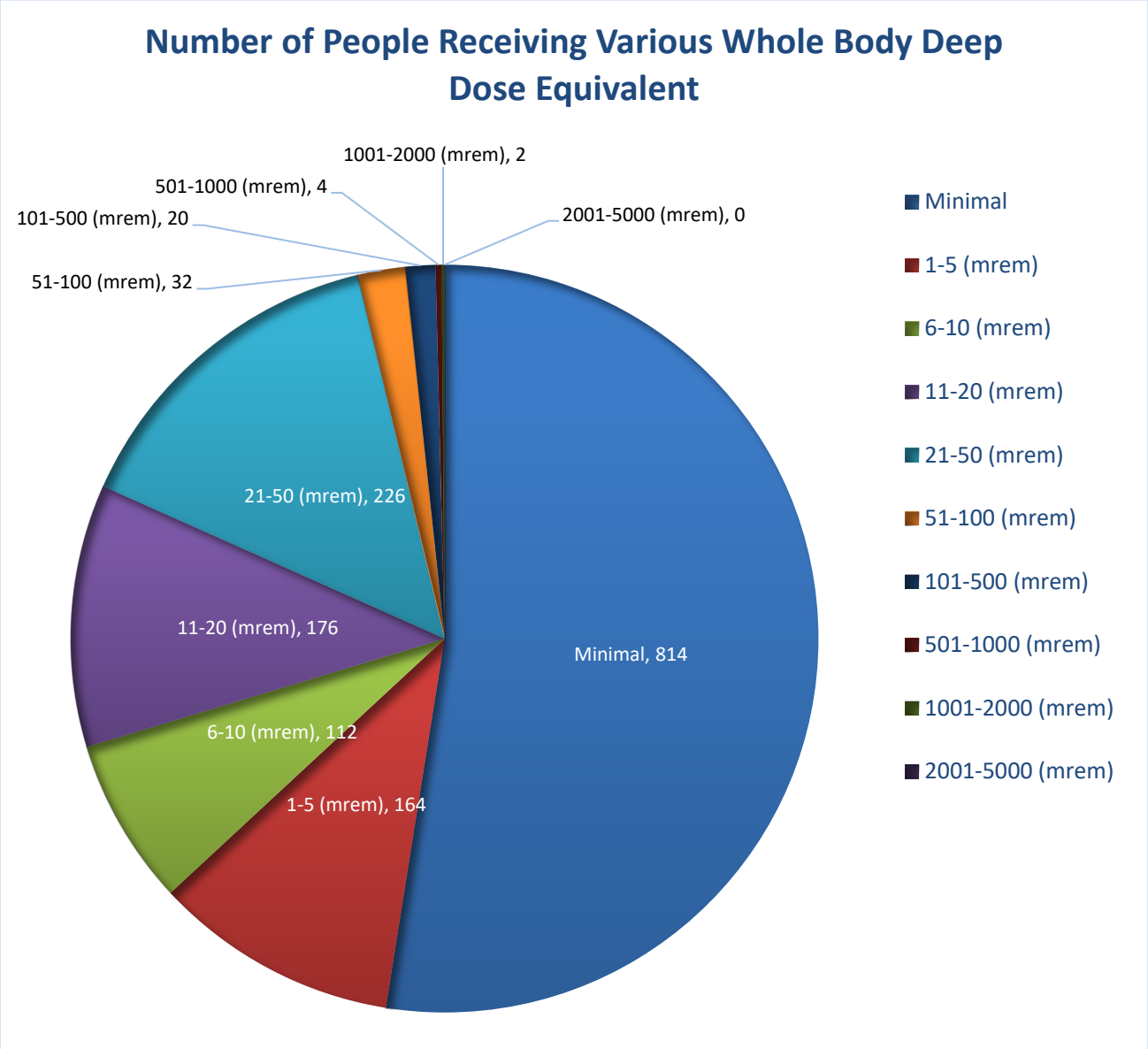

Figure 1 - The number of people receiving various values of whole body deep dose equivalent exposures is shown. M: "Minimal" indicates no measureable dose above background.

Review of Internal Dosimetry Data

There were 45 routine post-work thyroid screening bioassays performed for I-125. No urine bioassays were performed. No bioassays were performed for I-131. None of the bioassays performed required additional investigation.

Radioactive Waste Disposal

In 2021, one solid waste disposal to the local landfill were conducted via disposal methods allowed under the Texas Administrative Code (TAC), 25 TAC §289.202(fff)(1)(A), 25 TAC §289.202(fff)(1) B, 25 TAC §289.202(fff)(4) and 25 TAC §289.202(ggg)(7).

- On June 7th, 4.77 m^3 of short-lived waste containing P-32, S-35, I-125, Tc-99m , F-18, and In-111 for a total activity of 4.501 mCi, and 505.7 pounds of long lived waste containing H-3 and C-14 with an activity of 3.698 mCi was sent to the landfill.

Three liquid waste disposals were conducted in 2021. The total activity of all radionuclides released via the sanitary sewer in 2021 was 21.184 mCi. The total activity concentration for the year was 9.21E-08 $\mu Ci\ mL^{-1}$. The sum of the ratios of the radionuclides disposed was 3.39E-04 which is significantly less than 1. All of these values are well below the limits stated in 25 TAC 289.202 (ggg) regarding the discharge of radionuclides via sanitary sewer. Table 5 shows the summary of liquid waste disposals.

Shipment of waste to the Texas low-level waste disposal facility was conducted through the waste broker Bionomics, Inc. In 2021, there were two waste shipments from Texas A&M university, College Station. Table 6 shows the summary of waste disposed of through Bionomics.

Table 4 - Summary of 2021 Landfill Disposals

Date	Radionuclide	Volume (m^3) or Weight (pounds)	Activity (mCi)
5/21/2021	^{3}H and ^{14}C	505.7 lbs	3.698
	All Other Short Lived including ^{18}F	4.77 m^3	4.501

Table 5 – Summary of 2021 Liquid Disposals to the Sanitary Sewer

Radionuclide	^{3}H	^{14}C	^{32}P	^{33}P	^{35}S	^{125}I
Yearly Total (mCi)	13.051	7.056	0.018	0.001	0.001	1.057
Activity Concentration (µCi/mL)	5.67E-8	3.07E-8	7.65E-11	5.62E-12	3.06E-12	4.60E-9
25TAC289.202(ggg) Table III limits (µCi/mL)	1E-02	3E-04	9E-05	8E-04	1E-03	2E-05
Ratios of Concentration to limits	5.67E-6	1.02E-4	8.50E-7	7.03E-9	3.04E-9	2.30E-4

*Sum of the ratios: 3.39E-04 which is less than 1

Table 6 – Summary of 2021 Waste Disposals through Bionomics

Date	**Number**	**Container**	**Category**	**Activity (mCi)**
4/8/2021	3	55 gallon drum	Dry Solid Waste	0.187
8/10/2021	4	55 gallon drum	Vials (Exempt)	4.100
	4	55 gallon drum	Dry Solid Waste	0.353

POLICIES & PROCEDURES

As part of ongoing efforts to comply with the "two year rule" from 25TAC289.252(x)(11), procedures have been implemented for having a storage plan for Permit holders who are intending to store radioactive materials longer than 24 months following the last principal use. Adequate disposal options have been implemented. A document outlining the plan was submitted to the State as part of amendment 159 for license L00448.

Annual Radiological Safety Laboratory Reviews

In 2021, improvements in the coronavirus pandemic allowed the RSS to resume in-person laboratory reviews/inspections later in the year. A total of 49 radiological safety laboratory reviews/inspections were performed on the TAMU main campus. Moreover, RSS completed inspections of 11 remote site RAM neutron moisture gauge user permits under license L05683. Inspections for RPD and lasers under R00304 and Z00116 were performed on a periodic basis when new units were added and /or decommissioned respectively. These reviews were conducted in addition to other visits to the labs such as package delivery, waste pickup, contamination/radiation surveys, etc. Laboratories that required follow-up visits by RSS due to minor discrepancies were completed.

Radiological Safety Committee Audit

1. Sealed Source Leak Test Audit performed by Dr. Ursula Winzer-Serhan on April 1, 2021

Audit findings/recommendations:

- Records reviewed from 2015 to April 2021
- Procedures for leak tests were correctly spelled out
- Some delays and omissions on quarterly tests due to COVID-19
- Detailed review of current procedures for data entry and delayed wipe tests were performed.

RSS Comment: Wipe test results missing in the EHSA database were retrieved and completed. Worked with database vendor to update and customize leak test notifications and overdue reminders. The RSS thanks Dr. Winzer-Serhan for the detailed review of the program and comments.

2. Licenses and Permits Audit performed by Dr. Bryan Tomlin on September 9, 2021.

Audit findings/recommendations:

- RAM, RPD, and laser licenses and permits issued by the university were reviewed.
- A random selection of each kind were reviewed; database records did not reveal missing or outdated information
- Procedures and documentation found to be in good order – no deficiencies identified

RSS Comment: The RSS thanks Dr. Tomlin for the detailed review of the program and comments.

3. Organization and Scope Audit performed by Dr. John Ford on December 13, 2021.

Audit findings/recommendations:

- Examined the organizational chart and interviewed all available staff
- Scope and responsibilities of the program noted as greater than previously
- High turnover of staff noted – positions are not at competitive wage levels for the expertise needed

RSS Comment: The RSS thanks Dr. Ford for the detailed review of the program and comments.

State Inspections
Texas Department of State Health Services (TDSHS) Radiation control

Inspections performed by the Texas Department of State Health Services or Nuclear Regulatory Commission are summarized in Table 7. State inspections were completed and successfully passed

The September 1, 2021 inspection of L05683 at the site 018-RELLIS campus noted two violations. One Severity Level III violation was due to sealed source leak tests not being performed at proper intervals during COVID due to improper dates. A Severity Level IV violation was due to visual inspection and maintenance of a gauge not being performed at proper intervals. Corrective actions submitted to the state on October 5, 2021 were accepted and noted as complete on October 7, 2021. Due to the evidence provided by Texas A&M, it was determined that the violation of 25TAC289.201(g)(1)(B) was not repetitive and was reduced to a Severity Level IV violation.

The December 6, 2021 inspection of L0448 at site 042-Dallas HSC site was noted as an "attempted inspection", and was not recorded as an official initial inspection of the site. This site had been recently added to the license prior to this inspection.

Table 7 – Summary of 2021 State and Federal Inspections

License or Registration	Site Inspected	Date	Discrepancies or Violations
L00448	000 – Main Campus	6/14/2021	None
	042 – Dallas HSC	12/6/2021	The State considered this as an attempted inspection, and not the "Initial" inspection, so there were no letter sent with the inspection results.
L05683	004 – Beeville	8/23/2021	None
	009 – Vernon	7/21/2021	None
	012 – University Services Building	3/3/2021	None
	016 – Bushland	3/8/2021	None
	018 – RELLIS	9/1/2021	Severity Level III and Level IV violation. Level III is reduced to Level IV due to evidence provided by Texas A&M
	019 – Overton	8/16/2021	None
R00304	000 – Main Campus	2/10/2021	None
	016 – College of Pharmacy, Kingsville	1/21/2021	None
	017 – NESC	2/10/2021	None

Radiological Incidents/Events

Veterinary Radiograph Incidental Exposure

An incident on September, 29, 2021, during a contrast study radiograph indicated a portion of human hand in the field of view (FOV). The tehnologist immediately repositioned to remove the hand from the FOV. The estimated dose was 3.3 mrem.

An incident on September 27 mnoted extermities in a radiograph, which was the result of unintentional misalignment of the glove lining, resulting in a fingertip exposure. The person exposed was notified and the gloves were removed from service until fixed. Other PPE were inspected and defective items were removed from service.

On October 2, 2021, a radiograph was taken with an ungloved hand very close to the primary field during a large animal exposure. The student intervened due to patient motion, and was re-instructed on proper safety protocols after the exposure. The estimated dose was 29 mrem.

On October 21, 2021, during a fluoroscopic procedures, the technologist accidentally activated the unit while the veterinarian's hands were in the FOV. The hands were removed after ~ 2 s. The reported dosimetry reading for the radiologist were 9 mrem DDE, and the extremity dose was minimal.

On November 5, 2021, a small animal patient was administered CPR during an EP exam placing a pacemaker. Four additional staff members helped to intervene during the approximately 4:49 min exposure. The quarterly extremity badge result from the radiologist indictaed 65 mrem and it was not completely from this particular activity as the radiologist was involved with multiple flouro for the quarter. The four staff members dose were not significant.

University Services Building

On June 21, 2021, TAMU surplus notified a professor from Physics and Astronomy that magnet pieces collected for recycle from the University Services Building were radioactive, at which point Radiological Safety was contacted. The magnet was obtained from Fermi lab ~30 years prior, and no one was aware of any residual radioactivity. Radiological safety worked with the recycle/scrap yard to recover the radioactive pieces, including soil underneath. Rad safety coordinated with the rad waste contractor, Bionomics, Inc to facilitate removal of all metal pieces of the magent from the scrap yard into a roll off. The roll off containing the 14,750 lbs of waste (675 ft^3) was taken off of to the low level disposal facility for appropriate disposal. The cost for disposal was approximately $20,000.

Mechanical Engineering

A undergraduate student from Mechanical Engineering filed a workers compensation claim on August 3, stating that vision may have been impaired while using a laser and that provided protective eyewear was incorrect. Upon notification, Radiological Safety immediately stopped laser operations until the situation was evaluated, at which point it was discovered that a new laser system was not registered and the student had not reieved laser safety training, as the student's work was not to encompass use of lasers. Radiological Safety determined that the eye wear in use was not appropriate for the new laser in use. The student received an eye exam on 18 August, and no damage was noted by the opthamologist. The RSS made recommendations for correct eye protection, laser barriers, and other controls, which were implemented and verified by inspection on 27 August. Laser work in this lab was then restarted by recommendation of the RSC chair and the RSC laser safety member.

Report Submitted By: Latha Vasudevan Date: June 27, 2022

Radiological Safety Officer

Reviewed By: Date: 7/8/22

Chair, Radiological Safety Committee