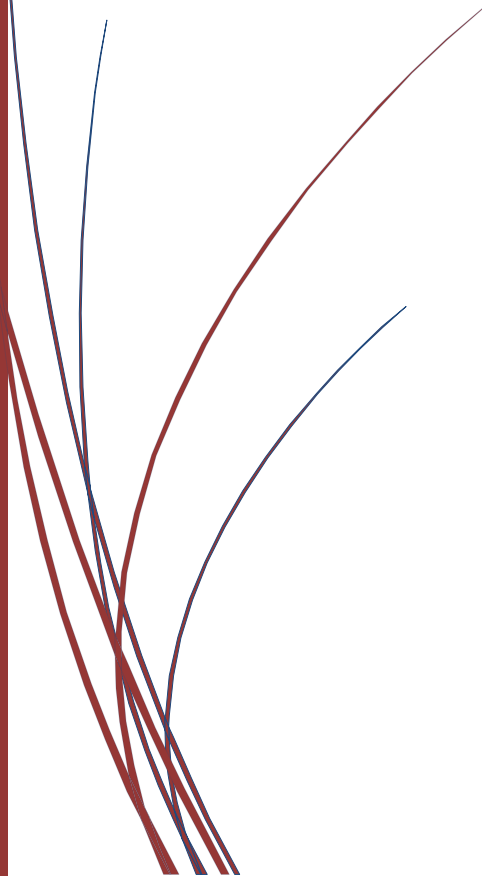




7/6/2023

Radiation Protection Program Review 2022

Texas A&M University



Environmental Health and Safety
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INTRODUCTION

This document provides a review of the Radiation Protection Program for Texas A&M University over the 2022 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 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 2022. 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 2022. 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, and Galveston, Institute of Biosciences and Technology-Houston, and Texas A&M College of Dentistry-Dallas. One amendment was completed during 2022: Amendment 160, approving the removal of generally licensed sources from devices for disposal. 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 includes Prairie View A&M University, RELLIS campus, Texas A&M Agrilife sites at Beeville, Lubbock, Plainview, Uvalde, Vernon, Weslaco, Bushland, Overton 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. No amendments were submitted in 2022. 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. Four amendments were completed in 2022. Amendment 05 updated the list of authorized users; Amendment 06 updated authorized use categories adding, “for research and development,” to differentiate from commercial production and use code difference; Amendment 07 included several small administrative updates to authorized uses and amounts, as well as the addition of Cu-62 and an update to the financial assurance obligation; Amendment 08 updated the possession limit for At-211. 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 Texas A&M University- College Station, RELLIS campus, Prairie View A&M University, Texas A&M University-

Galveston, HSC-Bryan campus, Institute of Biosciences and Technology (IBT)-Houston, Houston, Stephenville, Huntsville, Kirbyville, Kingsville and the Texas A&M Nuclear Engineering and Science Center. Two amendments became effective in 2022. The first amendment effective January 3rd, corrected the number of units at Prairie View A&M after an error was noted. The second amendment, effective August 3rd, increased the allowed number of units at Prairie View A&M and Texas A&M University-Galveston. 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 2022. The registration expires on February 28, 2026.

Z00116

This registration, issued by The Texas Department of State Health Services, authorizes the possession and use of Class III B and Class IV lasers at the College Station Campus, Bryan, RELIS campus, Galveston, Kingsville, Institute of Biosciences and Technology (IBT)-Houston, Prairie View A&M University, Lubbock, and Stephenville. Three amendments became effective in 2022. The first, effective May 2nd, added the use of one portable unit at Lubbock. The second, effective July 14th, added the use of one portable unit at Stephenville. The final, effective October 24th, added units at IBT and Bryan. The registration expires on 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 Committee Chair, appointed by the Vice President for Finance and Administration, plus three Ex-Officio (non-voting) members. The administration changed to Vice President of Facilities, Health, Safety, and Security and then towards the latter half of 2022, the administration changed to Vice President of Risk, Ethics, and Compliance.

The RSC acts as an advisory body to ensure 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 2022 calendar year.

Members	Department
John Ford, Ph.D., Chair	Nuclear Engineering
Jonathan Szczepanski, Ph.D.	Chemistry
Joseph Reibenspies, Ph.D.	Chemistry
Thomas Welsh, Ph.D.	Animal Sciences
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
Latha Vasudevan, Ph.D., CHP, <i>Ex-Officio</i>	Radiological Safety Officer
Christina Robertson, CIH, CSP, <i>Ex-Officio</i>	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 2022, 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. The Senior Health Physicist, Health Physicist, Assistant Health Physicist-II and Assistant Health Physicist-I positions became vacant early part of 2022.

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 2022, there were a total of 101 RAM permits, 71 RPD permits possessing a total of 150 RPDs, and 105 laser permits possessing a total of 500 laser units.

Radiological Safety Training

During 2022, several types of training were offered by EHS. There were a total of 26 live training sessions offered; 13 for General Radiation Safety Initial training, 12 for Veterinary Hospital Radiation Safety Initial training, and one for DEXA Radiation Safety Training. A total of 514 people were trained in these sessions; an additional 3,195 people were trained via online training modules. EHS offers General Radiation Safety and Veterinary Radiation Safety classroom 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 2022 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 2022, 63 portable survey instruments were sent to the manufacturer for calibration, and 86 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 2022, leak tests were performed for 97 sealed sources (15 of which are neutron soil moisture gauges), and 20 generally licensed sources.

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 12/1/2021-11/30/2022 and were reconciled on January 10, 2023.

Table 2– Summary of training provided by RSS in 2022

Training Type	Number of Times Offered in 2022	Number of Individuals Attended Training
General Radiation Safety Initial (Hybrid)	13	171
Veterinary Radiation Safety Initial (Hybrid)	12	315
DEXA Radiation Safety Training (In-Person)	1	28
General Laser Safety (Online)	--	1001
General Radiation Producing Device -RPD (Online)	--	352
Electron Beam Facility RPD Training (Online)	--	29
General Radiation Safety Refresher (Online)	--	337
Veterinary Hospital General Radiation Safety Laser, and RPD Refresher (Online)	--	415
Veterinary Radiation Producing Device - Vet RPD (Online)	--	322
Other (Radiation Safety Awareness for Vet, MRI Safety, etc.)	--	681
Total	26	3709

Review of External Dosimetry Data

This section addresses external dosimetry for the calendar year 2022. Through the end of 2022, 1717 individuals were monitored for external occupational radiation exposure. Of those monitored, 781 people (about 45%), had no reportable whole-body deep dose equivalent (DDE) above background. Of the remaining 936 individuals, five received doses exceeding 10% of the whole-body annual limit, or 500 mrem. These individuals received doses of 2663, 1502, 1211, 1464, 809, 548. The remainder received doses ranging from 1 mrem to 500 mrem. The cumulative dose for all individuals monitored for the entire year was 24.2 person-rem. The average deep dose equivalent for those who received a measurable dose was approximately 19 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 2022 was 2663 mrem, SDE of 2660 mrem, and LDE of 2671 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 2022 was 1136 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. EHS-RSS are working earnestly with the radiology supervisor on evaluating the radiation doses received by personnel and identifying ways to minimize the dose received during radiography.

For those individuals who received total effective dose equivalent of 100 millirem 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	Number Measured	Number w/ Measured Dose	Cumulative DDE (mrem)	Avg. DDE (mrem)	Max. DDE (mrem)
4 th year students	395	360	5774	16	116
Athletics	2	0	0	0	1
Student Health Center	3	0	0	0	0
Bio	1	0	0	0	0
CCCA	3	0	0	0	0
Cyclotron Institute	753	6	33	6	195
E-beam	4	1	3	3	8
EHS	31	3	8	2.6	107
GI	23	7	44	6	28
Human Clinical	2	1	1	1	4
IBT	1	0	0	0	0
Joides Research Vessel	7	1	2	2	1
LA/Med Surg	30	29	340	12	41
LA/Res Int	34	29	570	20	86
Monthly	41	38	9376	246	2663
Nuc Eng	33	14	620	44	88
Office of the State Chemist	2	0	0	0	0
RELLIS	2	0	0	0	0
SA/Fac Med	17	17	620	36	133
SA/Res Int	79	65	1564	24	127
SA/Spec	21	21	888	42	109
School of Public Health	5	1	1	1	0
Staff/Anes	14	14	644	46	636
Staff/LA ICU	13	11	84	8	33
Staff/LA Med	23	20	391	20	305
Staff/LA OR	26	21	276	13	190
Staff/Misc	10	10	132	13	34
Staff/RAD	3	3	81	27	50
Staff/SA Cardio	2	2	31	16	47
Staff/SA Dental	1	1	6	6	10
Staff/SA ER	31	30	1465	49	171
Staff/SA Int Med	9	9	124	14	38
Staff/SA Neuro	5	5	52	10	24
Staff/SA Onco	12	12	188	16	31
Staff/SA OR	32	27	522	19	99
Staff/SA Ortho	10	8	131	16	40
Staff/SA SX	7	6	98	16	37
TAES2	3	0	0	0	0
TIPS	12	1	24	24	1

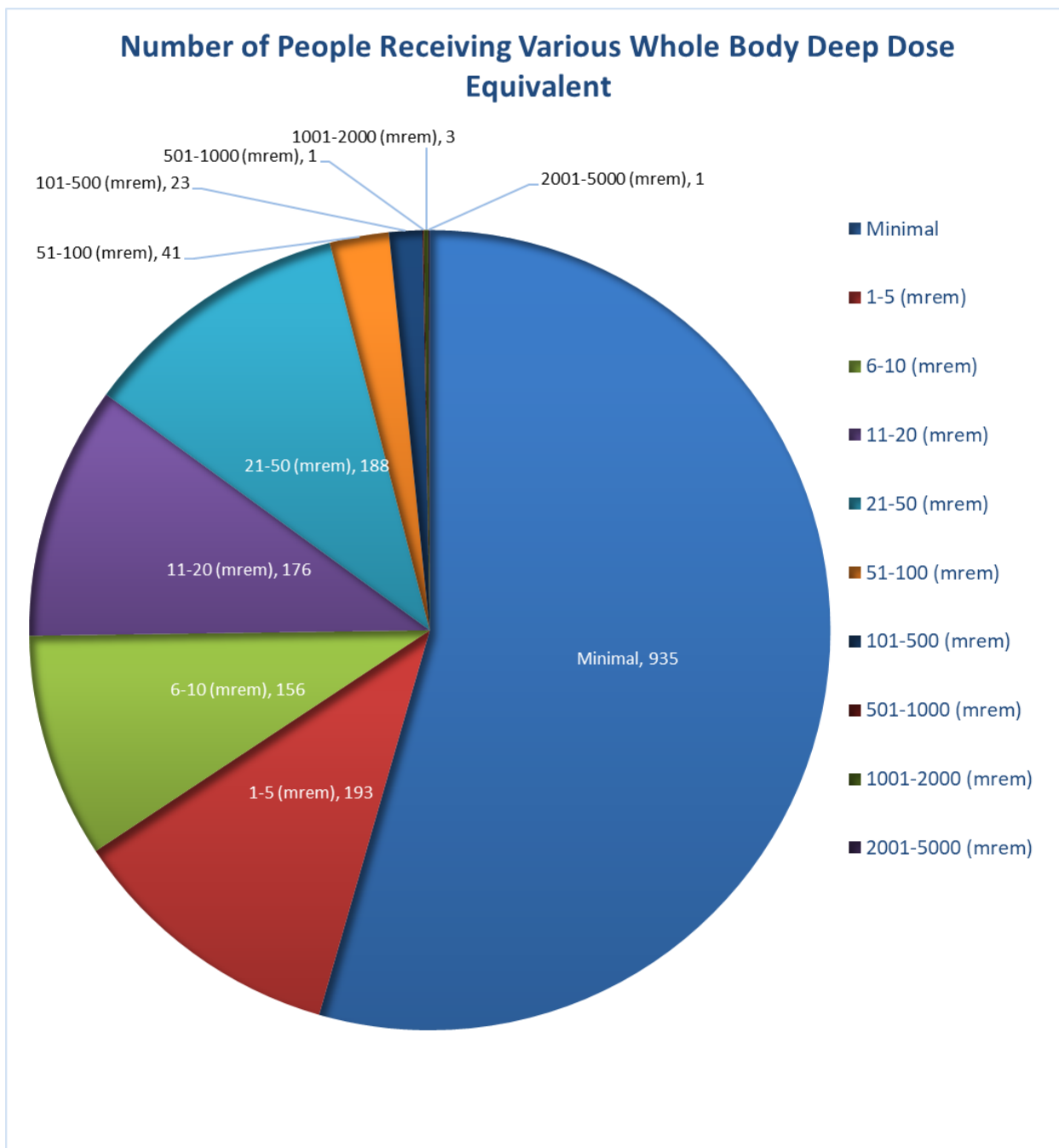


Figure 1 - The number of people receiving various values of whole body deep dose equivalent exposures is shown. M: “Minimal” indicates no measureable dose above background.

Review of Internal Dosimetry Data

There were 54 routine post-work thyroid screening bioassays performed for I-125. No urine bioassays were performed. None of the bioassays performed required additional investigation.

Radioactive Waste Disposal

In 2022, one solid waste disposal to the local landfill was 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). Table 4 shows the summary.

Three liquid waste disposals were conducted in 2022. The total activity of all radionuclides released via the sanitary sewer in 2022 was 1.715 mCi. The total activity concentration for the year was 7.46E-09 $\mu\text{Ci mL}^{-1}$. The sum of the ratios of the radionuclides disposed was 1.54 E-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 or other disposal sites was conducted through the waste broker Bionomics, Inc. In 2022, there were three waste shipments from Texas A&M university, College Station. Table 6 shows the summary of waste disposed of through Bionomics.

Table 4 - Summary of 2022 Landfill Disposals

Date	Radionuclide	Volume (m³) or Weight (pounds)	Activity (mCi)
9/27/2022	³ H and ¹⁴ C	461.2 lbs, 3.70 m ³	30.58
	All Other Short Lived including ¹⁸ F	5.43 m ³	8.18

Table 5 – Summary of 2022 Liquid Disposals to the Sanitary Sewer

Radionuclide	³ H	¹⁴ C	³² P	³³ P	³⁵ S	¹²⁵ I
Yearly Total (mCi)	0.950	0.00083	0.07083	0.00083	0.00378	0.68870
Activity Concentration (μCi/mL)	4.13E-09	3.62E-12	3.08E-10	3.62E-12	1.64E-11	2.99E-09
25TAC289.202(ggg) Table III limits (μCi/mL)	1.00E-02	3.00E-04	9.00E-05	8.00E-04	1.00E-03	2.00E-05
Ratios of Concentration to limits	4.13E-07	1.20E-08	3.42E-06	4.52E-09	1.64E-08	1.49E-04

*Sum of the ratios: 1.54E-04 which is less than 1

Table 6 – Summary of 2022 Waste Disposals through Bionomics

Date	Number	Container	Category	Activity (mCi)
2/21/2022	1	55 gallon drum	Compact Dry Solid	0.169
	1	55 gallon drum	Dry Solid	0.0002
	4	55 gallon drum	Vials	1.965
7/18/2022	1	55 gallon drum	Compact Dry Solid	3.478
	2	55 gallon drum	Dry Solid	0.261
	1	55 gallon drum	Vials	2.550
	1	5 gal drum	Type A	5
10/19/2022	60	5 gal drum	Dry Solid (ThF4)- 480 kg	39.7

POLICIES & PROCEDURES

Rule changes

On January 4, 2022, several changes were made to the 25 TAC §289.252 rules to incorporate NRC rules that were not previously included and also added additional limitation.

- **Ability to require a separate license if additional site locations are more than 30 miles from the main site in §289.252(d)(4)**
- Expanding the definitions and requirements of broad scope licenses in §289.252(h) and adding the appendix “Broad scope license limits (for use in subsection (h) of this section)” in §289.252(jj)(10)
- Substantial revisions were made to many medical rules in 25 TAC §289.256 to reflect the changes in, and to maintain compatibility with, the NRC rules.

Annual Radiological Safety Laboratory Reviews

In 2022, A total of 31 radiological safety laboratory reviews/inspections were performed on the TAMU main campus. Moreover, RSS completed inspections of 13 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. Radiation Dosimetry audit performed by Dr. Thomas Welsh on July 5,

2022 Audit findings/recommendations:

- No updates to the manual are suggested at this time
- Dosimetry and bioassay data are complete and well organized
- Management issue noted is the timely submission of dosimetry badges by vet students. As the expenses are paid by the College of Veterinary Medicine and/or the Veterinary Teaching Hospital, the time is appropriate to re-engage with their administrative leadership regarding compliance with health and safety policy.

RSS Comment:

Rad Safety has been in communication with Dr. Karen Cornell, Associate Dean for the DVM Professional Program specifically on dosimetry for vet students going for externships outside TAMU. Letter addressing this change has been sent

out explicitly outlining the vet school/ hospital responsibility with exchange of badges.

With regards to the audit report, rad safety suggested a letter be sent through RSC (concurrence from RSC members) to the Vet school administration outlining the expectations of the badge requirements and get their commitment.

- Rad safety facilitated two sets of badges, one for externship and one for normal use with concurrence from vet school administration

2. Surveys and Instrumentation Audit performed by Dr. Craig Marianno and Dr. Kris Hagel on September 2, 2022

- Examined all paperwork pertaining to calibration records of the instruments
- Documentation of surveys in the past several years
- Staff members were available to answer the questions during the audit
- No deficiencies were noted on any of the paperwork
- All documents were consistent and well documented

RSS Comment:

We thank the RSC for the detailed review. No further comments.

3. Training program Audit performed by Dr. Joseph Reibenspies on November 18, 2022

Two topics were discussed from the previous audit (Sept 2019)

- Software updates that automate the online training and notification has been implemented to allow for streamlined reporting.
- Course evaluations through satisfaction surveys. The data collected was not used to track or record the data or used the results to improve the training process. In this regard the EH&S is still working toward its goals. The COVID-19 lockdowns have affected the time table for completion of a proper survey, record keeping and implementation of a well constructed feedback mechanism

Date and review of training documents.

- The training documents are to be reviewed atleast once a year.
- The date of the review should be clearly indicated on the documents.

RSS Comment:

- Rad safety is working towards completion of proper survey of course evaluation and implementation of feedback mechanism
- Rad safety will include the review date on the training modules and if no changes, will add a note to reflect it was reviewed

State Inspections

Texas Department of State Health Services (TDSHS) Radiation Control

Table 7 – Summary of 2022 State and Federal Inspections

License or Registration	Site Inspected	Date	Discrepancies or Violations
L00448	Site 042-Dallas	December 6, 2021	Only attempted inspection and no inspection results
	Site 011-Galveston	January 26, 2022	No violation and the program in compliance
	Site 042-Dallas	July 12, 2022	No violation and the program in compliance
L06561	Cyclotron Institute	July 7, 2022	No violation and the program in compliance
R00304	Site -013-Huntsville (remote inspection)	September 30, 2022	No violation and the program in compliance

Radiological Incidents/Events

Minor veterinary radiology events

Small Animal Radiology (X-Ray suite)-January 10, 2022:

Small Animal Radiology (X-Ray suite)

- Student technician ungloved her left hand to better help position the patient’s stifle.
- The image was taken before the student technician removed her hand from the patient.
- Dose assessment was performed and the calculated dose was approximately 22.57 mrem.

Small Animal OR – Cath Lab (C-arm)-January 27, 2022

- A veterinarian accidentally initiated the fluoroscopy while another vet was trying to adjust a catheter in the patient’s Rectum.
- All PPE was worn including whole body badge. But not her extremity badge.
- The extremity dose was estimated to be around 4.5 mrem.

Small Animal OR – Cath Lab (C-arm)-March 24, 2022

- A technician took the C-Arm out of standby mode while another technician was standing out of view.
- The technician (7ft away) was exposed to radiation without lead for 1 second.
- The dose to the individual from scatter radiation estimated to be less than 0.43 mrem

Small Animal OR- using C-ARM-5/25/2022

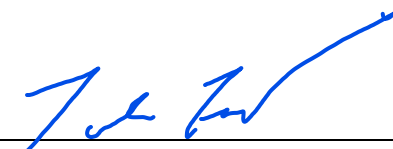
- Technician's hand inadvertently came in the beam while adjusting the patient's position.
- No rings
- Approximately less than 1 sec
- Dose insignificant

Radioactive waste (containing very small amounts of C-14) stored in one of the experimental areas (Cave 3) at the Cyclotron Institute couldn't be located-November 30, 2022

- Activity: ~1 microcurie of C-14 per bag, weight ~10 pounds per bag, 5 bags total
- After searching throughout Cyclotron Institute, it was concluded that the waste was inadvertently disposed in the landfill.
- The allowed disposal concentration for C14 in the landfill as per 25 TAC §289.202(fff) (1)(A) is 0.05 microCi/g of C14. The disposed activity concentration is well below the limit.
- Email sent out to Cyclotron Institute personnel emphasizing that tagged RAM is not to be disposed in ordinary trash

Report Submitted By: Latha Vasudevan
Radiological Safety Officer

Date: July 6, 2023

Reviewed By: 
Chair, Radiological Safety Committee

Date: 7/10/23