

TEXAS A&M UNIVERSITY

RADIATION PROTECTION PROGRAM: 2016 REVIEW

Environmental Health and Safety

Radiological Safety

June 2017

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INTRODUCTION

This document provides a review of the Radiation Protection Program for Texas A&M University over the 2016 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

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 2016. An overview of the various licenses maintained by Texas A&M University is provided in Table 1.

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Table 1 – Licenses maintained at Texas A&M

License No.	Issuing Agency	Expiration Date	Description
42-09082-09	United States Nuclear Regulatory Commission (USNRC)	Apr 30, 2018	Radioactive Materials License, Use aboard JOIDES (SEDCO/BP 471) and any other TAMU research ship
L00448	Texas Department of State Health Services (TDSHS)	Sep 30, 2016 (under timely renewal)	Radioactive Materials License, TAMU and Galveston
L05683	Texas Department of State Health Services (TDSHS)	Aug 31, 2024	Radioactive Materials License, TAMU, 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
R-23	United States Nuclear Regulatory Commission (NRC)		License for AGN-201 reactor, TAMU. AGN reactor was relocated to Nuclear Science Center (NSC) with the Texas A&M Engineering Experiment Station on December 2016 and License R-23 was transferred to NSC
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)	Feb 28, 2018	Certificate of Registration (RPD), JOIDES (D/V SEDCO/BP-471 aka JOIDES Resolution)

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Z00116	Texas Department of State Health Services (TDSHS)	April 30, 2019	Certificate of Registration (Laser), TAMU
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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 issued in 2016. The license expires on April 30, 2018.

L00448

The Texas Department of State Health Services issues this broad-scope license. It authorizes the University to use radioactive material in College Station and Galveston, Texas. One amendment was issued in 2016. Amendment 145 was issued on June 6, 2016, increasing the maximum activity of Pu-239. The technical renewal for this license was submitted in August 2016. The license is under timely renewal.

L05683

The Texas Department of State Health Services issues this specific license. It authorizes the University to use radioactive material at designated remote sites inside Texas. Unlike license L00448, this license is relatively specific with regard to the radioactive materials that may be possessed, as well as the individuals authorized to use the materials. Amendment 29 was issued on March 4, 2016 adding a new PI at site # 004 (Beeville) for use of Am-241/Be sealed sources in a gauging device. Amendment 30 was issued on October 7, 2016 adding a new PI and removing a PI at site #008 (Uvalde) for use of Am-241/Be sealed sources in a gauging device. The license expires on August 31, 2024.

L06561

The Texas Department of State Health Services issues this specific license. It authorizes the University to produce radioactive material for research and development at the Texas A&M University Cyclotron Institute in College Station, TX. 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 issued in 2016 and the license expires on July 31, 2023.

R-23

The U.S. Nuclear Regulatory Commission issued this license to operate a 5-watt AGN-201 nuclear reactor at Texas A&M University. In December 2016, the AGN reactor was moved from Zachry Engineering Center to the Nuclear Science Center. The reactor license was transferred from Texas A&M University to the Texas A&M Engineering Experiment Station.

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 Riverside Campus, Beeville, Prairie View A&M University, Galveston and Lufkin. The renewed registration was issued on January 8, 2016 with the expiration date of September 30, 2023.

R14497

This registration, issued by The Texas Department of State Health Services, authorizes the University to possess and use a diffraction x-ray unit aboard the D/V SEDCO/BP-471. This vessel is also referred to as the JOIDES Resolution. No amendments were issued in 2016. The registration expires on February 28, 2018.

Z00116

This registration, issued by The Texas Department of State Health Services and authorizes the University to possess and use Class IIIB and Class IV lasers at the College Station campus. One amendment was approved in June 20, 2016 that increased the number of units at site 000. The registration expires in April 30, 2019.

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 two times during the 2016 calendar year, with the third meeting postponed to January 2017 due to the major project involving AGN reactor move in December 2016. However, the third RSC meeting was conducted in February 2017 due to absence of voting members in January.

Members	Department
John W. Poston, Ph.D., Chair	Nuclear Engineering
John T. Jaques, Ph.D.	Texas Veterinary Medical Diagnostic Laboratory
Duncan MacKenzie, Ph.D.	Biology
Won-Bo Shim, Ph.D.	Plant Pathology
Vladimir Horvat, Ph.D.	Cyclotron Institute
Brian Applegate, Ph.D.	Biomedical Engineering
Jay Griffin, DVM.	Large Animal Clinical Sciences
John Ford, Ph.D.	Nuclear Engineering
Hays S. Rye, Ph.D.	Biochemistry & Biophysics
Christopher M. Meyer, CHP, <i>Ex-Officio</i>	Office of Safety and Security
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 2016, the RSS consisted of the RSO, a Senior Health Physicist, one Associate Health Physicist, one Environmental Safety Supervisor, one Asst. Health Physicist-IV, one Asst. Health Physicist-II, two Asst. Health Physicists-I, a Senior Office Associate, and 5-6 student technicians.

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 DSHS 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 2016, there were a total of 148 RAM permits, 69 RPD permits, and 86 Laser permits.

Radiological Safety Training

During 2016, several types of training were offered by EHS. There were a total of 41 classroom training sessions offered and 2607 people were trained (both classroom and online). 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 2016 is displayed in Table 2.

Instrument Calibrations

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 2016, 53 portable survey instruments were sent to the manufacturer for calibration, and 98 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. These services are also provided, as a courtesy, to users possessing sources authorized under a

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general license. Leak tests are performed quarterly. In 2016, leak tests were performed for 95 sealed sources, as well as 32 generally licensed sources.

Table 2– Summary of training provided by RSS in 2016

Training Type	Number of Times Offered in 2016	Number of Individuals Completing Training
General Radiation Safety (Classroom)	16	375
General Radiation Safety (TTVN-Distance Learning for Remote Sites)	4	24
Veterinary Radiation Safety (Classroom)	21	294
General Laser Safety (Classroom and Online)	--	882
General Radiation Producing Device -RPD (Online)	--	375
General Radiation Safety Refresher (Online)	--	305
Veterinary Radiation Producing Device -Vet RPD (Online)	--	352
Total	41	2607

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 12/1/2015-11/30/2016 and were reconciled in December 1, 2016.

Review of External Dosimetry Data

This section addresses external dosimetry for the calendar year 2016. Through the end of 2016, 1352 individuals were monitored for external occupational radiation exposure. Of those monitored, 652 had no reportable whole body deep dose equivalent (DDE) above background. Of the remaining 700 individuals, five received doses exceeding 10% of the whole body annual limit, or 500 mrem. The remainder received doses ranging from 1 mrem to 300 mrem. The total cumulative dose for all individuals monitored for the entire year was 15.3 person-rem. The average deep dose equivalent for those who received a measurable dose was approximately 30

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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) and dose equivalent to the lens of the eye (LDE). The maximum SDE and LDE values were 2302 mrem and 1159 mrem, respectively. In addition to whole body dosimeters, some users were issued extremity dosimeters to measure dose to the hand, when applicable. The highest extremity shallow dose equivalent for 2016 was 2370 mrem.

The individuals with the highest dose reported work in Nuclear Medicine and diagnostic radiology at the Veterinary Teaching Hospital and Texas Institute for Preclinical Studies (TIPS). 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.

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

Subaccount Code	Department	Number Measured	Number with Measured Dose	Cumulative DDE (mrem)	Avg. DDE (mrem)	Max. DDE (mrem)
A36	Athletic	2	0	*M	M	M
B21	Beutel Health Center	2	0	M	M	M
B38	BIO/BIO	1	0	M	M	M
C02	Cardio Pathology	20	19	99	5	11
A89	CCCA (Teague) A	3	0	M	M	M
CMP	CMP	3	3	19	7	10
B86	Cyclotron B	280	1	1	1	1
C86	Cyclotron C	224	23	302	2	255
D06	Declared Pregnancy	3	1	11	4	11
E19	E Beam	8	8	40	5	14
E93	EHS	35	7	57	2	43
JO3	JOIDES	1	0	M	M	M
A92	Nuclear Engineering A	24	18	170	8	45
P13	Physics	2	0	M	M	M
SPH	School of Rural Public Health	4	0	M	M	M
S01	Soil & Crop	1	1	8	8	8
S24	Spares	6	1	5	1	5
T04	TAES	1	1	1	1	1

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T05	TAES 2	3	1	7	3	7
T22	TIPS	44	24	3198	73	1154
G00	Von Gonten	15	1	2	1	2
V00	4 th Year Vet Students	304	278	6030	20	111
V01	LA Med Surgery	20	13	329	17	137
V02	LA Resident Intern	17	9	164	10	89
V03	SA Faculty Med	16	16	552	35	109
V04	SA Specialist	26	24	667	26	117
V05	SA Resident Intern	44	42	1128	26	108
V06	Staff Anesthesiology	24	23	682	29	153
V07	Staff Misc	6	4	50	9	26
V08	Staff LA OR	23	21	736	32	307
V09	Staff RAD	3	3	48	16	36
V10	Staff SA SX	6	5	64	11	24
V11	Staff SA OR	23	21	399	18	40
V12	Staff SA ER	24	24	900	38	176
V13	Staff SA ICU	0	0			
V14	Staff SA Int MED	6	6	114	19	38
V15	Staff SA Neuro	5	3	21	5	17
V16	Staff SA Cardio	2	2	40	20	36
V17	Staff SA Orthopedic	5	4	63	13	31
V18	Staff SA Oncology	2	2	5	3	4
V19	Staff SA Dental	1	1	19	19	19
V20	Staff LA ICU	16	10	46	3	15
V22	Staff LA MED	18	15	450	25	132
V23	Staff SA Zoo Med	2	2	15	8	12
V37	GI Lab	22	18	404	19	106
V91	Monthly Badges	39	38	3850	99	942
W0	Ward Ober	4	4	62	16	20
LAR	LARR	3	3	49	17	43
REN	Renuke	9	0	M	M	M

*M : “Minimal” indicates no measurable dose above background

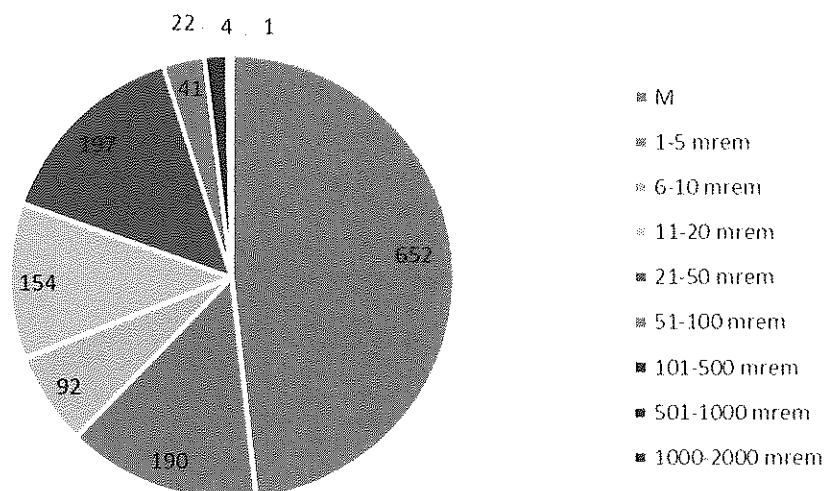


Figure 1 - The number of people receiving various values of whole body deep dose equivalent exposures is shown. M: “Minimal” indicates no measureable dose above background.

Review of Internal Dosimetry Data

Seventy seven routine and post-work thyroid screening bioassays were performed for I-125. No bioassays were performed for I-131. None of the bioassays performed required additional investigation.

Radioactive Waste Disposal

In 2016, two solid waste disposals to the local landfill were conducted via disposal methods allowed under the Texas Administrative Code. On May 6, 2016, 7.42 m³ of short-lived waste containing I-125 with an activity of 4.34E-4 mCi, were disposed in the landfill. On July 11, 2016, 6.89 m³ of short-lived waste containing P-32 and I-125 for a total activity of 0.105 mCi and 160 pounds of long lived waste containing H-3 and C-14 with an activity of 2.4 mCi was sent to the landfill. On July 11, 2016 and on November 10, 2016, about 45 pounds of animal carcasses (mice and chicken) used for F-18 (half-life of 1.82 hours) diagnostic imaging studies were disposed in the landfill. Table 4 shows the summary of landfill disposals.

Five liquid waste disposals were conducted in 2016. The total activity of all radionuclides released via the sanitary sewer in 2016 was 3.63 mCi. The total activity concentration for the year was 1.58E-08 μCi mL⁻¹. The sum of the ratios of the radionuclides disposed was 2.23 E-04

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which is significantly less than 1. All of these values are well below the limits stated in 25 TAC 289.202 (gg) regarding the discharge of radionuclides via sanitary sewer. Table 5 shows the summary of liquid waste disposals.

Shipment of waste to an authorized low-level waste facility was conducted in 2016 through Bionomics, Inc. Two shipments were made in 2016. The first shipment was on March 2, 2016 and the second shipment was on October 27, 2016. Table 6 shows the summary of waste disposed of through Bionomics.

Table 4 - Summary of 2016 Landfill Disposals

Date	Radionuclide	Volume (m ³) or Weight (pounds)	Activity (mCi)
05/06/2016	All Other Short Lived	7.42 m ³	4.34E-4
	³ H and ¹⁴ C	160 pounds	2.4
07/11/2016	All Other Short Lived	6.89 m ³	0.105
	¹⁸ F	45 pounds	0 -decayed
7/11/2016 and 11/10/2016			

Table 5 – Summary of 2016 Liquid Disposals to the Sanitary Sewer

Radionuclide	³ H	¹⁴ C	³² P	³⁵ S	¹²⁵ I	¹⁷⁵ Hf/ ⁸⁹ Zr
Yearly Total (mCi)	0.800	0.08	0.658	1.25	0.845	1.96
Activity Concentration (uCi/mL)	3.48E-09	3.51E-10	2.86E-09	5.42E-09	3.67E-09	8.54E-12
25TAC289.202(gg) Table III limits (uCi/mL)	1E-02	3E-04	9E-05	1E-03	2E-05	2E-04
Ratios of Concentration to limits	3.48E-07	1.172E-06	3.18E-05	5.423E-06	1.83E-04	4.26E-07

Sum of the ratios : 2.23E-04 which is less than 1

Table 6 – Summary of 2016 Waste Disposals through Bionomics

Date	Number	Container	Category	Activity (mCi)
3/2/2016	2	55 gal drum	Exempt scintillation vials	0.95
	1	55 gal drum	Non RCRA scintillation vials	1.57
	1	30 gallon drum	Aqueous liquids	1.5
10/27/2016	1	5 gallon plastic drum	Exempt Vials	0.042
	1	30 gallon	Aqueous liquid	2.04
	1	55 gallon plastic drum	Aqueous liquid	0.28
	3	55 gallon drum	Dry waste	4.63
	1	10 gallon plastic drum	Oil	0.228
	2	55 gallon drum	Non RCRA scintillation vials	0.611

POLICIES & PROCEDURES

The broad scope license technical renewal was submitted in August 2016. The radiological safety program manual was revised and submitted for review as part of license renewal.

Annual Radiological Safety Laboratory Reviews

In 2016, about 66 radiological safety laboratory reviews/inspections were performed on the TAMU main campus. Moreover, RSS completed inspections of 17 remote site permits under license L05683 and registration R00304. 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. In December 2016, RSS performed training and inspection for TAMU IODP ship- Joides resolution (42-0982-09 - NRC license for use at Sea).

No significant non-compliance issues were identified in any reviews/inspections.

Radiological Safety Committee Audit

Training audit was performed by Dr. Poston on March 3, 2016. The audit revealed that the training programs offered by the RSS were up-to-date, had clear learning objectives, and were well organized. No deficiencies or areas needing corrections and /or improvement were noted.

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The Dosimetry audit was performed by Dr. Ford on August 9, 2016. Overall the records were complete for the period examined, well organized, and easy to access.

Audit findings/recommendations:

Thyroid bioassays- some were hard copies and some were electronic and electronic records were hard to verify if it had been reviewed.

Archiving files –Maintain paper copy of contents of the storage boxes as well as electronic copies.

In response to the audit comments; RSS will maintain printed out copies with review signature for thyroid bioassays. When files are being archived, RSS will maintain paper copies of the contents of the storage boxes.

Surveys and Instrumentation audit was performed by Dr. Poston and Dr. Jaques on November 29, 2016. There were no discrepancies or weaknesses in the surveys, however they identified two areas for improvement.

- Laboratory survey comment section should summarize the results of the survey and areas of potential concern.
RSS already implemented the summary section on the survey form.
- Second area for improvement was to determine the status of the training for individuals assigned to laboratory while preparing for laboratory survey.
RSS sends out monthly reminders to personnel delinquent on their training. RSS also sends out permit verification reports to the PI that reflects training dates for all authorized users under that permit. If all the authorized users in one lab are not up to date on training, the laboratory cannot order radioactive materials. Moreover, when laboratory reviews/inspections are performed, the inspector reviews the preliminary inspection reports that includes the authorized users and their training.

State Inspections

L05683 (Site # 006-Overton) - State inspection was performed on August 16, 2016. The inspector erroneously noted the lab inspection date as radiation protection program review date and cited a violation. Texas A&M contested the violation and the violation was rescinded on September 6, 2016.

L05683 (Site #014-Dallas) - State Inspection was performed on December 1, 2016. No discrepancies or violations noted and radiation safety program is in compliance.

L06561 (Site #000-College Station) - State inspection was performed on October 31, 2016. No discrepancies or violations noted and radiation safety program is in compliance.

R00304 (Site # 013-Huntsville) - State inspection was performed on August 1, 2016. No discrepancies or violations noted and radiation safety program is in compliance.

Radiological Incidents/Events

No notable incidents.

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Noteworthy Additions

Texas A&M Health Science Center Environmental Health and Safety merged with Texas A&M University Environmental Health and Safety on December 2016 and plans were underway for office renovations to accommodate the health science center staff.

Zachry Engineering Center demolition was underway. All labs within the building around the AGN reactor were surveyed and released for unrestricted use in April 2016. The laboratory waste that contained low levels of radioactivity were disposed through commercial vendor to the low level disposal facility. The AGN reactor fuel/start up source/reactor tank and all associated components were transferred from its current location at the Engineering Center to the Nuclear Science Center in December 2016. Final safety survey of the reactor facility was performed and submitted to the Nuclear Regulatory Commission for approval of release of the building for further demolition and future construction of the new academic education center. The reactor license R-23 and the fuel inventory were transferred to Nuclear Science Center.

Report Submitted By: Lalitha Vasudevan
Radiological Safety Officer

Date: June 27, 2017

Reviewed By: John W. Astor, Jr.
Chair, Radiological Safety Committee

Date: July 20, 2017