



TEXAS TECH UNIVERSITY
Environmental Health *and* Safety

LABORATORY SAFETY MANUAL

FOREWORD

Texas Tech University is dedicated to excellence in the scientific laboratory. It is the desire of Texas Tech that all campus laboratory activities are conducted safely to protect the health of employees, students, and the community. To support this mission, the Laboratory Safety Program directed by the Department of Environmental Health and Safety strives to provide adequate laboratory safety resources to the University community.

The Laboratory Safety Plan is a compilation of Texas Tech University safety policies and procedures across scientific disciplines. Its purpose is to serve as a singular laboratory safety resource for faculty, staff and students.

For added document navigation, links (indicated in blue) are provided on the cover page of each section and in the table of contents.

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RECENT CHANGES

Chemical Hygiene Plan

Section A4 Policies

- Addition of Section A4.7 on requests for clarification and deviation

Section A5 Responsibilities

- DSO responsibilities now references TTU Operating Policy 60.29

A16 Chemical Identification

- Revision to allow SDSs databases for work areas to be kept in paper copy, electronic copy or via access to the internet

A17 Chemical Handling

- Pyrophoric chemicals shall be handled according to their respective SDS

A19 Waste

- Chemical waste must be stored in the designated Satellite Accumulation Area (SAA)
- Tubs and SAA signage are provided by EHS. Additional secondary containers shall be supplied by the PI.
- Hazardous Waste stored in the SAA shall not exceed 55 gallons of hazardous waste, 1 qt of acutely hazardous waste, or 1 Kg of solid acutely hazardous waste.
- Incompatible waste streams shall be segregated into separate secondary containment within the SAA.
- Only appropriately labeled, sealed containers with a corresponding EHS Transaction Number will be collected during routine collection.
- Biological waste container description only in Biosafety Manual

A21 Chemical Storage

- Pyrophoric chemicals shall be stored according to their respective SDS

A23 Non-Compliance

- Procedures for addressing non-compliant individuals in a work area have been added

Biosafety Manual

We would like to reiterate that checklists for basic biosafety at BSL1 and BSL2 containment were amended to reflect the requirements in the 6th edition of the BMBL in November of 2021. Certain requirements for all laboratories from the CHP have been reiterated in the BSL1 checklist. These are not new requirements.

Verbiage has been clarified regarding sinks and sharps containers at BSL1. A plumbed sink and eyewash are both required in the immediate (vs adjacent) work area at BSL1. There is no delineation of BSL1 vs other biocontainment in the regulations for the management of sharps. The use of FDA-approved containers (i.e., puncture-proof and securable) is required for the disposal of sharps in all biological laboratories.

Guidelines for double gloving have been added.

Policy changes

Special criteria have been added for animal (ABSL), plant (PCL), and arthropod (ACL) containment. These sections will continue to be expanded and updated as program needs are assessed. The checklists are located in section *B9.2.3 Special Considerations for Certain Research Foci*. References to biosafety level have been changed to containment level given the formalization of these new types of biocontainment areas.

B9.2.1 Regarding IBC protocol registration has been amended to address the transition to the online cloud-based Cayuse application. As announced in January 2023, all new protocols, protocol renewals, and protocol amendments will be completed within the Cayuse system. To get started in Cayuse, researchers and laboratory personnel will need to complete the personnel form to be added to the system. More information is provided on the IBC registration page:

<https://www.depts.ttu.edu/ehs/academicsafety/Biosafety/protocolregistration-bio.php>

B6.5 Biologically Derived Toxins section was added. These materials are subject to IBC oversight. Responsibilities to the PI and IBC in section B4 were also added to reflect this change.

B6.6 Prions and Prion-like Proteins was added. These materials are subject to IBC oversight. Responsibilities to the PI and IBC in section B4 were also added to reflect this change.

B6.7 Respiratory Viruses was added. These materials are subject to work using BSL2 Enhanced requirements.

B9.2.2.1(a) Cleaning equipment (i.e., brooms, mops, buckets, etc.) is dedicated to the work area for all containment levels.

B10.1.4.4 was amended to state that the PI is responsible for *coordination* and completion of annual BSC certification. This change was made so that our policies are not misinterpreted to imply that PIs are financially liable for certification. The financially responsible party (or parties) for BSC certification is determined by the department/college/school.

Chemical Hygiene Plan

(POLICIES AND PROCEDURES)

Updated August 2023

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HELPFUL LINKS AND DOCUMENTS

[29 CFR 1910.1450](#) (Occupational exposure to hazardous chemicals in laboratories)

[29 CFR 1910, subpart Z](#) (Toxic and Hazardous Substances)

[40 CFR 262](#) (Standards Applicable to Generators of Hazardous Waste)

[49 CFR 100-185](#) (DOT Hazardous Materials Regulations)

[Carcinogen List](#)

[NIOSH Pocket Guide to Chemical Hazards](#)

[Prudent Practices in the Laboratory](#)

[EHS Home Page](#)

[Barcode Request Form](#) (The fillable form cannot be opened in a web browser. Download the form to your computer and open using Adobe Acrobat Pro to complete and save).

[Barcode Return Form](#)

[Chemical Inventory \(SafetyStratus\)](#)

[Chemical Transfer Form](#) (The fillable form cannot be opened in a web browser. Download the form to your computer and open using Adobe Acrobat Pro to complete and save).

[ChemWatch](#) – SDS database, label printing

[Equipment Decontamination Form](#)

[Occupational Health Program](#)

RECENT CHANGES

Section A4 Policies

- Addition of Section A4.7 on requests for clarification and deviation

Section A5 Responsibilities

- DSO responsibilities now references TTU Operating Policy 60.29

A16 Chemical Identification

- Revision to allow SDSs databases for work areas to be kept in paper copy, electronic copy or via access to the internet

A17 Chemical Handling

- Pyrophoric chemicals shall be handled according to their respective SDS

A19 Waste

- Chemical waste must be stored in the designated Satellite Accumulation Area (SAA)
- Tubs and SAA signage are provided by EHS. Additional secondary containers shall be supplied by the PI.
- Hazardous Waste stored in the SAA shall not exceed 55 gallons of hazardous waste, 1 qt of acutely hazardous waste, or 1 Kg of solid acutely hazardous waste.
- Incompatible waste streams shall be segregated into separate secondary containment within the SAA.
- Only appropriately labeled, sealed containers with a corresponding EHS Transaction Number will be collected during routine collection.
- Biological waste container description only in Biosafety Manual

A21 Chemical Storage

- Pyrophoric chemicals shall be stored according to their respective SDS

A23 Non-Compliance

- Procedures for addressing non-compliant individuals in a work area have been added

A1 PURPOSE OF THIS PLAN

It is the desire of Texas Tech University to set forth policies, procedures, and work practices capable of informing employees of physical and chemical health hazards associated with chemicals in "work and storage spaces" as defined by [29 CFR 1910.1450](#) - Occupational Exposures to Hazardous Chemicals in Laboratories, and to train employees to maintain exposures below the limits prescribed in [29 CFR 1910, subpart Z](#). This document is designed to comply with the requirements and intent of [29 CFR 1910.1450](#) and employee "right-to-know" legislation.

TEXAS TECH UNIVERSITY HEALTH AND SAFETY POLICY

It is the policy of Texas Tech University to conduct all educational, research, and campus activities safely and in a manner that protects the health of employees, students, and the public.

Each administrator must be committed to the enforcement of the health and safety policies of the University and to implement appropriate safety practices within his or her area of responsibility.

All faculty members and others involved in instructional and/or research programs are responsible for seeing that the students in their courses and [laboratories](#)^d are properly trained and educated about applicable safety and health safety policies and practices prior to exposure to instructional or research hazards.

Each employee and student is entitled to have access to information about the University's health and safety policies and practices and is responsible for knowing and adhering to health and safety policies and practices as they are applicable to the instruction, research, and work settings in which he or she participates.

Each employee is responsible for maintaining a safe work place. Employees have a continuing responsibility to develop and follow practices that achieve these goals.

Each employee who manages or supervises the work of others is additionally responsible for ensuring that employees and students for whom they are responsible are properly trained and educated about safety and health practices.

Every guest, vendor, media personnel or contractor present on the University is expected to adhere to the health and safety policies of the University while on campus. TTU personnel who contract with invited individual(s) or oversee a work area are responsible for informing outside vendors of policies.

All University-related facilities, activities and programs shall be designed, conducted, and operated in a manner which reasonably protects human health and safety. Adherence to these principles is necessary in order for the University to achieve its mission of providing quality instruction, research and services.

The University strives to provide training and education conducive to the establishment and maintenance of safe educational, research and work environments.

Where there is conflict or overlap between state or federal regulations and TTU policies, the most protective provisions shall be used.

A2 EMERGENCY ASSISTANCE INFORMATION

TTU Environmental Health and Safety

Daytime Emergencies (M-F, 8:00am – 5:00pm) – 806-742-3876

TTU Emergency Maintenance

Operations Call Center – 806-742-4677

After hours and weekend emergencies (24 hrs/day, 7 days/week) – 806-742-4OPS (4677)

TTU Police (TTUPD)

Emergency – 911

Non-Emergency – 742-3931

A3 USEFUL ACRONYMS AND DEFINITIONS

A3.1

Useful Acronyms

AAALAC – Association for Assessment and Accreditation of Laboratory Animal Care

ACGIH – American Conference of Governmental Industrial Hygienists

ANSI – American National Standards Institute

BSL1 – Biosafety Level 1

BSL2 – Biosafety Level 2

BSL3 – Biosafety Level 3

BSL4 – Biosafety Level 4

C – Ceiling

CAS – Chemical Abstracts Service

CDC – Center for Disease Control

CFR – Code of Federal Regulations

CHO – Chemical Hygiene Officer

CHP – Chemical Hygiene Plan

CSA – Container Storage Area

DOT – Department of Transportation

DSO – Departmental Safety Officer

EHS – Environmental Health and Safety
EPA – Environmental Protection Agency
ERP – Emergency Response Plan
FAA – Federal Aviation Administration
GFCI – Ground-Fault Circuit Interrupter
GHS – Globally Harmonized System
HVAC – Heating, ventilation and air conditioning
HAZCOM – Hazardous Communications
HAZWOPER – Hazardous Waste Operations and Emergency Response
HEPA – High Efficiency Particulate Air
IACUC – Institutional Animal Care and Use Committee
IBC – Institutional Biosafety Committee
IDLH – Immediately Dangerous to Life or Health
IFC – International Fire Code
ILSC – Institutional Laboratory Safety Committee
IRB – Internal Review Board
ISO – International Organization for Standardization
LASER – Light Amplification by Stimulated Emission of Radiation
LC50 – Air concentration lethal to 50% of the test population
LD50 – Dose lethal to 50% of the test population
LEL – Lower Explosive Limit or Lower Exposure Limit
LOAEL – Lowest Observed Adverse Effect Level
LOEL – Lowest Observed Effect Level
NFPA – National Fire Protection Agency
NIOSH – National Institute for Occupational Safety and Health
NOAEL – No Observed Adverse Effect Level
NOEL – No Observed Effect Level
OHP – Occupational Health Program

OEL – Occupation Exposure Limit
OSHA – Occupational Safety and Health Administration
PEL – Permissible Exposure Limit
PI – Principal Investigator
PPE – Personal Protective Equipment
REL – Recommended Exposure Limit
RQ – Reportable Quantity
RSO – Radiation Safety Officer
SAA – Satellite Accumulation Area
SCAN – Safety Concern and Near-Miss
SDS – Safety Data Sheet
SOP – Standard Operating Procedure
STEL – Short Term Exposure Limit
TCEQ – Texas Commission on Environmental Quality
TLV – Threshold Limit Value
TWA – Time Weighted Average
UEL – Upper Explosive Limit and Upper Exposure Limit
USDA – United States Department of Agriculture
VOC – Volatile Organic Compounds
WASP – Work Area Safety Plan

A3.2

Useful Definitions

Action Level – a concentration designated in [29 CFR 1910](#) for a specific substance, calculated as an 8-hour time weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Administrative Controls – (or work practice controls) are changes in work procedures such as written safety policies, rules, supervision, schedules, and training with the goal of reducing the duration, frequency, and severity of exposure to hazardous chemicals or situations.

Chemical Gateway – an area at TTU Central Receiving under EHS control where chemical packages are received, opened, inspected, barcoded and inventoried before delivery to the responsible party.

ChemWatch – an online Safety Data Sheet (SDS) library that includes vendor SDSs and printable GHS labels for most chemicals. Available through the Safety Data Sheets Quick Link on the EHS website.

Combustible Liquid – A liquid that has a closed-cup flash point at or above 100°F (37.8°C).

Container Storage Area – a completely enclosed, self-supported structure under EHS control where hazardous waste is accumulated and stored before transport to a designated waste treatment facility.

Correction Period – the time period allotted for personnel to correct compliance issues identified during an inspection or in a written memorandum for potential work area closure.

Critical Finding - a safety departure that can result in personnel injury or exposure and/or environmental contamination. Non-critical findings that continue unaddressed or are found to be excessive within a work area and thus present more than a moderate hazard will be elevated to a critical finding. Critical findings must be corrected by lab personnel within 24 hours following the inspection that identified the finding(s).

Dangerous – a non-routine procedure that poses significant threat to life or health.

Departmental Representative – any TTU personnel who acts as a liaison between their department and EHS during any correspondence (e.g., incident report, facility planning, hazardous material shipping, etc.)

Dignitary – any representative from federal or state regulatory agencies, industry, law enforcement officials, investors, etc.

Engineering Controls – includes designs or modifications to plants, equipment, ventilation systems, and processes that reduce the source of exposure.

Energetic Materials – can be classified into three categories: explosives, propellants, and pyrotechnics. Explosives detonate not combust and contain oxygen as part of their mixture. Propellants combust and contain oxygen; however, the burn rate depends upon pressure. Pyrotechnics may contain propellant ingredients and tend to be made of metal salts and are intended to produce light, smoke, gas, sound and heat.

Finding – used synonymously with safety departure; describes behavior, practices or facility features that deviate from the University Laboratory Safety Manual or other regulatory guidelines.

Flammable Liquid – A liquid that has a closed-cup flash point at or below 100°F (37.8°C) and a maximum vapor pressure of 2068 mm Hg (40 psia) at 100°F.

Horseplay – rough or boisterous play.

Incident – an event or occurrence that results in damage to property and / or damage / exposure to person(s) that requires medical attention, including the use of available safety equipment and/or first aid.

Institutional compliance committee – a committee established by the University and/or required by federal/state law to maintain compliance with regulatory agencies and oversee and authorize certain activities. The ILSC, IBC, IRB, IACUC and IRLSC are the institutional compliance committees at Texas Tech University.

Laboratory – a facility equipped for experimental or observational study in a science or for testing and analysis and that contains chemical, biological, mechanical, radiological and / or LASER materials / equipment for these purposes.

Laboratory Personnel – anyone working in a TTU laboratory including principal investigators, staff, students, visiting researchers, volunteers, etc.

Localized Exhaust – an exhaust system designed to remove contaminants at the point of origin.

Minor – individual under the age of 18 years old.

Mixed Waste – waste generated in which at least two of the following are present: chemical, biological and / or radiological hazards.

Municipal Solid Waste – defined in Texas Administrative Code [30 TAC 330.3](#).

Nanoparticles – (also known as nanomaterials) defined as particles intentionally engineered and created that range from a size of 1 nm to 100 nm in size.

Non-critical finding – a safety departure that presents a moderate hazard and are generally indicative of inadequate safe work practice(s). Non-critical findings must be corrected by lab personnel within 30 days following the inspection that identified the finding(s).

Non-laboratory Personnel – any TTU personnel whose primary work area is not a laboratory.

Personal Protective Equipment (PPE) – Personal protective equipment includes all clothing and work accessories designed to serve as a barrier against laboratory hazards. Basic PPE requirements for most campus laboratories include, solid shoes, a lab coat and safety glasses; however other PPE may be required. Examples include gloves, face shields, surgical masks, respirators, head/shoe covers, splash goggles, impermeable lab coats or suits, fire retardant coats/suits, steel-toed shoes, full-face respirator, scrubs, solid-front gowns, aprons, etc.

Physical Barrier – an environmental control that serves as a means of containment in the event primary containment fails. Hazardous materials stored inside a closed cabinet, closed refrigerator, closed drawer, closed incubator, etc. are considered behind a physical barrier.

Primary Explosive – explosive initiated by simple ignition such as spark, flame or impact.

Portable Sink – a sink designed to be mobile and contains a reservoir for containing gray water.

Public Area – any are where non-laboratory personnel may be present such as common corridors, stairways, elevators, office spaces, etc.

Pyrophoric Materials – chemical in which oxidation by oxygen or moisture proceeds so rapidly that ignition occurs. Common examples of pyrophoric materials include, but are not limited to, finely divided metals (whose degree of reactivity depends on particle size), metal hydrides, alloys of reactive metals, low-valent metal salts and iron sulfides.

Quarterly – every 90 days.

Risk Assessment - continuous and evolving analysis of hazards associated with work procedures or operations, assessment of the risks of the identified hazards, identification of actions or equipment to manage and/or mitigate the risks and creation of an emergency plan.

Responder – any person designated by the employer, including employees from within the immediate release area, to respond to an incidental release of hazardous material.

Safety Concerns and Near Misses (SCAN) – an event or occurrence that was caught before an incident occurred, did not result in an incident but could have or unsafe practice(s), condition(s), environment that could result in an incident.

Safety Data Sheet – (SDS) OSHA Hazard Communication Standard (HCS) ([29 CFR 1910.1200\(g\)](#)) requires that chemical manufacturers, distributors, or importers provide a safety document, written in English, for each hazardous chemical to communicate information such as: the properties of each chemical; the physical, health, and environmental health hazards; protective measures; and safety precautions for handling, storing and transporting the chemical. See [Section A16.4](#) for SDS requirements for laboratories.

Safety survey / survey – an inspection of a work area where there are physical, chemical, and/or biological hazards to evaluate and assess the presence of safety departures as described in appendix AB.

Satellite Accumulation Area – (SAA) designated hazardous waste storage area at or near any point of generation where wastes initially accumulate inside of a work area (definition adapted from [40 CFR 262.15](#)).

Secondary Containment – (for chemical storage or transport) must be: 1) sturdy, 2) leak-proof, 3) capable of holding ten (10) percent of the volume of the containers or 100 percent of the volume of the largest container, whichever is greater, 4) able to be appropriately decontaminated, and 5) compatible with the chemicals it contains (i.e. no reaction should a spill occur).

Secondary Explosive – explosive initiated by shock created by primary explosives.

Select Carcinogens – substances that are classified as carcinogens or potential carcinogens in OSHA standard [29 CFR 1910, subpart Z](#).

Sharps – any metal object / device used to puncture or cut. Examples include any type of injection device and whatever is attached to it, razors, X-Acto knives, pointed scissors, scalpels, etc.

Shipper – individual who signs declaration and or shipping documents for hazardous materials shipping.

Spill Kit – a compilation of appropriate absorbent materials, cleaners, disinfectants, chemical neutralizers, personal protective equipment and other equipment (e.g., container for clean-up materials, scoop, broom, disposal bags, waste labels, etc.) used to contain and clean up spills. See Appendix AC for spill response and kit guidance.

TechBuy – (also known as SciQuest) a procurement website for TTU personnel to make University purchases from approved vendors. For more information visit <https://www.depts.ttu.edu/procurement/purchasing/> or contact techbuy.purchasing@ttu.edu.

Toxin – any substance poisonous to an organism; toxins may be synthetic or produced and released from the metabolic activities of a living organism (i.e. biological toxin). These substances can cause harmful effects when they are injected, inhaled, eaten or absorbed through the skin. Use of toxins listed as [Select Agents by the CDC](#) requires approval by the Institutional Biosafety Committee and is subject to regulations as described in [7 CFR 331, 9 CFR 121 and 42 CFR 73](#).

Vacuum Line Trap – equipment that protects a vacuum system from separated solvents and prevents vapors from being emitted back into the system or work area; in biological systems, the trap prevents contamination of the vacuum system with potentially biohazardous materials (see Appendix AE for guidance on vacuum line trapping).

Volunteer – individual who is assigned to perform duties for a department or area of TTU without compensation or the expectation of compensation, beyond reimbursement for pre-approved specified expenses. Potential volunteer workers may be members of the public, TTU alumni, students, faculty, staff or retired TTU faculty or staff (definition from [TTU OP 70.21](#)).

A4 POLICIES

A4.1

All policies included in this Chemical Hygiene Plan apply to all areas of TTU activity.

A4.1.1

The terms *laboratory*^d and *work area* are used interchangeably to refer to the areas on-campus and off-campus in which TTU faculty, students, or staff work with chemical, biological or physical hazards. These areas include, but are not limited to, laboratories^d, studios, shops, field sites and classrooms.

A4.2

Occupational Safety and Health Administration (OSHA) Regulated Substances

A4.2.1

Employee exposures to chemical substances will be kept below the OSHA exposure limits established in [29 CFR 1910, subpart Z](#) and as low as reasonably achievable through the use of [administrative controls](#)^d, [engineering controls](#)^d and personal protective equipment (PPE).

A4.2.2

The exposure limits include Permissible Exposure Limits (OSHA), Threshold Limit Values (ACGIH), Recommended Exposure Limits (NIOSH), Time Weighted Averages, Short Term Exposure Limits, and Ceiling Values. The most restrictive value is to be used.

A4.2.3

Substances regulated in [29 CFR 1910, subpart Z](#) will be identified within each work area. EHS will keep and maintain a chemical inventory for each lab^d in the EHS Assistant inventory system by barcoding all incoming chemicals.

A4.3

Proper Laboratory^d Attire

A4.3.1

Proper lab attire must be worn at all times in the laboratory^d.

A4.3.1.1

Proper footwear is required.

A4.3.1.1(a)

Footwear must be liquid-repellant. Canvas shoes, such as Toms, Converse and most tennis shoes are not liquid-repellant.

A4.3.1.1(b)

Footwear must cover the entire foot. Shoes such as ballet flats and sandals are not appropriate.

A4.3.1.2

Shorts or other garments which expose the skin of legs or feet shall not be worn in the laboratory^d. Clothing that allows any skin below the waist to be seen is not allowed.

A4.3.1.3

Secure long hair away from the face.

A4.3.2

Selection of [Personal Protective Equipment \(PPE\)](#)^d (e.g., lab coats, gloves, eye protection, etc.) must be appropriate for the work being done and agents being worked with.

A4.3.2.1

Lab coats and eye protection must be worn in the work area while chemical and/or biological agents are not behind a [physical barrier](#)^d.

A4.3.2.2

In teaching laboratories^d, the minimum PPE^d required while working with chemical or biological agents include all of the following: laboratory coats, safety glasses and gloves appropriate to the agents being used.

A4.3.2.3

Splash goggles are required when working with chemical / biological agents that present a splash hazard.

A4.3.2.4

Eye protection must be ANSI certified for the hazards present.

A4.3.2.5

Appropriate gloves must be worn while working with chemical / biological agents. Glove selection must be appropriate for the work being done or agent(s) being handled. The following provisions apply to glove usage:

A4.3.2.5(a)

Avoid touching your face, eyewear, personal items, or other environmental surfaces with your gloves.

A4.3.2.5(b)

Gloves should be removed in such a way as to not contaminate the wearer or aerosolize material on the gloves.

A4.3.2.5(c)

Used disposable gloves shall be discarded immediately after removal and not reused.

A4.3.2.5(d)

Gloves should be changed frequently. Gloves shall be changed when they are visibly contaminated, between procedures or when integrity has been compromised.

A4.3.2.5(e)

Wash hands prior to donning gloves to remove lotions which may compromise glove integrity.

A4.3.2.5(f)

Wash hands any time gloves are removed. Hands must be washed before leaving the laboratory^d.

A4.3.2.6

If a different type of PPE^d is required or the use of PPE^d could result in injury (e.g. loose clothing around moving machinery), the SOP (see [Section A12](#)) for these activities must state the PPE^d that must or must not be used while performing the required operation.

A4.3.3

Visitors are required to wear the PPE^d determined for the work area while hazardous operations are being conducted and / or chemical / biological agents are not behind a physical barrier^d. If visitors refuse to don PPE^d, or if PPE^d is not available, entry will be refused.

A4.3.4

Individuals at a desk or computer work station inside of the work area are required to wear the same PPE^d required to enter the lab^d while hazardous operations are being conducted and / or chemical / biological agents are not behind a physical barrier^d.

A4.3.4.1

If (and only if) no hazardous operations are being conducted and all chemical / biological agents are stored behind a physical barrier^d, PPE^d can be removed.

A4.3.4.2

All individuals in the work area must always put their PPE^d back on any time that hazardous operations are being conducted and / or chemical / biological agents are not behind a physical barrier^d.

A4.3.5

PPE^d should be dedicated to the work area and shall not to be worn in [public areas](#)^d.

A4.3.5.1

Laboratory coats must be stored in the work area and not in offices or public areas^d.

A4.3.5.1(a)

The coat must be stored in such a way that the inner surfaces that contact the user are not at risk of becoming contaminated.

A4.3.5.2

In instances where laboratory coats are transported outside a work area, such as in transit between work areas, the coat must be folded in such a way that the outside of the garment 1) is not exposed, and 2) does not touch the inner parts of the garment that directly contact the wearer.

A4.3.6

Defective, soiled and/or damaged PPE^d shall not be used.

A4.3.6.1

Defective and/or damaged PPE^d must be replaced by the supervisor (see A5.5.13).

A4.3.6.2

Soiled, reusable PPE^d must be decontaminated; regular laundering of PPE^d is encouraged.

A4.3.6.2(a)

A commercial laundry service shall be used for laundering laboratory coats or other washable, protective apparel where dedicated laundry units are not available. PPE^d shall not be laundered at home or at a public laundry mat.

A4.4

General Laboratory^d Practices

A4.4.1

Eating, drinking, chewing gum or tobacco, smoking, vaping, taking medications, applying cosmetics or lotions, etc. are strictly prohibited in laboratories^d.

A4.4.2

Storage of items identified in A4.4.1 and other personal hygiene products is not permitted in the laboratory^d.

A4.4.2.1

Items of this nature for research / experimental purposes shall be labeled “for research use only” or an equivalent phrase.

A4.4.2.2

First aid kits should be clearly labeled as such.

A4.4.3

Hand washing must occur before leaving the work area and when there is potential for contamination on hands such as after a spill.

A4.4.4

Mouth pipetting is prohibited.

A4.4.5

Appropriate disinfectants / neutralizers must be available before work begins.

A4.4.6

Mercury thermometers should be replaced with alcohol or digital thermometers. If assistance is needed to replace mercury thermometers, contact EHS at 742-3876.

A4.4.6.1

Contact EHS at 742-3876 to clean up broken mercury thermometers.

A4.4.7

Empty chemical containers not repurposed for waste collection must be disposed of in a proper container disposal area, if provided, or a dumpster.

A4.4.7.1

Containers for [P-listed](#) chemicals must be triple-rinsed with an appropriate solvent for removal of the material before disposal into a proper container disposal area, if provided, or a dumpster.

A4.4.8

Ignition sources must be kept away from where flammable materials are stored or used.

A4.5

Buddy System

A4.5.1

It is always best practice to have a partner in the work area with you (i.e., buddy system).

A4.5.2

In lieu of a physically present partner, supervisors/PIs should have a check in, check on, and check out policy for working outside of standard business hours (8:00am-5:00pm, Monday-Friday and University closures) or when the supervisor/PI is physically away from campus, which follows the following general guidelines.

A4.5.2.1

Upon entering a lab^d, the lab personnel^d should contact a designated contact person. The lab personnel^d should inform the designated contact of their entrance to the work area, the general nature of their activities, and their planned exit time.

A4.5.2.1(a)

The designated contact should be someone who understands the risk of the work and proper emergency response procedures related to the work. This can include supervisor/PI, lab manager, lab safety captain, or another designated lab personnel^d.

A4.5.2.1(b)

Contact includes email, phone calls, text messages, or other direct forms of communication as outlined in the work area safety plan (WASP).

A4.5.2.1(c)

If the total time in the work area is predicted to be less than three hours, the designated contact should be contacted again when lab personnel^d exits the work area.

A4.5.2.1(d)

If the total time is greater than three hours, the designated contact should be contacted at least once every three hours by the lab personnel^d to confirm safety and upon final exit of the work area.

A4.5.3

The responsibilities of the designated contact person include the following:

A4.5.3.1

Responding to receipt of all communications to acknowledge contact (i.e. lab entrance, 3-hour check-ons, and exit).

A4.5.3.2

If after three hours a check-on or exit time is not reported, the designated contact should attempt to contact the lab personnel^d.

A4.5.3.3

If attempts to contact the lab personnel^d fail, the designated contact must notify the PI/supervisor. Then either the contact person or the PI/supervisor should physically visit the work area and check for the lab personnel^d.

A4.5.4

It is recommended that experiments be planned to avoid conducting any high-risk procedure after hours (5 pm – 8 am), on weekends or holidays. Should this work be conducted outside regular business hours, Section A9.2.3 applies.

A4.6

Work Area Investigation

A4.6.1

Work areas may be investigated when 1) an [incident](#)^d has occurred in the work area, 2) a work area is found to have excessive non-compliance (see [Section A23](#)) to safety policy, and/or 3) there is an open investigation by a regulatory agency involving the work area / project.

A4.6.1.1

The WASP (see [Section A11](#)) in work areas under investigation will be reviewed during the investigation.

A4.6.1.2

Work areas under investigation will be surveyed [quarterly](#)^d. Safety surveys^d will continue on a quarterly^d basis until two consecutive [surveys](#)^d are without [critical findings](#)^d and all [findings](#)^d (critical^d and [non-critical](#)^d) are addressed.

A4.6.1.2(a)

A seven business day grace period will be granted to correct findings^d not corrected on site or were unable to be corrected on site. Documentation of the corrective actions must be submitted to EHS by email at ehs.lab.safety@ttu.edu. By submitting corrective actions within the grace period, the survey will be counted towards the two consecutive survey criteria defined in A4.6.1.2.

A4.6.1.3

The PI and all lab personnel for the work area will repeat EHS-required safety training(s) for the work area prior to the first quarterly^d inspection. Trainings may be in-person or online as dictated by the relevant [institutional compliance committee\(s\)](#)^d.

A4.6.1.3(a)

If retraining is not completed prior to the first quarterly^d inspection, work area operations will cease until all lab personnel and the PI for the area have completed training.

A4.6.2

Work areas with an open investigation will not be allowed to host non-TTU personnel (including visiting minors, students and researchers), visiting scholars, dignitaries, media, [volunteers](#)^d, or other visitors in any capacity.

A4.6.3

If the work area is closed, the work area will remain closed to lab personnel until EHS completes a root-cause analysis and corrective actions related to the cause are taken.

A4.7

Request for Clarification or Deviation

A4.7.1

Request for Clarification

A4.7.1.1

If a principal investigator would like clarification regarding a Texas Tech University policy/procedure in the University Laboratory Safety Manual (LSM) - Chemical Hygiene Plan, they will need to submit the request in writing to the Institutional Laboratory Safety Committee (ILSC).

A4.7.1.2

The ILSC's evaluation and response to the Request for Clarification will be communicated in writing to the PI in the form of a memorandum from the ILSC chair.

A4.7.1.3

The written Request for Clarification will need to address the following:

A4.7.1.3(a)

The policy(s) or procedure(s) for which clarification is needed as written in the LSM.

A4.7.1.3(b)

Why clarification is necessary, citing reputable references or peer-review literature as needed.

A4.7.1.3(c)

Whether they wish to address the committee in-person regarding this matter so the coordinator can inform the ILSC chair.

A4.7.1.4

The Request for Clarification is to be emailed to the ILSC at the institutional email address (ilsc.ehs@ttu.edu) no less than 5 business days before a scheduled meeting to be placed on the upcoming meeting's agenda. If the request is not received 5 business days prior to the meeting, the request may not be considered until the following meeting if the agenda is already full.

A4.7.2

Request for Deviation

A4.7.2.1

If a PI desires to deviate from Texas Tech University policy(s)/procedure(s) outlined in the University Laboratory Safety Manual - Chemical Hygiene Plan, they will need to submit the justification in writing to the Institutional Laboratory Safety Committee (ILSC).

A4.7.2.2

The ILSC's evaluation and response to the Request for Deviation will be communicated in writing to the PI in the form of a memorandum from the ILSC chair. Deviations may not be implemented unless approved by the ILSC.

A4.7.2.3

The written Request for Deviation will need to address the following:

A4.7.2.3(a)

The agents and/or hazards in use and/or impacted by the proposed changes.

A4.7.2.3(b)

How the PI wishes to modify the approved-SOP(s) or policy.

A4.7.2.3(c)

A final copy of their proposed SOP(s) or policy.

A4.7.2.3(d)

A written justification as to why the approved-SOP or policy is not appropriate which sites the specific deviations from the approved-SOP or policy citing reputable references and/or peer-review literature to support their position for the needed change; and

A4.7.2.3(e)

Whether they wish to address the committee in-person regarding this matter so the coordinator can inform the ILSC chair.

A4.7.2.4

The Request for Deviation is to be emailed to the ILSC at the institutional email address (ilsc.ehs@ttu.edu) no less than 5 business days before a scheduled meeting to be placed on the upcoming meeting's agenda. If the request is not received 5 business days prior to the meeting, the request may not be considered until the following meeting if the agenda is already full.

A5 RESPONSIBILITIES

A5.1

The implementation of University health and safety policies and procedures is the responsibility of management, faculty and staff of each department. All individuals in the [laboratory](#)^d (including faculty, employees, visiting researchers, students and [volunteers](#)^d) are expected to participate actively in the program to ensure its success.

A5.2

Environmental Health and Safety (EHS)

A5.2.1

Maintain a list of laboratories^d affected by the Chemical Hygiene Plan (CHP) that is provided to EHS annually by the individual departments;

A5.2.2

Maintain a chemical inventory for each laboratory^d;

A5.2.3

Maintain a [Safety Data Sheet \(SDS\)](#)^d library;

A5.2.4

Supply Occupational Health Program (OHP) information and training as required;

A5.2.5

Train [laboratory personnel](#)^d on the principles of the CHP;

A5.2.6

Provide chemical [spill kits](#)^d to TTU facilities upon request;

A5.2.7

Respond to emergencies in the event of a spill or release;

A5.2.8

Collect wastes and maintain waste records;

A5.2.9

Conduct weekly inspections of the [Container Storage Area](#)^d (CSA);

A5.2.10

Maintain a list of all [Satellite Accumulation Areas](#)^d (SAAs).

A5.3

Chemical Hygiene Officer (CHO)

A5.3.1

The University CHO is appointed by the Vice President of Environmental Health and Safety and is responsible for the oversight of all aspects of the CHP.

A5.3.1.1

The CHO may delegate certain aspects of the program to others. Senior safety officers may act as a proxy for the CHO as delegated by the CHO.

A5.3.2

Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;

A5.3.3

Monitor procurement, use and disposal of chemicals used on the TTU campus;

A5.3.4

Help [departmental representatives](#)^d develop precautions and adequate facilities;

A5.3.5

Conduct personnel exposure monitoring as necessary;

A5.3.6

Develop and implement the chemical fume hood surveillance program to include an inventory of chemical fume hoods, criteria for evaluating hood performance, and recommended corrective actions for deficiencies in hood performance (See [Section A22](#));

A5.3.7

Investigate [SCAN](#)^d or [Incident](#)^d Reports, provide root-cause determinations and corrective actions, and take appropriate action(s) as necessary;

A5.3.8

Maintain accurate records of the following:

A5.3.8.1

Any measurements taken to monitor employee exposures;

A5.3.8.2

Any medical consultation and examinations including tests or written opinions required by this Manual;

A5.3.8.3

Laboratory [safety surveys](#)^d conducted with responses for each laboratory^d; and

A5.3.8.4

Measurements of equipment performance.

A5.3.8.5

Records are kept, transferred, and made available in accordance with [29 CFR 1910.120](#).

A5.3.9

Assist in performing physical and health hazard determinations for chemicals generated within the lab^d;

A5.3.10

Know the current legal requirements concerning regulated substances;

A5.3.11

Seek ways to improve the Chemical Hygiene Program;

A5.3.12

Assist in implementing related training;

A5.3.13

Provide announced and / or unannounced chemical hygiene and housekeeping [surveys](#)^d;

A5.3.13.1

Deficiencies discovered upon survey^d will be given 30 days for correction. Notification of findings will be sent to the PI / supervisor, DSO and Department Chair.

A5.3.13.2

A follow-up survey^d will be conducted after the [correction period](#)^d. Notification of findings will be sent to the PI / supervisor, DSO, Department Chair and Dean of the College.

A5.3.14

The CHO has the authority to remove any individual from a work area that is not following the practices outlined in the CHP or the Work Area Safety Plan (WASP) for the work area in question.

A5.4

Departmental Safety Officer (DSO)

A5.4.1

This individual is appointed by the department chair.

A5.4.1.1

The appointment of a DSO must be relayed to EHS.

A5.4.1.2

The DSO will be the contact between the department and CHO.

A5.4.2

DSO responsibilities are outlined in [TTU OP 60.29](#).

A5.4.3

The DSO has the authority to remove any individual from a laboratory^d and / or take pictures of any individual or area in the laboratory^d that are not compliant with or following the practices outlined in the University CHP or the WASP for the work area in question;

A5.5

Principal Investigator / Supervisor

A5.5.1

Each work area shall have a Principal Investigator (PI) or supervisor assigned to it who is responsible for implementing all aspects of the University Laboratory Safety Manual;

A5.5.2

Prepare and implement a Work Area Safety Plan (WASP) (see [Section A11](#) for requirements of a WASP);

A5.5.3

Ensure chemical containers are labeled with required information, barcoded, segregated by their hazard class (see Appendix AA) and stored in an appropriate manner;

A5.5.4

Perform a hazard determination of chemicals generated within the laboratory^d;

A5.5.5

Ensure all individuals who enter their work area(s) know and follow the University Laboratory Safety Manual;

A5.5.6

Prepare written standard operating procedures (SOPs) for all operations conducted and all equipment used in the work area (see [Section A12](#));

A5.5.7

Date receipt and track the age of peroxide forming compounds;

A5.5.7.1

Test peroxide formers for peroxide formation at a minimum every six months after opening (see Appendix AH);

A5.5.7.2

Contact EHS for disposal of any peroxide former if the peroxide test yields 30 ppm or more or if there is visible crystallization, discoloration, or stratification.

A5.5.8

Provide regular chemical hygiene and housekeeping [surveys](#)^d, including routine inspections of emergency equipment using Appendix AB;

A5.5.8.1

The PI is responsible for ensuring chemical hygiene and housekeeping issues are corrected, or for completing a Work Order for issues that the PI needs assistance in fixing.

A5.5.9

Determine required [PPE^d](#) and [administrative^d](#) and [engineering controls^d](#) and document this information in written procedures;

A5.5.10

Ensure that facilities and training for any material being ordered or used are adequate;

A5.5.11

Notify the DSO and CHO of the need for medical monitoring, consultation and / or examinations;

A5.5.12

In the event of injury or damage to property an incident report is to be filled out and submitted to the DSO or CHO within 24 hours after [incident^d](#);

A5.5.12.1

Injuries that require or result in medical attention must be reported to EHS immediately.

A5.5.13

Supply all appropriate PPE^d to all individuals entering the work area(s) and ensure that the PPE^d is used and in good working order;

A5.5.14

Ensure that all personnel with access to work area(s) have taken and passed the required EHS safety training(s) outlined in [Section A14.2](#) prior to being given permission to enter the work area. Registration for safety trainings is done through EHS;

A5.5.15

Check eyewashes weekly to make sure they are running properly. If they need maintenance, contact TTU Building Maintenance and Construction at 742-2102 for repair;

A5.5.16

Check fire extinguishers to make sure they are charged and in date. If they have not been inspected within the last year or they are not charged, contact Physical Plant at 742-4677 to have them serviced;

A5.5.17

Appoint a member of the laboratory^d as the Laboratory Safety Captain;

A5.5.18

Ensure that equipment being removed from the work area for disposal, Surplus, or transfer is appropriately decontaminated and cleared by EHS;

A5.5.19

Submit protocols meeting any of the following criteria to the relevant [institutional safety committee\(s\)](#)^d for review and approval prior to work commencing:

A5.5.19.1

Protocols involving 1) organisms potentially pathogenic to plants, animals or humans, 2) biological toxins listed as [Select Agents](#), 3) recombinant or synthetic DNA / RNA, and / or 4) human materials must be submitted to the Institutional Biosafety Committee (IBC) regardless of sponsorship;

A5.5.19.2

Protocols involving the use of [energetic materials](#)^d must be submitted to the Institutional Laboratory Safety Committee (ILSC) regardless of sponsorship;

A5.5.19.3

Protocols involving any live vertebrate animals for research, instruction, demonstration, production, or maintenance purposes, whether the animals are located in facilities at TTU or elsewhere, must be submitted to the Institutional Animal Care and Use Committee (IACUC) regardless of sponsorship;

A5.5.19.4

Protocols involving human subjects require proposal submission and review by the Institutional Review Board (IRB) regardless of sponsorship;

A5.5.19.5

Protocols involving the use of radioactive materials, radiation producing equipment and lasers require proposal submission and review by the Radiation and LASER Safety Committee (RLSC) regardless of sponsorship.

A5.5.20

EHS must be informed by email to ehs.lab.safety@ttu.edu of any non-TTU inspectors (e.g., USDA, CDC, FAA, etc.) planning to enter research work areas as soon as a tentative or definite date and time is known.

A5.5.20.1

If non-TTU inspectors show up for an unannounced inspection, EHS shall be notified immediately by phone.

A5.5.20.2

Exclusions to A5.5.20.1 include: scheduled USDA and AAALAC inspections for animal facilities, TCEQ site visits, state fire marshal inspections, and inspections related to insurance policies.

A5.6

Laboratory Safety Captain

A5.6.1

The Laboratory Safety Captain will serve as the liaison between the PI, laboratory^d group members, DSO, CHO, and other offices. The responsibilities of the Laboratory Safety Captain will be outlined by the respective departments and PIs.

A5.7

[Laboratory Personnel](#)^d

A5.7.1

Follow all procedures outlined in the University Laboratory Safety Manual and WASP;

A5.7.2

Adhere to recommendations made by the Laboratory Safety Captain, PI, DSO and CHO;

A5.7.3

Receive biennial Laboratory Safety Training supplied by EHS online or by seminar and following any updates to this program;

A5.7.4

Receive any additional training required by the WASP (see [Section A11](#) for WASP details and [Section A14](#) for training requirements);

A5.7.5

Report safety concerns and near-misses through the SCAN system and report [incidents](#)^d that result in personnel injury or property damage immediately to their supervisor; and

A5.7.6

Report chemical fume hoods and / or other protective equipment that is damaged or not working properly to their supervisor;

A5.7.7

[Volunteers](#)^d that work in areas where chemical, biological and/or radiation hazards are present must provide the proper authorizations in writing from their sponsoring department, EHS, and Human Resources, as well as the *Adult Volunteer Worker Application*, *Volunteer Release Form*, and *Volunteer Worker Authorization Sheet* as described in [TTU OP 70.21](#).

A5.8

[Institutional Compliance Committees](#)^d

A5.8.1

Institutional Biosafety Committee (IBC)

A5.8.1.1

See [TTU OP 74.05](#) for the policies and procedures of the IBC.

A5.8.2

Institutional Laboratory Safety Committee (ILSC)

A5.8.2.1

See [TTU OP 74.18](#) for the policies and procedures of the ILSC.

A5.8.3

Institutional Animal Care and Use Committee (IACUC)

A5.8.3.1

See [TTU OP 74.11](#) for the policies and procedures of the IACUC.

A5.8.4

Institutional Review Board (IRB)

A5.8.4.1

See [TTU OP 74.09](#) for the policies and procedures of the IRB.

A5.8.5

Radiation and Laser Safety Committee (RLSC)

A5.8.5.1

See [TTU OP 60.11](#) for policies and procedures of the RLSC.

A6 **NON-LABORATORY PERSONNEL**^d

A6.1

Individuals seeking prolonged access (greater than 24 hours) to hazardous work area(s) on campus to perform work or experiments shall receive the permission of the Principal Investigator / supervisor in writing before entering the work area.

A6.2

Non-laboratory personnel^d entering a work area must wear the appropriate PPE designated for that work area unless hazardous operations are not being conducted and chemical / biological agents are behind a [physical barrier](#)^d.

A6.3

[Dignitaries](#)^d and media visiting a [laboratory](#)^d must wear the appropriate PPE for entrance to the laboratory^d and must be escorted by a senior member of the laboratory^d. Research operations shall be reduced to a level of demonstration.

A6.4

For [minors](#)^d that are going to be in the laboratory^d for a tour, the following guidelines shall be followed:

A6.4.1

The Department Chair must give written permission to the PI;

A6.4.2

Groups will be no larger than ten (10) minors^d per senior laboratory member at a time;

A6.4.3

The PI / supervisor must be in direct supervision while the tour group is in the work area;

A6.4.4

Appropriate [PPE](#)^d must be worn by all individuals while in the laboratory^d when chemical, physical or biological hazards are not behind a physical barrier;^d

A6.4.5

Research operations must be suspended while the tour group is in the laboratory^d; demonstration activities are allowed;

A6.4.6

If an active experiment is to be observed, [Section A8](#) must be followed.

A7 MAINTENANCE WORKERS IN [LABORATORIES](#)^d

A7.1

Maintenance workers shall complete annual Hazard Communication Training through TTU EHS (online).

A7.2

Maintenance workers must check in with the responsible party of a building before entering the work area(s).

A7.3

Maintenance workers must also notify the PI / supervisor, if present, before entering the work area(s).

A7.4

Maintenance workers must wear the required PPE while in the work area(s) if hazards are present as stated in [Section A4.3.3](#).

A8 **MINORS^d IN LABORATORIES^d**

A8.1

Minors^d Age 13 Years and Younger

A8.1.1

Minors^d age 13 and younger are not eligible for laboratory^d study or work experiences, or allowed to be present in laboratories or other hazardous work areas at TTU, with the following exceptions and guidelines:

A8.1.1.1

Special observation-only experiences may be arranged for minors^d (including those age of 13 years and younger) through the sponsoring department, the Associate Vice President for Research (Research Integrity) and EHS;

A8.1.1.2

Special participatory / educational laboratory^d experiences involving minors^d age 13 years and younger may be considered on a case-by-case basis by the sponsoring department, if authorized in accordance with [Section A8.5](#) below, provided that the minor^d is:

A8.1.1.2(a)

Under the direct supervision of the sponsoring investigator or senior [laboratory personnel^d](#), and

A8.1.1.2(b)

Not involved and / or exposed in any activities that could be considered “particularly hazardous” as defined in [29 CFR 570](#), “Child Labor Regulations, Orders and Statements of Interpretation,” or that may be considered to be detrimental to their health or well-being.

A8.1.1.3

For purposes of (A8.1.1.1) or (A8.1.1.2) above, all minors^d under the age of 14 must be properly supervised and accompanied by an adult while on TTU grounds and within TTU facilities where hazards are present.

A8.2

Minors^d Age 14 and 15 Years

A8.2.1

Minors^d of age 14 and 15 years may participate, if authorized in accordance with [Section A8.5](#) below, in laboratory^d study or work experiences that do not include work in areas or occupations

considered to be “particularly hazardous” as defined in [29 CFR 570](#), “Child Labor Regulations, Orders and Statements of Interpretation,” or that may be considered to be detrimental to their health or well being, including, but not limited to, the following:

A8.2.1.1

Any work in a workroom where ionizing radioactive materials or ionizing radiation-producing devices are present or used; and / or

A8.2.1.2

Any work in any workroom in which the following conditions may exist:

A8.2.1.2(a)

Potential presence or use of “highly hazardous” biological or chemical materials as defined by the TTU IBC and ILSC;

A8.2.1.2(b)

Potential presence of infectious diseases transmitted by an aerosol route;

A8.2.1.2(c)

Potential exposures to animals with infections potentially transmissible to humans, human blood, body fluids, or tissues;

A8.2.1.2(d)

Potential exposures to Level 3 or 4 biological agents (as defined by the CDC);

A8.2.1.2(e)

Potential exposures to Level 3 or 4 chemicals (as defined by the Hazardous Material Identification System (HMIS) or National Fire Protection Association (NFPA) System);

A8.2.1.2(f)

When Class IIIb or IV laser devices are in operation; use of Class I-IIIa devices is allowed if all personnel, including all minors^d, are wearing appropriate [PPE](#)^d for laser exposure.

A8.2.1.2(g)

Hazards requiring special protective wear (not including latex, vinyl or nitrile gloves, goggles, face shields or dosimeter badges);

A8.2.1.2(h)

Potential presence or use of controlled substances;

A8.2.1.2(i)

Potential presence or use of select agents (as defined by the CDC); or

A8.2.1.2(j)

Work in an area where there is a known risk of exposure to infectious diseases of human or animal origin.

A8.3

Minors^d Age 16 and 17 Years

A8.3.1

Minors^d age 16 and 17 years may participate, if authorized in accordance with [Section A8.5](#), in laboratory^d study or work experiences that include work in non-hazardous jobs or activities. Minors^d of age 16 and 17 years:

A8.3.1.1

Are prohibited from handling radioactive material source vials and must have prior written permission from the Radiation Safety Officer (RSO) at 742-3876 to use other radioactive materials, including performing contamination surveys; and / or

A8.3.1.2

Are prohibited from working directly with highly hazardous materials, including, but not limited to the following:

A8.3.1.2(a)

Select agents (as defined by the CDC);

A8.3.1.2(b)

Controlled substances;

A8.3.1.2(c)

Highly hazardous biological or chemical agents (as defined by the TTU IBC and ILSC); or

A8.3.1.2(d)

Potentially infectious animals or agents.

A8.4

Supervision of Minors^d

A8.4.1

Minors^d shall be closely and directly supervised by the sponsoring investigator or senior member of the laboratory^d.

A8.4.1.1

Sponsoring investigators hosting minors must be able to be directly and immediately contacted by phone or in person by minor and others while the minor is present in the laboratory or under the direction of the sponsoring investigator.

A8.4.2

All use of radioactive material by the RSO-approved minor^d must be directly supervised by a trained adult TTU staff member at all times, including performing contamination surveys;

A8.4.2.1

Failure to supervise the minor^d while using radioactive material will result in immediate suspension of the Authorized User's Radioactive Material Sublicense.

A8.4.3

Failure to supervise the minor^d while using chemical hazards will result in the immediate suspension of the laboratory's activities until the EHS investigation is complete.

A8.4.4

Failure to supervise the minor^d while using biological agents will result in the immediate suspension of the PI's IBC protocols.

A8.4.5

Failure to supervise the minor^d while working with animals will result in the immediate suspension of the PI's IACUC protocols.

A8.4.6

Failure to supervise the minor^d while working with human subjects will result in the immediate suspension of the PI's IRB protocols.

A8.4.7

Minors^d shall be provided with adequate and appropriate personal protective equipment, including dosimeter badges when required.

A8.4.8

Minors^d shall successfully complete all required laboratory^d and radiation safety training, as appropriate, and any site-specific training required by the sponsoring laboratory^d prior to commencing work activities.

A8.4.9

Under no circumstances will minors^d be allowed to work or study with or around radiation sources, biological agents, hazardous chemicals, equipment, or animals that pose a risk to their health or well-being.

A8.4.10

Supervisors overseeing hazardous work areas or laboratories are specifically responsible for the safety and compliance of all minors who are approved under institutional guidelines as employees, students, or visitors in their areas.

A8.5

Authorization of a Minor^d

A8.5.1

A parent or guardian must give written consent for minors^d to participate in laboratory^d study or work experiences, unless the minor is emancipated;

A8.5.2

The sponsoring department, EHS and Human Resources must also authorize the participation in writing. Authorization will be granted only for recognized TTU or other recognized sponsored educational programs;

A8.5.3

The *Minor^d Volunteer Worker Application, Volunteer Worker Authorization Sheet and Volunteer Release Form* shall be completed and submitted as described in [TTU OP 70.21](#).

A8.6

Minors^d may work in office space (not located in a laboratory^d) under the supervision of a PI / supervisor, faculty, staff or their personnel. Conditions presented in Section A8 apply.

A9 FACILITIES

A9.1

Access Control

A9.1.1

Work areas shall have doors for access control.

A9.1.1.1

Doors shall have a locking mechanism and be secured when there are no [laboratory personnel](#)^d present;

A9.1.1.2

[Laboratory](#)^d doors shall remain shut at all times with the exception of rooms acting as distribution points for refilling of chemicals / supplies for laboratories^d. In such cases, the area shall have a split door; the bottom half is to remain shut and the top half may remain open while distribution and refilling of chemicals / supplies is actively taking place.

A9.2

Required Signage

A9.2.1

Door signs for laboratories^d will be produced, modified and supplied by EHS.

A9.2.2

Special hazard signs (e.g., biohazard, LASER, radiation, etc.) must be clearly posted on all doors entering the work area so that any reasonable person can see the sign prior to opening the door.

A9.2.3

If [dangerous](#)^d activities are being conducted in the laboratory^d that require restricted access, a temporary sign must be posted on the door stating what activity is being conducted. The sign must clearly state:

A9.2.3.1

Name of personnel conducting the experiment and provide contact information. Contact information must be good for date(s) and time(s) specified in A9.2.2.2;

A9.2.3.2

The start date / time and expected stop date / time of the experiment;

A9.2.3.3

Specifically who is to have access to the laboratory^d; and

A9.2.3.4

Additional [PPE](#)^d, [engineering controls](#)^d and precautions must be used when entering the laboratory^d while the experiment is in progress.

A9.2.3.5

The CHO, DSO, and Department Chair must be notified of what activities require restricted access.

A9.2.4

Emergency contact information shall be posted in a highly visible location in the laboratory^d in close proximity to the entrance.

A9.2.4.1

The minimum contact information shall include the 1) PI and / or supervisor after hours contact information, 2) EHS contact information, 3) University Police contact information, and 4) Emergency Medical contact information.

A9.3

Hygiene

A9.3.1

Laboratories^d must have a sink for hand washing.

A9.3.1.1

Plumbed sinks are preferred, but if circumstances warrant, a [portable sink](#)^d may be used. Contact the DSO and CHO if a portable sink^d might be used.

A9.3.1.2

It is permissible to have a sink in an adjacent room such that the path of travel does not use a [public area](#)^d. BSL2 and BSL3 laboratories must have a sink in the immediate work area.

A9.3.1.3

Soap and paper towels must be available at sinks used for handwashing.

A9.3.2

The laboratory^d shall be designed so that it can be easily cleaned. Carpets and rugs shall not be placed in laboratories.

A9.3.3

Spaces between benches, cabinets and equipment shall be accessible for cleaning.

A9.3.4

Vertical surfaces and floors shall be regularly decontaminated.

A9.3.5

First aid kits or supplies are recommended but not required for laboratory^d work areas.

A9.4

Housekeeping

A9.4.1

Aisles must be free of slip, trip and fall hazards.

A9.4.2

Bench tops must be free of excess storage and clutter.

A9.4.3

Trash must be disposed of properly with glass and [sharps](#)^d waste segregated from other trash. Trash must not be left on bench tops.

A9.4.3.1

Broken glass to be repaired must be secured in a labeled drawer or container.

A9.4.4

Counters and liners that become contaminated must be cleaned or replaced immediately after contamination. Lab paper is not recommended as a permanent bench top covering. Appropriately-sized paper may be used for procedures and discarded after use.

A9.4.5

Any equipment that becomes contaminated must be cleaned immediately after contamination.

A9.4.6

Fire extinguishers, fire blankets, safety showers, eyewashes and electrical panels shall be kept clearly visible and free of obstruction.

A9.4.6.1

Eye wash covers shall be in place to prevent contamination.

A9.4.7

There must be no obstruction within 18" of the center of the spray from the safety shower.

A9.4.8

If first aid kits are made available, the kits must be checked regularly. Any expired items shall be removed and may be replaced with unexpired items.

A9.4.9

There must be a minimum 32" clearance at the exit(s) from the laboratory^d.

A9.4.10

Overhead storage must be at least 18" lower than the fire sprinkler head.

A9.5

Furniture

A9.5.1

Furniture must be capable of supporting anticipated loads and uses.

A9.5.2

Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis and other chemicals.

A9.5.3

Chairs used in laboratories must be covered in a non-porous material that can be easily cleaned and decontaminated with an appropriate disinfectant.

A9.5.4

Flammable storage units must be properly installed and not left on the transport materials / pallet.

A9.6

Equipment

A9.6.1

Equipment in the laboratory^d must be maintained, used appropriately, kept clean and in good repair.

A9.6.1.1

Equipment accessories, such as tubing, rotors and other attachments, are considered part of the equipment and must meet the requirements of A9.6.1.

A9.6.2

Freezers shall be defrosted periodically to prevent ice build-up.

A9.6.3

Common household appliances shall be labeled "Lab Use Only".

A9.6.4

Vacuum lines must be equipped with [traps](#)^d (see Appendix AE).

A9.6.5

Devices containing mercury shall be secured in [secondary containment](#)^d so that if a spill occurs the mercury is contained. Do not attempt to clean a mercury spill yourself. Contact EHS immediately at 742-3876 if a mercury spill occurs.

A9.6.6

Equipment that is not working shall be labeled as out of service.

A9.6.6.1

Equipment being offered to TTU Surplus must be appropriately decontaminated by lab personnel, cleared by EHS and have a completed Equipment Decontamination Form (Appendix AJ) attached.

A9.6.6.2

Equipment being shipped for repair must be appropriately decontaminated by lab personnel, cleared by EHS and a completed Equipment Decontamination Form (Appendix AJ) must accompany any documentation required by the servicing company.

A9.6.6.3

Equipment being disposed of must be appropriately decontaminated and cleared by EHS.

A9.6.6.4

Equipment containing refrigerants must have refrigerants collected before removal to Surplus or disposal. Contact TTU Work Control at 806-742-4677 to submit a work order.

A9.6.6.5

Equipment leaking fluid(s) must be taken out of service (i.e., secured and labeled as “out of service”) and repaired.

A9.6.7

Any biologically contaminated equipment should follow guidelines provided in Section B10.3 in the Biosafety chapter of the University Laboratory Safety Manual.

A9.7

Electrical

A9.7.1

Electrical cords must be kept in good repair.

A9.7.2

Extension cords must only be used on a temporary basis and shall be plugged directly into an outlet.

A9.7.3

Serial connections of electrical cords (i.e. daisy chaining) are not permitted; power strips and extension cords may only be plugged into wall outlets, not into another power strip / extension cord.

A9.7.4

Electrical outlets within six (6) feet of a water source must have a ground-fault circuit interrupter (GFCI).

A9.7.5

Only one item may be plugged into an individual receptacle.

A9.7.5.1

Electrical devices with multiple receptacles must possess grounding and circuit-breaking mechanisms.

A10 PHYSICAL HAZARDS

A10.1

Work Practices

A10.1.1

Large or heavy items are to be stored as close to ground level as possible.

A10.1.2

[Horseplay](#)^d is not acceptable in the [laboratory](#)^d.

A10.2

Trip Hazards

A10.2.1

Walkways are to be unobstructed and be 36" wide at minimum per NFPA 7.3.4.1(2).

A10.2.2

Trip hazards must be removed or mitigated.

A10.2.2.1

Electrical cords and hoses that have to run along the floor must be secured to prevent trip hazards. The securing devices used for the securing electrical cords and hoses must not present a trip hazard themselves.

A10.2.2.2

Equipment and containers that must be placed on the floor must be positioned so that they are highly visible and out of the path of travel.

A10.3

[Sharps](#)^d

A10.3.1

Avoid using sharps^d whenever possible; use blunted needles and plastics when possible.

A10.3.2

Use disposable sharps^d to avoid the hazards associated with decontaminating the items.

A10.3.2.1

Used sharps^d must be discarded immediately after use into a puncture-resistant sharps container.

A10.3.2.1(a)

Do not overfill sharps^d containers. Remove from service when container is 3/4 full, close, and dispose of in accordance with [TTU OP 60.10](#).

A10.3.2.1(b)

Sharps^d containers must be easily accessible.

A10.3.3

Be prepared to use the device the moment the sharp^d is exposed and secure or discard immediately after use.

A10.3.4

Do not bend, break or otherwise manipulate sharps^d by hand.

A10.3.5

Needles must not be recapped.

A10.3.5.1

If there is a need to recap needles, a valid written reason and protocol must be submitted to and approved by EHS.

A10.3.5.1(a)

Appropriate documented training in a one-handed recapping technique must be given to each individual and documented demonstration of proficiency must be recorded.

A10.3.5.1(b)

If an EHS-approved recapping SOP is in place, it should be posted in the immediate work area where sharps are recapped.

A10.3.6

Reusable sharps^d must be placed in a closeable, rigid container for transport or decontamination. The sharp end must be secured in such a manner so as to prevent accidental injury.

A10.3.7

Sharps^d that are to be stored must be secured in such a manner so as to prevent accidental injury.

A10.3.8

Do not hand-pass exposed sharps^d. Place sharps in a predetermined neutral zone to pass to others.

A10.4

Required Precautions

A10.4.1

A blast shield must be in place when working with energetic or potentially [energetic materials](#)^d.

A10.4.2

Closed systems under heat and / or pressure must be contained behind a blast shield or fume hood with the sash closed.

A10.4.3

Proper gas cylinder handling and operation is required (see Appendix AD).

A10.4.4

Pulleys, belts, and other moving parts shall be properly guarded.

A10.4.5

Dewar flasks and cold [traps](#)^d are wrapped with screens, friction tape or a metal jacket.

A10.4.6

Soldering

A10.4.6.1

Work areas with soldering stations must have a ten (10) foot zone of clearance between soldering stations and desk or seating areas.

A10.4.6.2

If using solder containing lead, soldering stations must be located inside a fume hood or under [localized exhaust](#)^d or be equipped with a table top air scrubber.

A11 WORK AREA SAFETY PLAN (WASP)

A11.1

The WASP is a research group-specific document that identifies potential hazards in the [laboratory](#)^d, outlines laboratory group-specific policies and procedures, and gives guidance to [laboratory personnel](#)^d in the event of an incident for all lab^d locations. This document shall at minimum contain:

A11.1.1

The laboratory^d location(s) that are covered in the plan;

A11.1.2

Responsible party / parties for the laboratory^d locations that are covered in the plan, including designation of personnel responsible for WASP implementation;

A11.1.3

Emergency contact information for the responsible party for the laboratory^d locations, including the DSO's contact information;

A11.1.4

Locations of [SDSs](#)^d, University Chemical Hygiene Plan, and any other laboratory documents, such as SOPs;

A11.1.5

Rules and policies of the laboratory^d that are not less stringent than the University Laboratory Safety Manual;

A11.1.6

Good laboratory^d hygiene practices;

A11.1.7

Procedures to assess performance and operate chemical laboratory fume hoods and other protective equipment;

A11.1.8

Identification of hazards and mitigation strategies in the laboratory^d, including:

A11.1.8.1

Physical, electrical, chemical, biological and radiological hazards present;

A11.1.8.1(a)

Employees must be informed of physical and health hazards associated with hazards present; and

A11.1.8.1(b)

Employees must be informed of the Permissible Exposure Limits (PEL) for all hazards present.

A11.1.8.2

Control measures for reducing employee exposure to these hazards such as [engineering controls](#)^d, [personal protective equipment \(PPE\)](#)^d, and hygiene practices;

A11.1.8.3

The instances under which a particular laboratory operation, procedure, or activity shall require knowledge or presence of an appropriate [responder](#)^d;

A11.1.8.4

Provisions for medical consultation and medical examinations;

A11.1.8.5

Provisions for additional employee protection for work with particularly hazardous substances including but not limited to, "[select carcinogens](#)^d", reproductive toxins and substances which have a high degree of acute toxicity. Alternatively, these provisions may be addressed in a separate SOP (see [Section A12](#)). The provisions must cover:

A11.1.8.5(a)

Establishment of a designated area;

A11.1.8.5(b)

Use of containment devices such as laboratory hoods or glove boxes;

A11.1.8.5(c)

Procedures for safe removal of contaminated waste; and

A11.1.8.5(d)

Decontamination procedures.

A11.1.9

Waste disposal procedures for all waste streams;

A11.1.10

Clean-up procedures in case of a spill;

A11.1.10.1

Procedures must be specified for all hazard classes present (e.g., acid, base, biological, radiological, etc.).

A11.1.11

Guidance on what to do in case of emergency (e.g., fire, medical emergency, severe weather, etc.);

A11.1.12

Acknowledgement sheet that all individuals working in the laboratory^d are required to sign that states they have read and understood the plan and will follow what is outlined in the plan; and

A11.1.12.1

Acknowledgement sheet should reflect active [laboratory personnel](#)^d.

A11.1.12.2

Inactive laboratory personnel^d should be indicated by a single strikethrough and PI / supervisor initials.

A11.1.13

Current training records for all active laboratory personnel^d, including the PI / supervisor.

A11.2

Plan Availability

A11.2.1

The WASP shall be readily available to employees, employee representatives and regulatory agencies upon request.

A11.2.2

A hard copy of the most recent version of the WASP must be available in all laboratory^d locations.

A11.3

The WASP shall be reviewed biennially and revised to address new hazards, operations, equipment, etc. prior to introduction to the work area.

A12 STANDARD OPERATING PROCEDURES (SOPs)

A12.1

SOPs are written, step-by-step procedures that must be created for all [laboratory](#)^d functions, such that anyone with similar training would be able to use the procedure to complete the same

task. The use of photographs, diagrams and flowcharts can be helpful in conveying information. The following sections must be included:

A12.1.1

Appropriate title;

A12.1.2

Creator name, creation date, and PI approval;

A12.1.3

Training requirements for the SOP operator;

A12.1.4

Purpose that explains the objective and relays any other pertinent information to understand the SOP;

A12.1.5

List of hazards and safety precautions;

A12.1.6

List of [PPE](#)^d and / or other safety equipment needed for the task(s);

A12.1.7

List of materials and equipment needed to fully complete the task(s);

A12.1.8

Sequence of each task in detail;

A12.1.9

Information pertaining to interpretation of anticipated results, data collection and / or data analysis;

A12.1.10

Shut-down procedures including decontamination and waste disposal. Procedures may reference Work Area Safety Plan (WASP) (see [Section A11](#));

A12.1.11

Emergency procedures such as spill response and response to personnel exposure which include decontamination, waste disposal and OHP referrals. Procedures may reference the WASP (see [Section A11](#)); and

A12.1.12

List of references such as associated SOPs, cited literature and / or vendor documentation, if available.

A12.2

All SOPs must be followed as written and approved by the PI or supervisor.

A13 **EMPLOYEE EXPOSURE ASSESSMENT AND MONITORING**

A13.1

An employee exposure assessment will be performed for hazardous chemicals regulated by OSHA in [29 CFR 1910, subpart Z](#). This determination is based upon the nature of the material and the conditions of use as described in Appendix AI.

A13.2

Exposure Determination for Substance-Specific Standards

A13.2.1

Initial monitoring - The CHO shall initiate monitoring of the employee's exposure to any substance regulated by a standard which requires monitoring, if there is reason to believe that exposure levels for that substance routinely exceed the [action level](#)^d or Permissible Exposure Limit (PEL). This may be done using the guidance in Appendix AI.

A13.2.2

Periodic monitoring - If the initial monitoring discloses employee exposure over the action level^d or PEL, the CHO will comply with the exposure monitoring provisions of the relevant OSHA standard.

A13.2.3

Termination of monitoring - Monitoring may be terminated in accordance with the relevant OSHA standard.

A13.2.4

Employee notification of monitoring results - The CHO shall, within 15 days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

A13.3

Routine Exposures Over PEL's for Substance Specific Standards

A13.3.1

If air monitoring results indicate that employee exposures are above the limits prescribed in the OSHA substance specific standards, medical monitoring is provided as required in the applicable

standard for the regulated substance. The person responsible for establishing the need for employee medical monitoring is the CHO.

A13.4

Exposure Evaluation Following an Incident

A13.4.1

The initial evaluation of an incident for possible overexposure shall be conducted by the DSO, who will establish the need for a medical consultation / examination.

A13.4.2

The supervisor or DSO will fill out the *Initial Investigation of Possible Overexposure* found in Appendix AL, and provide copies to the examining physician and the CHO.

A13.5

Responsibilities

A13.5.1

The person responsible for determining the need for monitoring employee exposure is the supervisor or any [departmental representative](#)^d.

A13.5.2

The person responsible for monitoring employee exposure is the CHO.

A14 TRAINING REQUIREMENTS

A14.1

Training Timeline

A14.1.1

All personnel who may be exposed to hazardous substances are to participate in the education and training program established by the University.

A14.1.2

All TTU personnel will be informed about the hazards in their normal work area(s) as well as hazards in other areas where they may be required to work.

A14.1.3

At the time of initial assignment, new employees shall receive the required training from the department and complete TTU EHS safety training online.

A14.1.3.1

New employees shall be informed about the University Laboratory Safety Manual and the SOPs by their supervisor.

A14.1.4

Refreshers for TTU EHS safety trainings are required as detailed in Section A14.2.

A14.1.4.1

Refresher information for departmental training shall be provided at scheduled intervals as determined by the supervisor but at least annually.

A14.1.5

When a new hazard is introduced into a work area, employees will be informed of the new hazard and receive the appropriate training from their supervisor.

A14.1.6

All personnel must complete training prior to work commencing.

A14.2

Required EHS Safety Trainings Based on Activities

A14.2.1

Any university employee – Safety Awareness Training through [Cornerstone](#) (online). Refresher training is required biennially for all personnel.

A14.2.2

Any [non-laboratory personnel](#)^d occupationally exposed to chemicals – Hazard Communication Training through TTU EHS (online). Refresher training required annually for all personnel.

A14.2.3

Any [laboratory personnel](#)^d – Laboratory Safety Training through TTU EHS (seminar or online). Refresher training is required biennially for all personnel.

A14.2.4

BSL2 laboratory personnel – Biological Safety Training through TTU EHS (seminar or online). Refresher training is required biennially for all personnel.

A14.2.5

Personnel exposed to human materials – Bloodborne Pathogen Training through TTU EHS (online). Refresher training is required annually for all personnel.

A14.2.6

Personnel working with radioactive materials – Phase I Radiation Training through TTU EHS (online) and Phase II Radiation Safety Training through TTU EHS (lecture). Online refresher training is required biennially for all personnel.

A14.2.7

Personnel working with radiation producing equipment – Phase I Radiation Training through TTU EHS (online) and generation of a safety SOP for the particular piece of equipment being used to be reviewed by the TTU Radiation Safety Officer. Online refresher training is required biennially for all personnel.

A14.2.8

Personnel working with lasers – Laser Safety Training through TTU EHS (online). Refresher training is required biennially for all personnel.

A14.2.9

Additional training may be required based on agent or activities.

A14.3

Research Group / Departmental Training

A14.3.1

It is the supervisor's responsibility to provide or ensure that everyone under their supervision has completed the proper training for the operations they will be performing.

A14.3.1.1

[Non-laboratory personnel](#)^d and visitors entering the [laboratory](#)^d shall be notified of physical and health hazards that are presented by chemical and biological material in the laboratory^d (see [Section A6](#)).

A14.3.2

TTU personnel and [volunteers](#)^d shall be informed of the locations of the Work Area Safety Plan (WASP), University Laboratory Safety Manual, [SDSs](#)^d, chemical inventory and any other relevant documents.

A14.3.3

Training shall include:

A14.3.3.1

Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the department / EHS, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

A14.3.3.2

The physical and health hazards of chemicals in the work area;

A14.3.3.3

Physical hazards presented by chemicals (as distinguished from physical hazards ([Section A10](#))) can cause harm by triggering a secondary event not related to direct contact. These include, but are not limited to, explosives, flammables chemicals, combustible chemicals, oxidizing chemicals, gases under pressure, self-reactive substances, [pyrophoric chemicals](#)^d, self-heating substances, water reactive chemicals, organic peroxides, and chemicals corrosive to metals. This training shall include:

A14.3.3.3(a)

Identification of the physical hazards;

A14.3.3.3(b)

Precautions used while handling these physical hazards such as the location where the agent is to be handled and the proper [PPE](#)^d required;

A14.3.3.3(c)

Proper storage of agents to minimize physical hazards; and

A14.3.3.3(d)

Procedures in case of uncontained release.

A14.3.3.4

Health hazards presented by chemicals include acute toxicity, skin corrosion, irritation, serious eye damage or irritation, respiratory or skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicology, target organ systemic toxicity from acute or chronic exposure and aspiration hazard. This training shall include:

A14.3.3.4(a)

Identification of the health hazards;

A14.3.3.4(b)

Precautions used while handling this health hazards such as location where the agent is to be handled and the proper [PPE](#)^d required;

A14.3.3.4(c)

Proper storage of agents to minimize health hazards; and

A14.3.3.4(d)

Procedures in case of release.

A14.3.3.5

The measures employees can take to protect themselves from these hazards, such as appropriate work practices, emergency procedures and PPE^d;

A14.3.3.6

The WASP (see [Section A11](#)) and SOPs (see [Section A12](#));

A14.3.3.7

Detailed review of SDSs^d for products which present physical and / or health hazards present in the work area;

A14.3.3.8

Proper disposal of waste chemicals reiterating the fact that no chemical may be disposed of in the sanitary sewer system; and

A14.3.3.9

Proper decontamination procedures for work area, equipment and person.

A15 OCCUPATIONAL HEALTH PROGRAM (OHP)

A15.1

The OHP at Texas Tech is designed to monitor, mitigate and treat health issues that can develop due to occupational hazards. Employees may enroll in the Program under the following circumstances:

A15.1.1

Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the work area;

A15.1.2

If an [incident](#)^d occurs in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee can enroll in the OHP; and /or

A15.1.3

Personnel may be assigned to the Program or enroll voluntarily due to occupational risks.

A15.1.3.1

Personnel meeting requirements outlined in the Respiratory Protection Program ([TTU OP 60.05](#)) or Bloodborne Pathogen Protection Program ([TTU OP 60.24](#)) shall be enrolled in the OHP.

A15.2

Program Steps

A15.2.1

An occupational [risk assessment](#)^d should be performed by the workplace supervisor using the [Occupational Risk Assessment](#) and details of workplace hazards should be described in the position description of the employee.

A15.2.1.1

EHS should be consulted when encountering unknown or undefined hazards.

A15.2.2

The employee should complete the [Assessment and Enrollment Form](#) and submit the form to ehs.ohp@ttu.edu to complete enrollment.

A15.2.3

EHS will submit the form to the Occupational Health Provider.

A15.2.4

The Occupational Health Provider will coordinate and perform appropriate medical care and maintain all health records.

A15.2.5

The Occupational Health Provider will provide recommendations to EHS and the workplace supervisor as to recommended work status and any restrictions for the employee.

A15.2.6

As necessary, EHS will provide exposure assessments, necessary training and recommendations for [engineering controls](#)^d, [administrative controls](#)^d and [PPE](#)^d to mitigate workplace hazards.

A15.2.7

During an emergency response, medical care can be provided by any medical professional with a follow-up Incident Form (Appendix AL) submitted to the OHP and coordinated follow-up medical care through the Occupational Health Provider.

A16 CHEMICAL IDENTIFICATION REQUIREMENTS

A16.1

Labeling on Incoming Chemical Containers

A16.1.1

Suppliers of chemical products must label their materials in accordance with the OSHA Hazard Communication Standard ([29 CFR 1910.1200](#)) using the Globally Harmonized System (GHS).

A16.1.1.1

If containers are received at the [Chemical Gateway](#)^d without the required information, the container will be held until proper labeling is submitted by the responsible party. Container labels may be obtained through [ChemWatch](#)^d on the EHS website.

A16.1.2

The DSO and supervisor are responsible for ensuring that incoming containers are labeled with the required information.

A16.1.3

Labels on chemical containers must not be removed or defaced while container holds the indicated chemical.

A16.2

Labeling on Secondary Chemical Containers

A16.2.1

Secondary containers 15 mL or smaller may be labeled with an abbreviation if an abbreviation chart written in English is posted where the containers are used and stored and can be easily read.

A16.2.2

Containers larger than 15 mL must be labeled with the full English name according to the [SDS](#)^d.

A16.2.3

Samples may be labeled to correspond with a lab notebook.

A16.3

Chemical Substances Developed in a [Laboratory](#)^d

A16.3.1

Chemical substances produced in a laboratory^d must be labeled to correspond with a lab notebook that is located in the laboratory^d.

A16.3.2

If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the supervisor shall determine if it is a hazardous chemical as defined by the OSHA Hazard Communication Standard ([29 CFR 1910.1200](#)).

A16.3.2.1

If the chemical is determined to be hazardous, the supervisor shall provide appropriate training as required by this plan (see [Section A14](#)).

A16.3.3

If the chemical produced is a byproduct whose composition is not known, the supervisor shall assume that the substance is hazardous and provide appropriate training as required by this plan.

A16.3.4

If the chemical substance is produced for another user outside of the laboratory^d, the supervisor shall comply with the OSHA Hazard Communication Standard ([29 CFR 1910.1200](#)) including the requirements for preparation of a [SDS](#)^d and container labeling.

A16.4

[Safety Data Sheets \(SDSs\)](#)^d

A16.4.1

SDSs^d shall be obtained for all chemicals obtained.

A16.4.2

The responsibility for obtaining, evaluating and maintaining SDSs^d is assigned to each individual laboratory^d. Most SDSs^d can be obtained through [ChemWatch](#)^d or [online chemical inventories](#).

A16.4.2.1

If a SDS^d is not available through ChemWatch^d, the laboratory group shall contact the manufacturer(s) and / or distributor(s) for procurement of the SDS^d. A copy of the SDS^d must be submitted to EHS.

A16.4.3

Access to SDSs should be maintained in the work area either in paper copy, electronic copy or accessible via internet. Most SDSs^d can be obtained through [ChemWatch](#)^d or [online chemical inventories](#).

A16.4.3.1

SDSs^d can be maintained in hard or electronic copy in a central location for work areas in the same building. Signage in each work area shall identify this location.

A16.4.4

SDSs^d for hazardous materials shall be readily accessible to employees during each work shift.

A16.4.5

The location of these SDSs^d, along with reference materials, will be addressed in the Work Area Safety Plan (WASP).

A16.4.6

SDSs^d shall be readily available for review upon request.

A17 CHEMICAL HANDLING

A17.1

Chemical Containers

A17.1.1

All chemical containers must be kept in a good condition.

A17.1.2

Chemical containers that are compromised shall not be used.

A17.1.2.1

Chemicals may be transferred to a different compatible container and labeled according to the GHS labeling system.

A17.1.3

Parent (i.e., original) chemical containers shall be barcoded.

A17.2

Chemical Storage

A17.2.1

Chemicals shall be stored according to Appendix AA. Each storage group shall be stored in [secondary containment](#)^d if multiple groups are stored on the same shelf.

A17.2.1.1

There is a corresponding number on the EHS barcode for the chemical storage group as defined by Appendix AA.

A17.2.1.1(a)

Chemicals with an NFPA health hazard rating of 3 or 4 will have a blue dot affixed to the EHS barcode. Such chemicals should be treated with caution.

A17.2.1.1(b)

Chemicals in storage Group 9 (Compatible Pyrophoric and Water Reactive Materials) shall be

stored according to their respective SDS.

A17.2.1.1(c)

When a chemical container is emptied, the yellow portion of the EHS barcode must be removed, affixed to [Barcode Return Form](#) and returned to EHS at Campus Mail Stop 1090.

A17.2.2

If chemicals are stored in a non-visible area such as a drawer or cabinet, the drawer or cabinet shall be marked as chemical storage.

A17.2.3

Chemical containers must be stored in an upright position to prevent accidental spills.

A17.2.4

Chemicals must be stored in a secured location when not in use.

A17.2.4.1

Secure locations are cabinets or shelving that should have a lip or restraining wire. Secondary containment^d is recommended if no lip or restraining wire is present.

A17.2.4.2

Cabinets must be appropriate for the type of chemical being stored.

A17.2.5

Chemicals collected to be recycled or reclaimed must be affixed with a label that states that purpose (e.g., Xylene To Be Recycled or Xylene To Be Reclaimed).

A17.2.6

Chemical containers stored on the floor must be secured in [secondary containment](#)^d to collect spills.

A17.2.7

Chemicals must be stored away from intense light or heat sources.

A17.3

Flammable Storage

A17.3.1

Keep [flammable liquids](#)^d used in the work area in original containers or safety cans.

A17.3.2

In the event that such cans are not available, glass bottles no larger than four (4) liters may be used with the proper precaution.

A17.3.3

Minimize the amount of flammable chemicals used and stored in the work area and do not exceed the maximum allowable storage quantity as defined in Table A1.

A17.3.4

Flammables shall be stored in approved rated flammable storage cabinets at all times.

A17.3.5

A maximum of five (5) gallons of flammable liquids^d may be in use at any one time in the work area. All flammable liquids shall be put away when not in use.

A17.3.6

Flammables that require refrigeration shall be stored in a refrigerator that is designated and rated for flammable or explosive storage.

A17.3.7

Flammable waste in a [lab](#)^d shall be counted in the total allowable amount of flammable liquids in the lab^d.

A17.4

Chemicals of Special Concern

A17.4.1

Safety procedures for chemicals of special concern including carcinogens, teratogens and other highly toxic chemicals must be posted in the immediate work area.

A17.4.2

Hydrofluoric Acid (HF)

A17.4.2.1

Work areas where HF is used or stored must have unexpired calcium gluconate gel available.

A17.4.1.1(a)

Gel should be in the immediate work area when actively working with HF.

A17.4.2.2

Personnel working in areas where HF is used must be trained on SOPs and emergency procedures for HF and be informed of the dangers of this chemical.

A17.4.2.2(a)

Never use HF when working alone or after hours.

A17.4.2.2(b)

HF may be used when working alone during regular working hours provided personnel versed in first aid have been alerted and are in the general vicinity.

A17.4.2.3

Additional [PPE](#)^d, including a face shield, chemically-resistant lab apron, and hand protection in addition to basic nitrile or latex gloves, is required when working with HF.

A17.4.3

Perchloric Acid

A17.4.3.1

Heated perchloric acid operations must be performed inside a perchloric acid fume hood.

A17.4.4

Poisonous Gases

A17.4.4.1

Proper [administrative](#)^d and [engineering controls](#)^d for the storage and use of poisonous gas(es), as defined [49 CFR 173.115\(c\)](#), must be in place prior to acquisition of poisonous gas(es).

A17.4.4.2

Work requiring the use of poisonous gas(es) must be submitted to and reviewed by EHS before acquisition of poisonous gas(es).

A17.4.5

[Energetic Materials](#)^d (i.e., explosives, propellants, pyrotechnics)

A17.4.5.1

Administrative^d and engineering controls^d for the storage, use and disposal of energetic materials^d must be outlined in the WASP (see [Section A11](#)).

A17.4.5.2

WASP and SOPs (see [Section A12](#)) related to energetic materials^d will be reviewed and approved by the Institutional Laboratory Safety Committee prior to acquisition of energetic materials^d. The following points must be addressed:

A17.4.5.2(a)

Compatibility of laboratory instruments and appropriate safety barriers for laboratory instruments;

A17.4.5.2(b)

Maximum quantities for use; and

A17.4.5.2(c)

If performing controlled detonations, procedures for dealing with unexploded ordinance will be written in the WASP.

A17.4.6

Volatilizing Chemicals

A17.4.6.1

Solvents and other chemicals that volatilize must be used inside a chemical fume hood or under [localized exhaust](#)^d.

A17.4.6.2

Instrumentation that uses volatilizing chemicals should be operated in a chemical fume hood or under exhaust when possible.

A17.4.6.3

Instrumentation that uses volatilizing chemicals that cannot be placed in a hood or used under localized exhaust^d shall have all chemical containers sealed or filtered.

A17.4.6.4

Small quantities of volatilizing chemicals may be used outside of a fume hood for routine decontamination or cleaning of equipment or work surfaces.

A17.4.7

[Pyrophoric Materials](#)^d

A17.4.7.1

Pyrophoric materials^d should be stored according to their respective [SDS](#)^d.

A17.4.7.2

Flame-resistant lab coats must be worn while working with pyrophoric materials^d.

A17.4.7.3

Researchers using energetic materials^d must complete and submit an application to and receive approval from the ILSC before procurement or synthesis of materials.

A17.4.8

Mercury

A17.4.8.1

All devices and equipment containing mercury must be contained in [secondary containment](#)^d unless actively being used.

A17.4.8.2

Additional PPE^d, such as disposable shoe covers and chemically-resistant aprons, may be required for work areas using unsealed, free mercury.

A17.4.8.3

Work areas housing mercury-containing equipment must be designed with the appropriate barriers including sealed HVAC systems and a possible floor trap.

A17.4.9

[Toxin](#)^d Handling

A17.4.9.1

Avoid handling dry forms of toxins^d when possible.

A17.4.9.2

Clean room gloves are recommended for handling dry forms of toxins^d that are electrostatic.

A17.4.9.2

Handle toxins^d within a fume hood, biological safety cabinet or glove box. Do not use toxins^d within a laminar flow hood.

A17.4.9.2(a)

Toxins^d that are electrostatic or particularly hazardous should be used with a glove bag within a fume hood, biological safety cabinet or glove box.

A17.4.9.3

Consider toxin^d, diluent / solvent and infectious material when selecting gloves and other [PPE](#)^d.

A17.4.9.4(a)

When handling toxins that present a cutaneous (i.e. affecting the skin) or percutaneous (i.e. permeable through skin) hazard, select gloves that are known to be impervious to the toxin and diluent / solvent.

A17.4.9.4(b)

If not handling within a glove bag, a barrier lab coat with glove cuffs worn over sleeves is recommended to minimize skin exposure.

A17.4.9.5

Decontamination procedures must be specified for individual toxins^d and be included in the Work Area Safety Plan (WASP) as outlined in [Section A11.1.8.5](#).

A17.4.10

[Nanoparticles](#)^d

A17.4.10.1

Dry, powder nanomaterials^d of unknown toxicity / reactivity or nanoparticles^d in solution that may become dry or aerosolized during manipulation shall be used in fume hoods, biological safety cabinets (Class I or II), or glove boxes.

A17.4.10.2

[Administrative](#)^d and [engineering controls](#)^d for the storage, use and disposal of nanomaterials^d must be outlined in the WASP (see [Section A11](#)) and/or SOPs (see [Section A12](#)).

A17.4.10.3

A general [risk assessment](#)^d must be performed for the nanomaterials^d in bulk and in non-nanoparticled forms (e.g., contained in solid matrix, suspension in solution or slurry, powdered form, etc.) and included in the WASP.

A17.4.10.4

Proper training on methods involving nanomaterials^d will be provided by the PI/supervisor.

A17.4.10.5

Chemicals that present a physical hazard caused by a secondary event not related to direct contact (e.g., fire, explosion, corrosion of equipment, etc.) shall be handled as outlined in the WASP (see [Section A11](#)) and / or individual SOPs (see [Section A12](#)).

A17.4.11

Picric Acid

A17.4.11.1

Picric acid must be stored hydrated at all times.

A17.4.11.2

A usage log must be maintained for the use of picric acid.

A17.5

Spill Prevention Measures

A17.5.1

Secure containers and equipment to minimize the possibility of tipping.

A17.5.2

Keep containers and experimental equipment as low as possible.

A17.5.3

Plan experimental reactions to anticipate and to provide controls for undesired outcomes such as overheating.

A17.5.4

Check the material and construction of chemical containers and equipment with a goal of maintaining structural integrity.

A17.5.5

Use manageable volumes of chemicals.

A17.5.6

Use [secondary containment](#)^d during procedures requiring chemical transfers.

A17.6

Chemical Spill Response

A17.6.1

If the spill involves: 1) greater than four (4) liters of any material, 2) toxic, flammable, corrosive, or reactive materials, 3) unknown materials, 4) mercury and / or 5) [laboratory personnel](#)^d are not comfortable responding to the spill, they may use the following procedure:

A17.6.1.1

Stabilize any reactions (if possible);

A17.6.1.2

Immediately evacuate the lab^d; and

A17.6.2.3

Contact EHS at 742-3876 immediately for clean-up. Personnel should be immediately available to convey spill details.

A17.6.2

[Spill kits](#)^d must be appropriate for the chemicals used in the work area. Spill kits^d supplied by EHS may not be appropriate for all chemicals.

A17.6.3

General spill response should be evaluated on a case-by-case basis as outlined by [29 CFR 1910.120\(q\)](#). Lab personnel^d may clean the spill themselves following the guidance in Appendix AC if the following criteria are met:

A17.6.3.1

The spill is easily controlled (i.e. a manageable volume and state);

A17.6.3.2

Personnel have been trained on proper spill response and are comfortable cleaning up the spill;

A17.6.3.3

Personnel have access to adequate spill response materials and equipment;

A17.6.3.4

The hazards of the spill are known;

A17.6.3.5

The hazards presented by the spill do not exceed the hazards of routinely working with the chemical; and

A17.6.3.6

There is a limited possibility of the spill escalating to an emergency situation (e.g., fire, oxygen deprivation, IDLH, etc.).

A17.6.4

If the spill involves a biological material refer to Section B6 in the Biosafety chapter of the University Laboratory Safety Manual.

A17.6.5

If the spill involves radiological materials refer to Section V.(G) in the Radiation Safety chapter of the University Laboratory Safety Manual.

A17.7

Chemical Review

A17.7.1

Chemicals that have been in inventory for five years shall be assessed by the PI to determine if the containers and/or chemicals are in acceptable condition to keep in service. These same chemicals will need to be assessed again every five years.

A17.7.1.1

Once a year each PI that has a chemical inventory assigned to them will be sent a list of chemicals to review by EHS. This list will be generated from the inventory system currently in use by EHS.

A17.7.2

Chemical containers shall be assessed by the PI to determine if they have been compromised through degradation or wear of usage.

A17.7.2.1

If the container is in acceptable condition, ensure the labeling is in accordance with the Globally Harmonized System.

A17.7.2.2

If the container is compromised, transfer the contents to a new compatible container and label in accordance with the Globally Harmonized System.

A17.7.3

The chemicals shall be assessed by the PI to determine if the chemicals are acceptable for use or should be disposed of through EHS.

A17.7.3.1

If chemicals are determined to be acceptable for use, ensure they are to be stored in accordance to Appendix AA.

A17.7.3.2

If chemicals are determined to not be acceptable or are no longer wanted, label the chemical for disposal in accordance to Section A19 and submit a waste request for pickup.

A17.7.4

Upon completion of the Chemical Review the PI will acknowledge this review was completed by submitting a Chemical Review Form.

A18 RESPIRATORY PROTECTION PROGRAM

A18.1

Respirators shall be selected and used in accordance with the requirements of [29 CFR 1910.134](#) and [TTU OP 60.05](#).

A18.1.1

Respirators shall be used only where [engineering](#)^d or [administrative controls](#)^d are not practical and where a respirator-assigned protection factor is sufficient for worker protection.

A18.1.2

The department / supervisor shall provide, at no cost to the employee, the proper respiratory equipment as determined by EHS.

A18.1.3

Prior to use of any respiratory protective equipment, all personnel required to wear a respirator for job duties will:

A18.1.3.1

Submit the [Occupational Health Program Enrollment Form](#) to EHS;

A18.1.3.1(a)

Personnel requiring a respirator for job duties shall be enrolled in the Occupational Health Program (OHP) (see [Section A15](#) for more information on the OHP);

A18.1.3.2

Be deemed physically capable of wearing a respirator by a licensed physician using the OSHA Respirator Medical Evaluation;

A18.1.3.3

Take and pass Respirator Protection Program online training provided by EHS; and

A18.1.3.4

Be fit tested by EHS for a respirator appropriate to the hazard(s).

A18.1.4

All personnel enrolled in the Respiratory Protection Program must complete all steps outlined under Section A18.1.3 annually.

A18.1.5

Voluntary use of respirators must complete all steps outlined in Section A18.1.3.

A19 WASTE MANAGEMENT AND DISPOSAL

A19.1

Training for Non-Municipal Wastes

A19.1.1

All requestors must complete online Waste Request training through the EHS website before submitting pick up requests for universal, chemical, untreated biological or radioactive waste.

A19.2

Waste Segregation and Labeling

A19.2.1

Waste disposal must follow [TTU OP 63.06](#). All universal, chemical, untreated biological and radioactive waste must be segregated from [municipal solid waste^d](#) to be collected and disposed of through EHS.

A19.2.1.1

Universal waste is defined in [40 CFR 273](#).

A19.2.1.1(a)

A completed Universal Waste label must be affixed to waste items/container prior to EHS pick up. Labels may be obtained from EHS upon request.

A19.2.1.2

Hazardous waste is defined in [40 CFR 261.3](#).

A19.2.1.2(a)

When waste is first added to a container, waste containers shall be labeled as “Hazardous Waste” with a waste label provided by EHS with hazardous characteristic(s) indicated as they pertain to the container contents.

A19.2.1.2(a)(i)

Building – Building name;

Room Number – Room number where waste is being generated; and

A19.2.1.2(b)

During waste collection prior to EHS pick up, complete the remaining waste identification fields.

A19.2.1.2(b)(i)

pH of contents – Provide pH if known. At minimum, identify as acidic, basic or neutral.

A19.2.1.2(b)(ii)

Contents – Provide full name of each individual chemical waste added to the container upon addition to the container. Abbreviations or formulas are not acceptable.

A19.2.1.2(b)(iii)

Hazard – Indicate toxic, reactive, flammable, corrosive, poison and / or carcinogenic, etc. as applicable to the container contents.

A19.2.1.3

Biological waste receptacles must be labeled with a biohazard symbol (see Section B7.4.1.2 in the Biosafety chapter of the University Laboratory Safety Manual).

A19.2.1.4

Radioactive waste receptacles must be labeled with “radioactive material” labels (see Section II.H.14 in the Radiation Safety chapter of the University Laboratory Safety Manual).

A19.3

Waste Containers

A19.3.1

Chemical Waste Containers

A19.3.1.1

The container must be in good condition and compatible with the contents to be added.

A19.3.1.2

Chemical containers being repurposed as waste or secondary containers must meet the following requirements:

A19.3.1.2(a)

Container must be triple rinsed. Each rinse must be at least 1/10 the volume of the container and collected as hazardous waste. Repurposed containers are not required to be rinsed if chemical waste is the same as the original contents.

A19.3.1.2(b)

Labels on repurposed containers must be completely covered or removed such that all writing and symbols are completely illegible prior to affixing EHS Waste label.

A19.3.1.3

Metal cans are not to be used with corrosive chemical waste.

A19.3.1.4

Food or drink containers are not acceptable as hazardous waste containers.

A19.3.1.5

Venting caps must be used with wastes that have the potential to build up pressure. Caps are available free of charge from EHS and the Chemistry Department stockroom.

A19.3.1.6

[Sharps](#)^d containers used in chemical [laboratories](#)^d must have the following features: 1) heavy-duty plastic (e.g., laundry detergent container), 2) stay upright during use, 3) able to close with a tight-fitting, puncture-resistant lid, 4) leak-resistant.

A19.3.2

Radioactive Waste Containers

A19.3.2.1

Containers for radioactive waste are provided by the Radiation Safety Officer. See Section II.H.14 in the Radiation Safety Manual for more guidance.

A19.3.3

Glass Waste Containers

A19.3.3.1

Glass waste must be segregated from other solid municipal waste and disposed of in a sturdy, puncture-resistant, closable box labeled as broken glass. Specific glass disposal boxes are available from various laboratory vendors.

A19.4

[Satellite Accumulation Areas](#)^d (SAAs)

A19.4.1

All chemical waste shall be managed and stored in the designated Satellite Accumulation Area (SAA) within work areas. Tubs and SAA signage are provided by EHS. Additional secondary containers shall be supplied by the PI.

A19.4.2

A waste determination shall be conducted for all waste generated.

A19.4.2.1

Incompatible wastes (e.g., halogenated and non-halogenated, acid and base, inorganic and organic, etc.) shall not be mixed. A different container, compatible with the waste, shall be used to store the waste material.

A19.4.2.2

Waste generation and disposal procedures for all waste streams shall be outlined in the WASP (see [Section A11](#)) and / or individual SOPs (see [Section A12](#)).

A19.4.2.3

Contact EHS if [mixed waste](#)^d is to be generated.

A19.4.2.4

Contact EHS for disposal and handling instructions of high hazard waste (e.g., dried picric acid, ether with high levels of peroxides, explosives, [energetic materials](#)^d, toxic gases, etc.).

A19.4.3

The contents of the SAA shall be inspected weekly for the following: identification of leaking or compromised containers and spills; containers are kept closed; containers are labeled as Hazardous Waste; if containers are greater than 3/4 full, submit a Waste request.

A19.4.4

Waste accumulation should not exceed three-quarters (3/4) of the volume of the container.

A19.4.5

Hazardous Waste stored in the SAA shall not exceed 55 gallons of hazardous waste, 1 quart of acutely hazardous waste, or 1 Kilogram of solid acutely hazardous waste.

A19.4.6

Hazardous waste containers shall always remain closed except for the following: adding waste; proper operation of equipment; and the prevention of a dangerous situation (buildup of pressure).

A19.4.7

Waste containers stored on the floor shall be placed in [secondary containment](#)^d to collect spills.

A19.4.8

Waste containers must be kept free of contamination (e.g., outside of liquid collection containers and inner portions of solid collection containers).

A19.4.9

Incompatible waste streams shall be segregated into separate secondary containment within the SAA. (e.g., flammable waste and inorganic acid waste.)

A19.4.9.1

Only appropriately labeled, sealed containers with a corresponding EHS Transaction Number will be collected during routine collection. The Transaction Number is obtained from the waste request confirmation email.

A19.4.10

Waste picked up by EHS will be handled according to [40 CFR 262](#).

A19.5

Glass Waste

A19.5.1

Glass must be decontaminated before disposal in a glass disposal box.

A19.5.2

Full glass disposal boxes should be taped closed and disposed of in a dumpster by the accumulator.

A20 TRANSPORT AND SHIPMENT OF CHEMICALS

A20.1

Transport of Chemicals on or to TTU Property

A20.1.1

Do not take chemicals to [public areas](#)^d or leave items unattended during transport.

A20.1.2

Chemicals discussed in [Section A17.4](#) may not be transported from their approved storage and use areas.

A20.1.3

Chemicals must be properly packaged in [secondary containment](#)^d or original shipping packaging during transport. Absorbent pads are recommended when transporting liquids.

A20.1.4

Chemicals are not to be opened during transport for any reason.

A20.1.5

A TTU vehicle must be used when transporting DOT-regulated materials on public roadways. An appropriate [spill kit](#)^d must accompany the transport. Exemptions to this policy may be addressed through EHS.

A20.1.5.1

TTU personnel transporting DOT-regulated materials must take the DOT-driver training prior to transporting items. This training must be renewed every two years.

A20.1.6

Transporting chemicals between buildings on foot must be done using a laboratory cart. An appropriate spill kit^d should accompany the transport.

A20.1.7

Spills between work areas inside of a building may be cleaned up by the transporter. Spills that occur outside of buildings must be cleaned up by EHS. Personnel should notify EHS immediately at 742-3876.

A20.2

Shipment of Hazardous Materials

A20.2.1

EHS shall be notified about all chemical or biological shipments when:

A20.2.1.1

Shipments to or from the University are initiated by TTU personnel (i.e. TTU personnel is the [shipper](#)^d); or

A20.2.1.2

TTU personnel are importing materials to the University or exporting materials from the University.

A20.2.1.3

EHS can assist in identifying applicable shipping requirements.

A20.2.2

Personnel offering hazardous materials for shipping must have completed Hazardous Material Shipping training through EHS or be able to submit a valid certificate showing completion from an acceptable entity;

A20.2.3

A completed [Material Shipping Form](#) must be submitted to EHS prior to shipment. A [SDS](#)^d for the material must be provided to EHS if one is not found in [ChemWatch](#)^d.

A20.2.4

All shipments must meet the requirements put forth in of the [Department of Transportation 49 CFR 100-185](#) and the International Air Transportation Association Dangerous Goods Regulations.

A20.2.4.1

In accordance with [29 CFR 1910.1200 \(b\)\(3\)\(iv\)](#), hazardous chemical containers must be labeled with: 1) product identifier, 2) signal word, 3) hazard statement(s), 4) pictogram(s), precautionary statement(s), and 6) name, address, and telephone number of the chemical manufacturer, importer, or other responsible party.

A20.2.4.1(a)

The required information in A20.2.4.1 must be located together on the label, tag or mark.

A20.2.4.1(b)

The required information in A20.2.4.1 must not conflict with the requirements outlined in [DOT 49 CFR 100-185](#).

A20.2.5

Chemical shipments being returned to the vendor must meet the requirements outlined in Section A20.2.

A20.2.5.1

Return of chemicals to the vendor due to vendor error is not advised. Contact EHS regarding chemical returns.

A20.2.6

Proprietary materials may be subject to a Material Transfer Agreement (MTA) if the material was developed or recovered at Texas Tech University/Texas Tech University Health Sciences Center. Visit <http://www.depts.ttu.edu/vpr/ors/preaward/forms-boilerplates.php> for more information.

A20.2.7

For details regarding the transport and shipment of biological materials, see Section B12 in the Biosafety chapter of the University Laboratory Safety Manual.

A21 **CHEMICAL GATEWAY**^d

A21.1

Procurement of Chemicals for [Laboratories](#)^d

A21.1.1

Laboratory^d and non-laboratory chemical purchases are approved by EHS.

A21.1.2

Laboratory^d chemical deliveries must be shipped to TTU Central Receiving, 3122 Main Street, Lubbock, TX 79409.

A21.1.2.1

Compressed gases are to be delivered to the immediate work area.

A21.1.3

Chemicals shall be purchased through [TechBuy](#)^d.

A21.1.3.1

The principal investigator responsible for the chemical and the building and room number where the chemical will be stored must be included on the Purchase Order.

A21.1.4

Chemicals unavailable for purchase through TechBuy^d may be purchased using a TTU Procurement Card. EHS approval must be granted prior to purchase.

A21.1.5

Procurers should review [Safety Data Sheets](#)^d (SDSs) for chemicals not previously purchased to ensure proper [administrative](#)^d and [engineering controls](#)^d are in place to address hazards.

A21.1.6

For procurement of biological material, see Section B8.3 in the Biosafety chapter of the University Laboratory Safety Manual.

A21.1.7

For procurement of radioactive material, see Section II.H.3a in the Radiation Safety chapter of the University Laboratory Safety Manual.

A21.2

Chemical Inventory for Laboratories^d

A21.2.1

In general, items with CAS number(s) will be entered into the PI's online chemical inventory.

A21.2.1.1

Chemical mixtures will be barcoded according to the most relevant CAS number as determined by EHS.

A.21.2.2

Chemical containers must be properly labeled as defined by [29 CFR 1910.1200 \(f\)\(6\)\(ii\)](#) before inventory.

A21.2.2.1

Inadequately labeled chemicals will be held at the Chemical Gateway^d until full GHS label information is submitted to EHS by the responsible party.

A21.2.3

Properly labeled chemicals will be barcoded when entered into the PI's online chemical inventory.

A21.2.3.1

The large number on the barcode designates the chemical storage group as defined in Appendix AA.

A21.2.3.2

Chemicals with a NFPA health hazard rating of 3 or 4 will have a blue dot affixed to the EHS barcode. Such chemicals should be treated with caution.

A21.2.3.3

Chemicals in storage Group 9 (Compatible Pyrophoric and Water Reactive Materials) shall be stored according to their respective SDS.

A21.2.4

When a chemical container is emptied, the yellow portion of the EHS barcode must be removed, affixed to a [Barcode Return Form](#) and returned to EHS at Campus Mail Stop 1090.

A21.2.5

PI inventory access is granted after all required EHS safety training is completed and WASP (see [Section A11](#)) is submitted to EHS.

A21.2.6

A [Chemical Transfer Sheet](#) must be completed and submitted to EHS for barcoded chemicals being permanently transferred from their storage locations.

A21.2.7

A [Barcode Request Form](#) must be completed for chemicals received without a barcode. Submit completed forms to ehs.lab.safety@ttu.edu. Barcode(s) will be campus mailed to the Mail Stop indicated on the form.

A21.3

Damaged packages may not be accepted by TTU Central Receiving personnel.

A21.3.1

EHS will notify the PI of rejected chemical purchases and offer assistance in initiating a replacement.

A21.4

Accepted packages containing compromised chemical containers will be treated as hazardous waste.

A21.4.1

EHS will notify the PI of compromised containers and initiate obtaining a replacement with the vendor.

A21.5

Incoming chemical shipments from collaborators or other institutions must be disclosed to EHS prior to the arrival of the shipment.

A21.6

Barcoded chemical containers will be repackaged in original shipping packaging and delivered to the designated location by EHS.

A22 CHEMICAL FUME HOODS

A22.1

Chemical Fume Hood Operating Procedures

A22.1.1

Chemical fume hoods are required to be functioning properly.

A22.1.2

Specific measures shall be in place and taken to ensure proper and adequate performance of chemical fume hoods.

A22.1.3

Each PI/supervisor must ensure that all personnel within their work area(s) are trained in the safe use of chemical fume hoods (see [Section A14](#)).

A22.1.4

Chemical fume hoods are required to have a visual indicator of air flow.

A22.1.5

All manipulations must be at least six (6) inches inside the chemical fume hood face. A line drawn on the work surface six inches inside the face can be an effective reminder.

A22.1.5.1

Laboratory equipment shall be located as far back in the chemical fume hood as practical.

A22.1.6

Chemical fume hood exhaust slots shall not be blocked.

A22.1.7

Elevate large pieces of equipment off the work surface.

A22.1.8

Chemical fume hoods shall be kept clear of excess storage.

A22.1.9

The chemical fume hood sash should be kept as low as possible to perform work and not raised above the indicated sash height except when loading / unloading large equipment.

A22.1.10

The chemical fume hood sash must be fully closed when not actively manipulating materials inside the chemical fume hood.

A22.2

Chemical Fume Hood Surveillance Program

A22.2.1

Chemical Fume Hood Flow Requirements

A22.2.1.1

Chemical fume hoods shall have an average airflow of 80 - 100 feet per minute.

A22.2.1.2

Chemical fume hoods where radioactive material is used shall have an average airflow of 100 - 120 feet per minute.

A22.2.1.3

“Low flow” chemical fume hoods shall be certified based on manufacturer specifications.

A22.2.2

Routine Chemical Fume Hood Performance Surveys

A22.2.2.1

Hood face velocity surveys will be conducted annually by EHS.

A22.2.2.2

Calibrated airflow measuring devices capable of accurately measuring air velocity in the range of 0 to 1500 feet per minute will be used.

A22.2.2.3

A typical chemical fume hood survey procedure involves performing a multi-point traverse in the plane of sash travel. The average face velocity (the arithmetic mean of these point readings) is then calculated and recorded.

A22.2.2.4

Additional notations or comments, such as excessive storage in the chemical fume hood, sashes or unusual velocity readings are noted during the survey.

A22.2.2.5

If the chemical fume hood is performing to established standards, an adhesive sticker is completed and posted on the sash of the hood at the time of the survey.

A22.2.2.6

The supervisor will be notified of any unusual findings or extreme deficiencies of the chemical fume hood by a posted 'out-of-service' tag on the sash of the fume hood.

A22.2.2.6(a)

TTU Physical Plant must be contacted by [laboratory personnel](#)^d to address the functioning of the chemical fume hood.

A22.2.2.6(b)

Once the issue with the chemical fume hood is resolved, EHS needs to be notified to return to the [laboratory](#)^d to test the chemical fume hood for proper operation.

A23 **NON-COMPLIANCE**

A23.1

[Section A24](#), [laboratory](#)^d closure, will be followed in situations where non-compliance resulted in conditions immediately dangerous to life and/or health or an [incident](#)^d occurred.

A23.1.1

Non-compliance will be addressed on a case-by-case basis. The following will be considered non-compliance:

A23.1.1.1

Work areas in which [critical findings](#)^d are not corrected upon follow-up [survey](#)^d which will occur no less than 30-calendar days after the initial survey^d.

A23.1.1.2

Work areas where the specific [finding\(s\)](#)^d on three consecutive surveys^d are identical.

A23.1.1.3

Laboratory personnel, Principal Investigators, or other personnel who fail to comply with safety policies or direct instruction from a safety authority (e.g., EHS, DSO, supervisor, instructor, etc.).

A23.2

The following measures will be taken to restore safety in non-compliant work areas.

A23.2.1

The Department of Environmental Health & Safety (EHS) will inform the Institutional Laboratory Safety Committee (ILSC) of incidences of work area non-compliance. The nature of the finding(s)^d and any history of delinquency will also be presented to the ILSC for their consideration.

A23.2.2

The ILSC will determine any additional timeline allowed for [findings](#)^d to be corrected and the consequences if findings are left unaddressed.

A23.2.3

Non-compliant work areas will be placed on a [quarterly](#)^d inspection schedule. The duration of the quarterly^d survey^d schedule will be determined by the ILSC.

A23.2.4

Information from the committee's decisions regarding A23.2.2 and A23.2.3 will be conveyed in a letter from the committee. This letter will be electronically delivered to the work area supervisor's university email account. A hard copy of the letter will also be sent via campus mail.

A copy of the letter will also be sent in hard copy and electronically to the corresponding department chair, dean, department safety officer and college safety officer.

A23.2.5

Cases of serial non-compliance will result in laboratory^d closure.

A23.3

The following measures will be taken to restore safety compliance with non-compliant individuals in research spaces.

A23.3.1

The non-compliant individual may be removed from the work area if deemed necessary.

A23.3.2

Provisions for return to the work area will be dictated by the safety authority to include remediation to address the non-compliant behavior.

A23.3.3

EHS or safety authority will inform the supervisor in writing if lab personnel are removed from the work area.

A23.3.3.1

The supervisor will be informed in writing if the work area is deemed unsafe with the letter copied to departmental chairperson, academic Dean, and VPR office.

A23.4

The following measures will be taken to restore safety compliance with non-compliant individuals in teaching spaces.

A23.4.1

The non-compliant individual may be removed from the work area if deemed necessary, including Campus Security as appropriate.

A23.5

Repeated instances of non-compliance will be referred to the Director or Department Chair responsible for that unit that will include a conference with EHS and may be considered excessive non-compliance and initiate procedures outlined in Section A4.6.

A24 LABORATORY OR STUDIO SPACE CLOSURE

A24.1

Conditions for Closure

A24.1.1

Closure of a work area is considered on a case-by-case basis.

A24.1.1.1

Closure refers to a spectrum of restrictions which include but is not limited to: signage restricting entry, prohibited entry and / or work during specified work hours or re-keying of the work area(s).

A24.1.1.2

Personnel will be allowed to enter the work area if the environment is deemed safe by the CHO to stop or stabilize operations to prevent incidents during closure.

A24.1.2

A work area that poses an immediate danger to life or health (IDLH situation) may be closed immediately by EHS.

A24.1.3

A [laboratory](#)^d or studio space that is chronically and / or seriously non-compliant with the practices outlined in the University Laboratory Safety Manual or the Work Area Safety Plan (WASP) may be closed as recommended by the relevant institutional safety committee(s).

A24.1.4

A laboratory^d or studio space in which an event has occurred that requires EHS investigation may be closed.

A24.1.4.1

If a significant event occurs during normal business hours, an evaluation will be performed to determine if the work area is compliant with applicable regulations.

A24.1.4.1(a)

If there are no issues or if issues can be resolved by the end of that work day, the work area will not be re-keyed.

A24.1.4.1(b)

If the issues are unable to be addressed that work day, the work area will be re-keyed and will stay re-keyed until all issues have been addressed.

A24.1.4.2

If a significant event occurs after normal business hours, the work area may be closed or re-keyed until an evaluation can be performed the following business day to determine if the work area is compliant with applicable regulations.

A24.2

Procedures for Closure

A24.2.1

The Office of the Vice President for Research, in consultation with the CHO, DSO / department and relevant institutional safety committee(s), will issue a written memorandum (or email, as appropriate) to the supervisor(s), Department Chair and Dean of the College which includes: 1) the reason(s) for (potential) closure, 2) corrective action(s) to be taken, 3) modification(s) to [administrative](#)^d or [engineering control\(s\)](#)^d, 4) a [correction period](#)^d and any other pertinent information (e.g., work restrictions, allowable maintenance operations, etc.).

A24.2.2

The PI(s)/supervisor(s) and/or suitable departmental representative will be invited via explicit email to the relevant institutional safety committee(s) meeting(s) to address the compliance issues.

A24.2.2.1

The PI(s)/supervisor(s) and/or suitable departmental representative (e.g., department chair) will be excused prior to final discussion and vote.

A24.2.3

The relevant institutional safety committee(s) will decide the merits of the appeal and either issue a revised correction period^d to readdress the compliance issues, accept the appeal without closure, or continue with the original correction period^d.

A24.2.4

Supervisor Actions

A24.2.4.1

The supervisor shall report, in writing, any condition(s) outside of their control which delay corrective action(s) to the relevant institutional safety committee(s) and / or EHS;

A24.2.4.2

The supervisor may appeal, in writing, the work area closure outlined in Section A23.2.1 to the relevant institutional safety committee(s) subsequent to the closure.

A24.2.5

If the issues described in Section A23.2.1 are not corrected as required by the relevant institutional safety committee(s) in the time indicated, the work area(s) may be closed and re-keyed until the compliance issues are corrected.

A24.2.6

Conditions for Resumption

A24.2.6.1

The issues described in Section A23.2.1 must be corrected before the work area is reopened.

A24.2.6.1(a)

The work area will remain closed until the EHS can perform an evaluation to ensure the work area is in compliance with applicable regulations.

A24.2.6.2

The work area will be returned to the department once all compliance issues are resolved, the investigation into the incident is complete and/or the work area is compliant with applicable regulations.

A24.3

EHS will offer assistance and additional training as needed to resolve compliance issue(s) and complete corrective action(s).

A25 **DECOMMISSIONING A WORK AREA**

A25.1

General Information

A25.1.1

Supervisors vacating a work area are required to properly dispose of any hazardous materials and decontaminate the work area and equipment prior to departure. See Appendix AK for the Laboratory Decommissioning Checklist.

A25.1.1.1

[Laboratory personnel](#)^d are responsible for packing and moving the laboratory^d. Labels with the PI's name, a content description and any hazard information shall be affixed to all boxes.

A25.1.1.2

All waste generated in the work area must be disposed of properly through EHS.

A25.1.2

The supervisor will notify EHS that a work area is to be decommissioned no less than 30 calendar days prior to departure.

A25.1.2.1

Laboratories^d that have or have had radioactive materials are required to notify the Radiation Safety Officer (RSO) of the move 30 days prior to departure or when known. The RSO will direct the laboratory decommissioning of these spaces and will clear the laboratory^d once decommissioning is complete.

A25.1.3

EHS will inspect the work area to identify the hazards to be addressed. A second inspection will be conducted to confirm all identified hazards are mitigated and to clear the work area for renovation and / or new occupancy.

A25.1.4

If a supervisor departs before the work area is decommissioned, the department will take over the area and complete decommissioning as time allows.

A25.2

Allowable Material Transfers

A25.2.1

Hazardous materials left in a work area by a PI become the property of EHS upon the PI's departure. Materials will be reallocated or destroyed.

A25.2.2

Opened and unopened chemicals may be transferred to a different PI at TTU by submitting a [Chemical Transfer Form](#) to EHS.

A25.2.3

Transfer of materials under the purview of the Institutional Laboratory Safety Committee, Institutional Biosafety Committee or Radiation and LASER Safety Committee must be coordinated through the relevant [institutional safety committee\(s\)](#)^d.

A25.2.4

Equipment may be transferred to a different PI at TTU following appropriate decontamination before removal from the work area. Receiving party may request EHS clearance of equipment.

A25.2.4.1

Thermometers and other loose items shall be removed from equipment and packaged separately.

A25.2.4.2

Oil and water shall be drained from pumps, baths and other equipment and disposed of in the appropriate waste stream.

A25.2.4.3

Furniture and fixtures are to be left in the laboratory^d unless an item is essential to a piece of equipment that is eligible to be moved.

A25.2.5

Compressed gases shall be capped and secured. Arrangements shall be made with the vendor if gases are to be moved to a new campus location. Empty tanks shall be returned to the vendor. Contact EHS for disposal of non-returnable tanks.

A26 **REVIEWS AND UPDATES**

A26.1

The University Chemical Hygiene Plan will be reviewed and, if necessary, updated annually. The ILSC is responsible for initiating this review.

A26.2

A list of [departmental representatives](#)^d will be updated annually by the CHO as received by department heads.

A26.3

The departmental representatives^d shall review and evaluate the effectiveness of the CHP at least annually and forward any suggestions or updates to the CHO for review and filing with the ILSC.

Biosafety Manual

(POLICIES AND PROCEDURES)

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Implemented: November 2005

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RECENT CHANGES

2023 update

We would like to reiterate that checklists for basic biosafety at BSL1 and BSL2 containment were amended to reflect the requirements in the 6th edition of the BMBL in November of 2021. Certain requirements for all laboratories from the CHP have been reiterated in the BSL1 checklist. These are not new requirements.

Verbiage has been clarified regarding sinks and sharps containers at BSL1. A plumbed sink and eyewash are both required in the immediate (vs adjacent) work area at BSL1. There is no delineation of BSL1 vs other biocontainment in the regulations for the management of sharps. The use of FDA-approved containers (i.e., puncture-proof and securable) is required for the disposal of sharps in all biological laboratories.

Guidelines for double gloving have been added.

Policy changes

Special criteria have been added for animal (ABSL), plant (PCL), and arthropod (ACL) containment. These sections will continue to be expanded and updated as program needs are assessed. The checklists are located in section *B9.2.3 Special Considerations for Certain Research Foci*. References to biosafety level have been changed to containment level given the formalization of these new types of biocontainment areas.

B9.2.1 Regarding IBC protocol registration has been amended to address the transition to the online cloud-based Cayuse application. As announced in January 2023, all new protocols, protocol renewals, and protocol amendments will be completed within the Cayuse system. To get started in Cayuse, researchers and laboratory personnel will need to complete the personnel form to be added to the system. More information is provided on the IBC registration page: <https://www.depts.ttu.edu/ehs/academicsafety/Biosafety/protocolregistration-bio.php>

B6.5 Biologically Derived Toxins section was added. These materials are subject to IBC oversight. Responsibilities to the PI and IBC in section B4 were also added to reflect this change.

B6.6 Prions and Prion-like Proteins was added. These materials are subject to IBC oversight. Responsibilities to the PI and IBC in section B4 were also added to reflect this change.

B6.7 Respiratory Viruses was added. These materials are subject to work using BSL2 Enhanced requirements.

B9.2.2.1(a) Cleaning equipment (i.e., brooms, mops, buckets, etc.) is dedicated to the work area for all containment levels.

B10.1.4.4 was amended to state that the PI is responsible for *coordination* and completion of annual BSC certification. This change was made so that our policies are not misinterpreted to imply that PIs are financially liable for certification. The financially responsible party (or parties) for BSC certification is determined by the department/college/school.

B1 PURPOSE AND POLICY STATEMENTS

B1.1

Purpose

This document serves as a statement of official Texas Tech University policy to establish and maintain compliance with the documents listed below. Where there is conflict or overlap between state or federal regulations and TTU policies, the most protective provisions shall be used.

The chapters that comprise the University Laboratory Safety Manual are managed by separate institutional committees; changes may be made in one document prior to another. If there are questions about conflicting information, please contact EHS regarding the situation so that such matters can be addressed.

Biological laboratories are subject to additional requirements outlined in other sections of the University Laboratory Safety Manual (LSM) as they apply to the work area – this includes the appendices. Some information from other sections is referenced in this manual.

[National Institutes of Health Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules](#) (NIH Guidelines), April 2019.

[Biosafety in Microbiological and Biomedical Laboratories](#) (BMBL), 6th edition.

[Select Agent Regulations](#) 7 CFR 331, 9 CFR 121, and 42 CFR 73.

[OSHA Bloodborne Pathogen Standard](#) 29 CFR 1910.1030.

[Transportation of Hazardous Materials Regulations](#) 49 CFR Subchapter C

[International Air Transport Administration](#)

[Texas Administrative Code](#): 25 TAC 1 Subchapter K, and 30 TAC 326

[Texas Tech University Operating Policies](#)

B1.2

Policy

Texas Tech University is actively committed to preserving the health and safety of its students, staff, and faculty and to protecting the environment and the surrounding community. It is recognized that use of microorganisms, organisms containing recombinant/synthetic nucleic acids, disease vectors, and human and animal materials is necessary in many university research and teaching laboratories.

To ensure the safe handling of these materials, Texas Tech University requires compliance with the guidelines and regulations listed in section B1.1, as well as other resources as they apply to the Biosafety Program. Compliance with other applicable federal, state, local and University regulations not specifically mentioned in section B1.1 is also required.

In an effort to facilitate a culture of safety at Texas Tech University, biosafety training pertinent to the content of this manual is required for all individuals prior to beginning work with biological materials as appropriate and biennially thereafter for all students, faculty, and staff working with such materials.

Texas Tech University policy requires compliance to state and federal regulations regarding the use of potentially hazardous biological materials; thus, certain research involving such materials requires proposal submission and review regardless of sponsorship prior to work commencing.

The most current copy of the University Laboratory Safety Manual (LSM) is available for download from the EHS website at <https://www.depts.ttu.edu/ehs/>. The direct link to the LSM is <https://www.depts.ttu.edu/ehs/academicsafety/labsafetydocs/LabSafetyManual.pdf>.

B2 IMPORTANT CONTACT INFORMATION

B2.1

IF YOU HAVE AN EMERGENCY AND REQUIRE FIRE & RESCUE, POLICE, OR EMERGENCY MEDICAL SERVICE, CALL 911.

B2.2

University Emergency Assistance Numbers

B2.2.1

Environmental Health & Safety

- Emergency during University Operating Hours 806-742-3876

24-Hour Emergency Contact (Maintenance & Operations – including EHS)

- 806-742-4OPS (4677)

B2.2.2

University Police Department

- Emergency 911
- Non-Emergency 806-742-3931

B2.3

Safety and Compliance Contact Information

B2.3.1

Environmental Health & Safety (EHS) Contacts and Information

EHS: <https://www.depts.ttu.edu/ehs/>; Directory: <https://www.depts.ttu.edu/ehs/staff/index.php>

Email: safety@ttu.edu

Academic Safety (Lab): <https://www.depts.ttu.edu/ehs/academicsafety/index.php>

Email: ehs.lab.safety@ttu.edu

Environmental Protection (Waste): <https://www.depts.ttu.edu/ehs/environmental/index.php>

Email: ehs.environmental.safety@ttu.edu

Occupational Health Program: <https://www.depts.ttu.edu/ehs/occupationalsafety/OHP/index.php>

Email: ehs.ohp@ttu.edu

Safety Training: <https://www.depts.ttu.edu/ehs/Training/index.php>

Email: ehs.safety.training@ttu.edu

TTU System Risk Management: <https://www.texastech.edu/offices/risk-management/>

Office Phone: 806-742-0212

B2.3.2

Compliance Committee Contact Information

Institutional Biosafety Committee Webpage:

<http://www.depts.ttu.edu/ehs/academicsafety/icc/ibc.php>

Email: ibc.ehs@ttu.edu

Institutional Laboratory Safety Committee Webpage:

<http://www.depts.ttu.edu/ehs/academicsafety/icc/ilsc.php>

Email: ilsc.ehs@ttu.edu

Institutional Animal Care and Use Committee Webpage: <http://www.depts.ttu.edu/iacuc/>

Email: iacuc@ttu.edu

Radiation and Laser Safety Committee Webpage:

<http://www.depts.ttu.edu/ehs/academicsafety/icc/irlsc.php>

Institutional Review Board Webpage: <http://www.depts.ttu.edu/research/irb/>

B3 USEFUL ACRONYMS AND DEFINITIONS

B3.1

Acronyms

AAALAC – Association for Assessment and Accreditation of Laboratory Animal Care

ABLS1 – Animal Biosafety Level 1

ABSL2 – Animal Biosafety Level 2

ABSL3 – Animal Biosafety Level 3

ABSA – American Biological Safety Association

ACL1 – Arthropod Containment Level 1

ACL2 – Arthropod Containment Level 2

ACS – Animal Care Services

BMBL – Biosafety in Microbiological and Biomedical laboratories

BSC – Biosafety Cabinet

BSL – Biosafety Level

BSL1 – Biosafety Level 1

BSL2 – Biosafety Level 2

BSL/ABSL2 - Ag – Animal Biosafety Level 2 Agriculture

BSL3 – Biosafety Level 3

BSL/ABSL3 - Ag – Animal Biosafety Level 3 Agriculture

BSM – University Biosafety Manual

BSO – Biological Safety Officer

CDC – Center for Disease Control

CFR – Code of Federal Regulations

CHO – Chemical Hygiene Officer

CHP – Chemical Hygiene Plan

Co-PI – Co-Principal Investigator

DOT – Department of Transportation

DSO – Departmental Safety Officer

EHS – Environmental Health and Safety

EPA – Environmental Protection Agency

ERP – Emergency Response Plan
FAA – Federal Aviation Administration
FWS – US Fish & Wildlife Service
GMO – Genetically Engineered/Modified Organism
HAZWOPER – Hazardous Waste Operations and Emergency Response
HEPA – High Efficiency Particulate Air
IACUC – Institutional Animal Care and Use Committee
IATA – International Air Transport Administration
IBC – Institutional Biosafety Committee
IFDC – Institutional Financial Disclosure Committee
ILSC – Institutional Laboratory Safety Committee
IRB – Internal Review Board
IRLSC - Institutional Radiation and LASER Safety Committee
ISO – International Organization for Standardization
LSM – University Laboratory Safety Manual
NIH – National Institutes of Health
NIH-OSP – National Institutes of Health, Office of Science Policy
NIOSH – National Institute for Occupational Safety and Health
OHP – Occupational Health Program
OSHA – Occupational Safety and Health Administration
PCL1 – Plant (or environmental) Containment Level 1
PCL2 – Plant (or environmental) Containment Level 2
PI – Principal Investigator
rNA/sNA – recombinant / synthetic nucleic acid
RG – Risk Group
RSO – Radiation Safety Officer
SA – Select Agent(s)
SCAN – Safety Concern and Near-Miss
SDS – Safety Data Sheet
SOP – Standard Operating Procedure

TCEQ – Texas Commission on Environmental Quality

TTU – Texas Tech University

TTU OP – Texas Tech University Operating Policy

VHP – Vapor-Phase Hydrogen Peroxide

WASP – Work Area Safety Plan

WHO – World Health Organization

B3.2

Definitions

Aseptic technique - a set of practices that when used, serve to minimize, or prevent contamination to the worker, the work area, the items being manipulated, and/or others.

Administrative Controls – (i.e., work practice controls) are work procedures such as written safety policies, rules, supervision, schedules, and training implemented to reduce the duration, frequency, and severity of exposure to a hazard.

Antisepsis – the application of a liquid antimicrobial chemical to living tissue with the intent to prevent infection. Antiseptics and germicides are used to prevent infection on living humans/animals and are thus not disinfectants but drugs, regulated by the FDA.

Biological Risk Assessment – Regarding biological risks, the continual process of identifying the hazardous characteristics of an agent or material (if known); the activities that can result in exposure to an agent; the likelihood that such exposure will cause disease; and the probable consequences of such an infection. Generally speaking, risk assessment is the continuous and evolving analysis of hazards through the sciences and perceptions that are associated with the materials, personnel, and work procedures/operations; evaluating the probability an identified hazard will result in an effect (as a function of frequency and severity of the risk).

Biological Risk Management – The continual process of developing strategies (i.e., identifying actions, equipment, training, PPE, etc.) and implementations of these strategies to control, reduce, and/or eliminate risks posed by identified hazards.

Biohazard – a material/substance that harbors or could potentially harbor a biological agent that presents a potential risk to the health of humans, animals, or the environment.

Biosafety –the containment principles, technologies, and practices that are implemented to prevent the unintentional exposure to or accidental release of biological materials; synonymous with biological safety.

Biosafety Cabinet (BSC) – containment equipment designed to protect personnel and the environment from biohazards present within the cabinet when used properly. Some BSCs also protect the materials within the cabinet from contamination. There are three classes of cabinets (Class I, II, and III); class II BSCs are further divided into types: A1 (formerly A), A2 (formerly B3), B1, B2, and C1(new type as of 2017). Class and type are determined by differences in inflow velocity, ducting/exhaust, and portion of air recirculated within the BSC interior.

Biosafety Level (BSL) – In the United States, this refers to ascending levels of containment for handling biological agents that pose different levels of risk to the workers and the environment; consist of combinations of laboratory procedures, practices, safety equipment, and laboratory facilities which allow manipulation of biological agents of increasing danger to life and health. In the BMBL document put forth by CDC & NIH, four levels of containment are identified; these levels build on each other from 1-4 as containment needs increase.

Biosecurity –the protection, control and accountability for biological materials and research-related information within laboratories in order to prevent their unauthorized access, loss, theft, misuse, diversion or intentional release; synonymous with biological security.

Biowaste – comprised of animal waste (carcasses, body parts/fluids and bedding of animals intentionally exposed to potential pathogens), animal cell cultures, human and non-human primate blood/body parts/cultures, microbiological waste (cultures, stocks, specimens, transfer devices, etc.) pathological waste, and sharps as these terms are defined in 25 TAC §1.132; any enriched sample/specimen; samples/specimens that are reasonably considered to contain, have been purposefully exposed to, or tested positive for a pathogen.

(Biological) Work Area Safety Plan – a laboratory-specific manual that identifies the hazards that will or may be encountered, and that specifies practices and procedures designed to minimize or eliminate exposures to these hazards. Personnel must be advised of special hazards and are required to read and follow the required practices and procedures. May also be referred to as a bioWASP, WASP, biosafety manual, etc. See [B9.1.3.1](#).

Chemical disinfectant – chemicals used to render a contaminated material safe for further handling. Except for, bleach, ethanol or isopropanol, only use chemical disinfectants that are registered by the EPA. Lists are available at <http://www.epa.gov/oppad001/chemregindex.htm>

-cidal – kills or inactivates an agent or material. (e.g., bactericidal, fungicidal, sporicidal, tuberculocidal, virucidal, etc.)

Cleaning – the removal of foreign material, such as soil or other organic material, from objects or surfaces through water with detergents/enzymes. Cleaning is necessary for high-level disinfection and sterilization as inorganic and organic matter interferes with the efficacy of these processes. Additionally, failure to remove material may result in buildup and/or biofilm formation; thus, further difficulties to disinfect and/or sterilize for further applications.

Contact time – the duration of exposure required for a disinfectant to effectively destroy or irreversibly inactivate a biological agent.

Contamination – the presence of an unwanted or potentially hazardous agent, material or substance.

Containment – Series of barriers that provide protection to workers and the environment.

Containment level – laboratory classification for the nature of the biohazards present; may be a general biosafety level (BSL) or denote specific hazards such as plants (PCL), animals (ABSL), or arthropods (ACL).

Co-Principal Investigator – see [principal investigator](#)

Decontamination – the removal or neutralization of a hazardous/unwanted agent or the destruction/removal of microorganisms to some acceptable level, which may not necessarily be zero, but is generally considered safe. Cleaning, sanitation, disinfection, antisepsis, and sterilization are all forms of decontamination.

Dignitary – any representative from a federal or state regulatory agency, industry, law enforcement officials, investors, etc.

Disease vector – any agent which acts as an intermediary to carry and/or transmits an infectious agent to another living organism, primarily concerns arthropods.

Disinfection – the use of a (generally) chemical or thermal procedure or procedures that eliminates nearly all recognized pathogenic microorganisms/agents on inanimate objects; efficacy is

dependent on multiple factors. Disinfection destroys or irreversibly inactivates all infectious fungi and bacteria but not their spores, thus does not ensure “kill” level. Disinfectants can be “general” or “hospital” grade. Hospital grade disinfectants are required in areas where human materials are used. These disinfectants consist of EPA-registered tuberculocidal agents, a registered germicide on the EPA Lists D & E or a freshly made 1:10 dilution of household bleach.

Engineering Controls – includes designs or modifications to plans, facilities, equipment, ventilation systems, and processes that reduce the source of exposure.

Exposure – The condition of having contact with a potentially harmful agent, material or substance. What is defined as “exposure” will differ with the hazard. Routes of exposure in a laboratory are injury/injection, absorption, ingestion and inhalation.

Fomite – an inanimate object or surface that can, when contaminated, serve as a source of agent transmission.

Generator – in regard to biowaste, the party responsible for producing the waste.

Genetically Engineered/Modified Organism or Microorganism (GMO, GMMO) – micro- or macro-organisms which contain [recombinant and/or synthetic nucleic acid molecules](#).

Greenhouse – The term "greenhouse" refers to a structure with walls, a roof, and a floor designed and used principally for growing plants in a controlled and protected environment; may also be referred to as “glasshouse”. The walls and roof are usually constructed of transparent or translucent material to allow passage of sunlight for plant growth. The term "greenhouse facility" includes the actual greenhouse rooms or compartments for growing plants, including all immediately contiguous hallways and head-house areas, and is considered part of the confinement area.

Incident – an event or occurrence that results in one of the following: 1) damage to property, 2) damage to person(s), and/or 3) exposure to person(s) that requires medical attention, including the use of available safety equipment and/or first aid.

Institutional Compliance Committee – a committee established by the University and/or required by federal/state law to maintain compliance with regulatory agencies and oversee and authorize certain activities. The ILSC, IBC, IRB, IACUC, IRLSC, and IFDC are the institutional compliance committees at Texas Tech University.

Laboratory – a facility equipped for experimental or observational study, for testing and/or analysis and that contains or functions to collect chemical, biological, mechanical, radiological, and/or LASER materials/equipment for these purposes.

Laboratory Attire – for traditional lab spaces, this consists of long hair tied back, no exposed skin from the waist down, and solid shoes that cover the top of the foot. Contacts are allowed at the discretion of the PI. Jewelry should be minimal but is best to be removed prior to entering the lab. Proper attire for field work is dictated by a risk assessment.

Laboratory Personnel – anyone working in a TTU laboratory including principal investigators, staff, students, visiting researchers, volunteers, etc.

Minor – individual under the age of 18 years old.

Mixed Waste – waste generated in which at least two of the following are present: chemical, biological and / or radiological hazards.

Municipal Solid Waste – defined in Texas Administrative Code [30 TAC 330.3](#).

Non-laboratory Personnel – any TTU personnel whose primary work location is not a laboratory.

Personal Protective Equipment (PPE) – Personal protective equipment includes all clothing and work accessories designed to serve as a barrier against laboratory hazards. Basic PPE requirements for most campus laboratories include solid shoes, a lab coat and safety glasses though other PPE may be required. Examples include gloves, face shields, surgical masks, respirators, head/shoe covers, splash goggles, impermeable lab coats or suits, fire retardant coats/suits, steel-toed shoes, respirator(s), scrubs, solid-front gowns, aprons, etc.

Primary containment – consists of techniques and equipment that when used properly, prevent the release of biological material. Such items include laboratory equipment (centrifuges with sealed rotors or safety cups, biosafety cabinets), splash shields, keyboard covers, and personal protective equipment.

Principal Investigator – the primary individual responsible for preparing, conducting, and managing sponsored research and/or teaching (including internal funding) and the subsequent management of the work areas and personnel pertinent to execution of research/teaching. Only TTU faculty can be listed as a PI on an IBC application. Co-PIs share equal liability and responsibility regarding the adherence to TTU safety policies. Research scientists and postdoctoral fellows may be listed as Co-PIs if they fulfill those responsibilities.

Portable Sink – a sink designed to be mobile and contains a reservoir for containing gray water; may or may not be equipped with a water source.

Public Area – any area where non-laboratory personnel may be present such as common corridors, stairways, elevators, office spaces, etc.

Risk –The likelihood of an outcome. For biosafety purposes, risk is the likelihood that a particular event which may possibly result in adverse outcomes will occur. Such events may include exposure to or misuse, release, loss, theft, etc. of a biohazard.

Risk Group (RG) – classification of agents based on the hazard posed by assessing characteristics of the agent such as pathogenicity, virulence, and naturally occurring route of transmission. Both the NIH and WHO have outlined criteria for 4 risk groups (the most dangerous agents being RG4).

Risk Mitigation – process of communicating and offsetting risks associated with identified hazards.

Recombinant and synthetic nucleic acid molecules (rNA/sNA) – (i) molecules that a) are constructed by joining nucleic acid molecules and b) that can replicate in a living cell, i.e., recombinant nucleic acids; (ii) nucleic acid molecules that are chemically or by other means synthesized or amplified, including those that are chemically or otherwise modified but can base pair with naturally occurring nucleic acid molecules, i.e., synthetic nucleic acids, or (iii) molecules that result from the replication of those described in (i) or (ii) above.

Responder – any trained person designated by the employer, including employees from within the immediate release area, to respond to an incidental release of hazardous material.

Safety Concerns and Near Misses (SCAN) – an event or occurrence that was caught before an incident/accident occurred, did not result in harm/damage but could have; unsafe practice(s), condition(s), and/or environment(s) that could result in an incident/accident.

Sanitation – the reduction of microbial load on an inanimate object/surface to an acceptable level.

Secondary containment – consists of facility design and construction that functions to protect workers, the public, and the environment. Laboratories may include advanced features such as directional air flow (negative pressure in lab spaces), air treatment systems, or air locks at lab entrances, and may be as simple as restricted access in lab corridors, impervious lab furniture and bench tops, and locking doors.

Sharps – any object / device used to puncture or cut. Sharps, according to [25 TAC §1.132](#) include but are not limited to the following when contaminated: hypodermic needles; hypodermic syringes with attached needles; scalpel blades, razor blades, disposable razors, and disposable scissors used in surgery, labor and delivery, or other medical procedures; intravenous stylets and rigid introducers (e.g., J wires); glass Pasteur pipettes, glass pipettes, specimen tubes, blood culture bottles, and microscope slides; broken glass from laboratories; and tattoo needles, acupuncture needles, and electrolysis needles. Regardless of contamination, hypodermic needles and hypodermic syringes with attached needles are considered sharps.

Shipper – trained individual legally able to determine shipment packaging, labeling, and marking and signs any declaration and/or shipping documents for shipping biological materials.

Spill Kit – a compilation of appropriate absorbent materials, cleaners, disinfectants, chemical neutralizers, personal protective equipment, and other equipment (e.g., container for clean-up materials, scoop, broom, disposal bags, waste labels, etc.) used to contain and clean up spills. See [B7.1](#) for spill response and kit guidance.

Static – repression of growth or multiplication of an agent in its presence. (e.g., bacteriostatic, fungistatic, etc.)

Sterilization – implies destroying all viable organisms and their spores on the surface of an article or in a fluid; measured as the probability of a single viable microorganism surviving the process.

Vacuum Line Trap – often consists of suction flasks in sequence to create a trap to prevent contamination of the vacuum system with potentially biohazardous materials (see Appendix AE for guidance on vacuum line trapping).

Volunteer – individual who is assigned to perform duties for a department or area of TTU without compensation or the expectation of compensation, beyond reimbursement for pre-approved specified expenses. Potential volunteer workers may be members of the public, TTU alumni, students, faculty, staff or retired TTU faculty or staff (definition from [TTU OP 70.21](#)).

B4 RESPONSIBILITIES

The [Principal Investigator](#) (PI) is directly and primarily responsible for the safe operation of the laboratory. While safety is a shared responsibility among all [laboratory personnel](#), the PI's knowledge and judgment are critical in assessing risks and appropriately applying the principles in this manual.

A PI may choose to appoint a laboratory supervisor to assist in addressing their required responsibilities. Each laboratory should appoint a safety captain per responsibility A5.5.17 of the [Laboratory Safety Manual](#) (LSM). In addition to the help of laboratory personnel, many resources exist to assist PIs with their safety and compliance responsibilities, including the Department of Environmental Health & Safety (EHS), the Institutional Biosafety Committee (IBC), the Institutional Laboratory Safety Committee (ILSC), the Institutional Radiation and Laser Safety Committee (IRLSC), the Institutional Animal Care and Use Committee (IACUC), Animal Care Services (ACS), the Institutional Review Board (IRB), and Departmental and/or College Safety Officers (DSOs and CSOs, respectfully).

Please see Section A5 of the LSM, as well as the pertinent sections of the radiation and laser safety manuals, for additional responsibilities as they apply to the respective disciplines.

B4.1

Regarding biological safety, Environmental Health & Safety (EHS) shall:

B4.1.1

Prepare this Biosafety Manual, with revisions as necessary;

B4.1.2

Provide online access to the University Laboratory Safety Manual;

B4.1.3

Investigate laboratory Safety Concerns & Near Misses (SCANs), incidents and accidents;

B4.1.4

Collect and dispose of biological waste in areas without access to functional autoclaves;

B4.1.5

Design, provide, and coordinate safety trainings as requested or as needs are identified;

B4.1.6

Assist laboratory personnel with risk assessments as requested;

B4.1.7

Monitor laboratories for compliance with all elements of the University Laboratory Safety Manual and applicable TTU operating policies (TTU OPs);

B4.1.8

Assist faculty with submission of IBC protocol applications and maintain accepted protocol files;

B4.1.9

Promote and assist in the University's vision of excellence in the laboratory by promoting awareness of issues that laboratories face in today's fast-paced and competitive research and teaching environments;

B4.1.10

Search out new ways and ideas to meet the ever-changing regulatory requirements while promoting research and teaching in the safest environment possible;

B4.1.11

Coordinate the IBC and help develop and implement the safety programs of this committee;

B4.1.12

Facilitate the testing of active University autoclaves with biological indicators at least annually and those which process biowaste at the frequency required by state law (i.e., provide indicators for testing, the SOP, and treatment logs - see Appendices BE and BF);

B4.1.12(a)

Incubate biological indicators for units located on Main Campus, provide copy of the testing record to users, and maintain records of EHS-facilitated testing (off-campus units will be provided biological indicators and provide EHS with a copy of the testing results); and

B4.1.13

Recommend Occupational Health Program enrollment for biological work as appropriate.

B4.2

With regard to biosafety, [Principal Investigators \(PI\)](#) shall:

B4.2.1

Assess the risks of their experiments and consult with EHS as needed;

B4.2.2

Ensure the safe and secure operation of their laboratory;

B4.2.3

Coordinate the annual service and certification of biosafety cabinets (BSCs);

B4.2.4

Provide documented in-lab training and assess worker proficiency in regard to safe work practices 1) before work begins, 2) when procedures change or new procedures/equipment are introduced, and 3) refresh such training & evaluation annually thereafter;

B4.2.5

Complete the applicable EHS safety training(s) at the required frequency and ensure all laboratory personnel complete and renew their safety training(s);

B4.2.6

Properly manage (segregate, contain, and dispose) generated biological wastes;

B4.2.7

Comply with the LSM and all applicable TTU OPs related to safety and health;

B4.2.8

Comply with all applicable University, local, state, and federal regulations and guidelines;

B4.2.9

Register experiments with the IBC (and other applicable committee(s) as required), when work involves:

1. Recombinant and/or synthetic nucleic acid (rNA/sNA) activities;
2. Materials or agents *potentially* infectious to humans, plants, and/or animals – including the storage or concentration of any potentially biohazardous materials;
3. Except for general surveillance, arthropods that serve as vectors of disease to humans, plants, or other animals, and arthropods that are considered an environmental hazard;
4. Use of soil seed, plants, plant pathogens (e.g., bacteria, viruses, fungi, or parasites) or other material received under a USDA APHIS compliance agreement or permit;
5. Use of potentially infectious human and/or non-human primate materials;
6. Use of cell lines that pose a danger to humans, animals, and/or plants, and/or those immortalized by means that render them dangerous to humans, animals, and/or plants;
7. The use of biologically derived toxins;
8. Work involving prions or prion-like proteins;
9. Any Select Agent or Toxin as listed in 7 CFR 331, 9 CFR 121, and/or 42 CFR 73.
10. Necropsy of animals not under the care of the University Veterinarian; necropsy that includes hands-on student involvement; and necropsy of animals with unknown health status and/or animals reasonably suspected or known to be infectious;
11. Other work as deemed necessary for review by the Biological Safety Officer; and/or
12. Work with other potentially biohazardous materials conducted at, or sponsored by the University for compliance with the guidelines in the CDC/NIH Biosafety in Microbiological and Biomedical Laboratories (BMBL) and approve those research projects that meet or exceed the requirements in the BMBL.

B4.2.10

Adhere to the conditions stipulated on approved IBC protocols;

B4.2.11

Report changes to personnel, facilities, materials, and/or methods on an existing IBC protocol through the amendment process and receive IBC approval before work begins in the laboratory.

B4.2.12

Write and implement a laboratory-specific biosafety manual (bioWASP) which covers, at-minimum, all topics listed in section [B9.1.3.1\(e\)](#) of this manual. This manual is available and accessible in hard copy in the lab, and biennially reviewed at minimum and updated as necessary;

B4.2.13

Notify EHS of all shipments of biological materials, including plasmids and nucleic acids, by submitting a materials shipping form and a copy of all shipping documents to EHS before the shipment departs; and

B4.2.14

Notify custodial services if their laboratory is a BSL2/PCL2/ACL2 space; custodial services is aware of such areas if a red dot is placed outside the door.

B4.2.15

Follow IBC-approved SOPs within the B-section of the Laboratory Safety Manual Appendices as written or submit deviations and justification to the IBC for approval.

B4.3

The Institutional Biosafety Committee (IBC) shall:

B4.3.1

Produce and update the Texas Tech University Biosafety Manual and oversee its implementation in the research laboratories and applicable work areas of Texas Tech University;

B4.3.2

Develop policies and procedures relating to potentially biohazardous materials, and implement biological safety programs for Texas Tech University;

B4.3.3

Review and recommend to EHS the need for general and specific training programs for university activities involving materials potentially biohazardous to humans, plants, and animals, and to review the appropriateness and effectiveness of such training programs;

B4.3.4

Determine the risk group and containment level for biological materials;

B4.3.5

Ensure recombinant/synthetic nucleic acid research conducted at or sponsored by the University is compliant with the NIH Guidelines, assess the safety of recombinant/synthetic nucleic acid research experiments and any potential risk to laboratory personnel, public health or the

environment, and approve those research projects that are found to meet or exceed requirements of the NIH Guidelines;

B4.3.6

Review all research and teaching activities involving the materials outlined in [B4.2.9](#).

B4.3.7

Approve PIs, and their work with materials outlined in B4.3.6 and notify the PI of the results of the IBC's review;

OB4.3.8

Report any significant problems with or violations of the NIH Guidelines and any significant research-related accidents or illness to the appropriate institutional official(s) and to the NIH Office of Science Policy (NIH-OSP) as required by the NIH guidelines (immediately and with a formal report within 30 days); and

B4.3.9

Follow the guidelines for membership defined by the NIH Guidelines, with adjustments as needed to properly conduct review of research at Texas Tech University.

B5 BIOCONTAINMENT

Four basic levels of biocontainment, or biosafety levels (BSLs), are defined in both the BMBL (pg.27) and the NIH Guidelines (Section II-B, referred to as BLs). Only BSLs pertinent to University research are discussed below. The levels build upon each other in ascending order by degree of protection provided to personnel, the environment, and the community such that the requirements for BSL2 are those for BSL1 with additional, defined protection measures. Each level consists of combinations of laboratory practices, safety equipment, and laboratory facilities which provide [containment](#) to allow manipulation of biological agents of increasing danger to life, health, and/or the environment. As the science and discipline of biosafety has evolved biocontainment designations for animal (ABSL), plant (PCL), and arthropod (ACL) have been better defined.

B5.1

General Biosafety Levels

BSL1 – BSL1 laboratory facilities and practices are suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans. Standard microbiological practices without the need for special primary or secondary barriers, other than basic PPE (see LSM A4.3) and a sink for hand washing.

BSL2 – BSL2 laboratory facilities and practices are suitable for work involving agents that pose a moderate hazard to personnel and/or the environment. Treatment for disease is generally available; however, illness is sometimes fatal. Specific training is required; restricted access is required while work is being conducted. The use of a biosafety cabinet may be required for certain procedures and/or agents.

BSL2 Enhanced – BSL2 facility that has upgraded administrative controls and PPE. Agents are still risk group 2 but the methods require additional precautions. Risks and the additional controls to mitigate these risks are discussed in detail in the lab-specific safety manual and the IBC

protocol. Laboratories with this designation will be provided with signage for both BSL2 and BSL2 Enhanced designations so that signage accurately reflects the work being conducted in the designated space. This is not an officially recognized BSL; however, the TTU IBC sees value in labeling areas of elevated risk at our institution.

BSL3 – BSL3 laboratory facilities and practices are suitable for work with indigenous or exotic agents that may cause serious or potentially lethal disease typically through the inhalation route of exposure. Treatment for exposure or vaccines may be available. Specific training, additional PPE, BSC use, and special engineering and design features are required.

Most microbiological work at Texas Tech University is conducted using BSL1 or BSL2 containment. The University does have active BSL3 research spaces. Inspection and certification of a facility as BSL3 is conducted by the CDC in addition to EHS. Program details regarding BSL3 practices and procedures are not a part of this manual as a biosecurity measure.

TABLE 1. SUMMARY OF RECOMMENDED BIOSAFETY LEVELS

	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
BSL1	<ul style="list-style-type: none"> • Not known to consistently cause disease in non-immunocompromised adults; minimal hazard to personnel & environment 	<ul style="list-style-type: none"> • Standard Microbiological Practices • Biohazard warning signs as appropriate 	<ul style="list-style-type: none"> • No additional safety equipment required. • PPE: protective clothing and eye/face protection; gloves. • Long hair secured. 	<ul style="list-style-type: none"> • Sink • Door • Eye wash • Windows are sealed or fitted with screens • Impervious surfaces • Adequate lighting
BSL2	<ul style="list-style-type: none"> • Associated with human disease; moderate hazard to personnel & environment • Primary routes of exposure routes are percutaneous injury, ingestion, mucous membranes • Human materials, clinical samples, and unknowns 	<p>BSL-1 practice plus:</p> <ul style="list-style-type: none"> • Limited access • Fever monitoring or other medical surveillance as determined by risk assessment. • Equipment and lab are regularly decontaminated. 	<ul style="list-style-type: none"> • BSC and other physical containment devices used for manipulations of agents when splashes or aerosols may be generated • PPE: Barrier lab coats are preferred. Additional PPE as dictated by risk assessment (i.e. double gloves, respirators, etc.). 	<p>BSL-1 plus:</p> <ul style="list-style-type: none"> • Autoclave available • Self-closing doors • Vacuum lines are protected by both liquid disinfectant traps and in-line HEPA filters or their equivalent • Sink preferred at exit • Sealed windows are preferred
BSL3	<ul style="list-style-type: none"> • Agent may have serious or lethal consequences • Primary route of exposure is inhalation • Materials likely to contain such agents (indigenous or exotic). 	<p>BSL-2 practice plus:</p> <ul style="list-style-type: none"> • Controlled access • Decontamination of all waste • Decontamination of lab clothing before laundering • Medical surveillance required • All agents are transported as Category A 	<ul style="list-style-type: none"> • BSC or other physical containment devices used for all open manipulations of agents • PPE: protective lab clothing; double gloves; eye/face protection; respiratory protection as needed 	<p>BSL-2 plus:</p> <ul style="list-style-type: none"> • Physical separation from access corridors • Double-door access • Exhausted air not recirculated • Negative airflow into laboratory • Hands-free sink at exit and each zone • Sealed penetrations • Designed for complete decontamination • Negative airflow with visual monitoring

B5.2

Animal Biocontainment

Four biosafety levels are also described in the BMBL and NIH Guidelines for activities involving infectious disease work with vertebrates - Animal Biosafety Levels 1, 2, 3, and 4, (ABSL1, ABSL2, ABSL3, ABSL4). As with general biosafety and containment, they provide increasing levels of protection to personnel and the environment. Only ABSL1 and ABSL2 are described below. In addition to ABSL levels described by the BMBL, the United States Department of Agriculture (USDA) has developed facility parameters and work practices for handling agricultural pathogens, ABSL-2Ag through ABSL-4Ag. See Appendix D of the BMBL for additional information.

Animal work can present unique hazards not found in standard biological laboratories. The co-application of BSL and ABSL are determined by a protocol-specific risk assessment.

Work involving animals in conjunction with potentially infectious materials or work involving animal pathogens must be approved by both IACUC and the IBC; IBC approval should be sought first as it is likely required for IACUC approval.

Please see the [IACUC website](#) for additional details and IACUC protocol submission forms. The [checklists for the CDC import permit program](#) are helpful tools in assessing animal containment.

Harmonized checklists from the BMBL are in sections [B9.2.3.1](#) and [B9.2.3.2](#).

B5.3

Arthropod Biocontainment

Resources used as guidance for arthropod biosafety, biosecurity, and biocontainment:

[Arthropod Containment Guidelines](#) (currently version 3.2) as published by the American Committee of Medical Entomology and the American Society of Tropical Medicine and Hygiene.

USDA-PHIS Containment Guidelines for [nonindigenous phytophagous arthropods and their parasitoids and predators](#).

[CDC Import Permit checklists for arthropod containment](#).

These resources have been used to develop harmonized checklists for research involving housing arthropods. Checklists for ACL1 and ACL2 are in sections [B9.2.3.3](#) and [B9.2.3.4](#), respectively.

B5.4

Plant Biocontainment

Resources used as guidance for plant biosafety, biosecurity and biocontainment:

[A Practical Guide to Containment: Plant Biosafety in Research Greenhouses](#)

USDA-APHIS Containment Guidelines for the following: 1) [Plant Pathogenic Bacteria](#), 2) [Fungal Plant Pathogens](#), 3) [Viral Plant Pathogens and their Vectors](#), 4) [Pathogenic Nematodes](#), and 5) [Noxious Weeds and Parasitic Seed Plants](#).

These resources in addition to the NIH Guidelines have been used to develop harmonized checklists for research involving plants. Checklists for PCL1 and PCL2 are in sections [B9.2.3.5](#) and [B9.2.3.6](#).

B6 CLASSIFICATION OF BIOLOGICAL MATERIALS

B6.1

Introduction

The NIH and the CDC publish containment measures for work with infectious microorganisms. These different categories of biological containment are addressed in Section B5 above.

Classification of an organism into a risk group involves evaluation of multiple factors. Information for certain agents can be found in Appendix B of the NIH guidelines and in the Agent Summary

Statements in the BMBL. The categorization of biological agents into risk groups (RGs) is done according to the hazard they pose to personnel and the environment.

As indicated in B4.3.4, the IBC determines the containment level and classification of agents at TTU. “No one should conclude that the absence of an agent summary statement for a human pathogen means that the agent is safe to handle at BSL-1 or without a risk assessment to determine the appropriate level of containment.” (BMBL 6th ed. pg 5)

B6.2

Risk Groups

A **risk group** (RG) is a category that applies to a biological agent, material, or substance. Risk groups are considered when determining at which BSL work should be conducted during a risk assessment. A biological **risk assessment** must be completed before any work with a biological material begins. The RG of an agent does not always indicate the BSL at which that agent is to be handled, because what is being done with the agent may modify the BSL necessary for safe handling of the material. New or emerging pathogens may not be classified, and classified agents may develop the ability to become more pathogenic and warrant greater caution or an elevation in RG. Performing frequent risk assessments addresses these situations.

Risk groups are based on the current state of knowledge and vary with geographic region such that indigenous agents are often handled at a lower level regionally than exotic agents. The following factors are generally considered when determining the RG of an agent:

- Pathogenicity
- Mode of transmission
- Host range
- Indigenous or exotic
- Risk to personnel & environment
- Availability of effective vaccines and treatment

Both the WHO and the NIH guidelines have outlined criteria for risk groups. They are similar, but not the same. The NIH guidelines are the authoritative document in the United States and define risk groups based on the following general descriptions:

RG 1 – This RG includes agents that are not associated with disease in healthy adult humans and present minimal risk to personnel & the environment. Please see section B9.1 for further discussion regarding host susceptibility considerations. Examples include E. coli K-12 and B. subtilis.

RG 2 – This RG includes agents that are associated with human disease which is rarely serious and for which preventative or therapeutic interventions are often available; materials present moderate risk to personnel & the environment, or the hazards are unknown.

RG 3 – This RG includes agents that are associated with serious or lethal human disease for which preventative or therapeutic interventions may be available. These agents present high individual risk but lower community risk and may be indigenous or exotic. The risk to the environment varies with the agent.

RG4 – This RG is not applicable to work performed at Texas Tech University. It includes agents that are likely to cause serious or lethal human disease for which preventative or therapeutic interventions are not usually available. Agents in this category present high risk to the individual, community, and environment.

The American Biological Safety Association has assimilated a risk group database: <https://my.absa.org/tiki-index.php?page=Riskgroups>. This tool pulls information from a variety of sources about an agent's risk group; however, it does not contain information regarding biological toxins.

Vendor designations can serve as a guideline; however, these designations are primarily for shipping purposes. Vendors do not govern or regulate biosafety at Texas Tech University.

B6.2.1

Methods used in conjunction with the concentration, volume, and other characteristics of a biological material may increase the BSL at which a material needs to be handled.

B6.2.2

Initial processing of environmental or “unknown” samples, specimens, and/or identification of isolates shall be done at BSL2 containment unless additional information suggests the presence of an agent of higher risk (thus requiring BSL3 containment) or permission for use of BSL1 containment procedures and practices has been granted by the IBC.

Selected groups of biological materials are discussed below for additional clarification.

B6.3

Genetically Engineered/Modified Organisms (GMOs/GMMOs)

All work with [genetically engineered organisms](#) is to be done in compliance with the NIH Guidelines. These guidelines classify [recombinant/synthetic nucleic acid](#) experiments into four risk groups as discussed in the previous section. The USDA requires permits for field testing of genetically engineered plants. A summary (current as of April 2019) is below; please refer to the [NIH Office of Science Policy](#) (NIH-OSP) website for the most current guidelines. Certain experiments require approval by the NIH-OSP in addition to the TTU IBC.

B6.3.1

Experiments covered by the NIH Guidelines per Section III

All Experiments involving rDNA molecules require registration with the IBC regardless of NIH exemption per Section III-E or -F.

B6.3.1.1

Experiments that require NIH Director Approval and IBC approval before initiation (Section III-A) include those:

- (a) Experiments involving the deliberate transfer of a drug resistance trait to microorganisms that are not known to acquire the trait naturally, if such acquisition could compromise the ability to control disease agents in humans, veterinary medicine, or agriculture.

B6.3.1.2

Experiments That Require NIH OSP and Institutional Biosafety Committee Approval Before Initiation (Section III-B):

- (a) Experiments involving the cloning of toxin molecules with LD50 of less than 100 nanograms per kilogram body weight (e.g., microbial toxins such as the botulinum toxins, tetanus toxin, diphtheria toxin, and *Shigella dysenteriae* neurotoxin).

B6.3.1.3

Experiments Involving Human Gene Transfer that Require Institutional Biosafety Committee Approval Prior to Initiation (Section III-C):

- (a) Experiments involving the deliberate transfer of recombinant or synthetic nucleic acid molecules, or DNA or RNA derived from recombinant or synthetic nucleic acid molecules, into one or more human research participants.

B6.3.1.4

Experiments that Require Institutional Biosafety Committee Approval Before Initiation (Section III-D):

- (a) Experiments that use Risk Group 2, 3, 4, or restricted agents as host-vector systems;
- (b) Experiments in which DNA from risk group 2, 3, 4, or restricted agents is cloned into nonpathogenic, prokaryotic, or lower eukaryotic host-vector systems;
- (c) Experiments that involve the use of infectious DNA/RNA virus, or defective DNA/RNA virus in the presence of helper virus in tissue culture systems;
- (d) Experiments that involve whole plants or animals;
- (e) Experiments that involve more than 10 liters of culture; and/or
- (f) Experiments that involve influenza viruses.

B6.3.1.5

Experiments that must be registered at the time of initiation include those (Section III-E):

- (a) Involving the formation of recombinant or synthetic nucleic acid molecules containing no more than 2/3 of the genome of any eukaryotic virus;
- (b) Involving nucleic acid molecule-modified whole plants, and/or experiments involving recombinant or synthetic nucleic acid molecule-modified organisms associated with whole plants, except those that fall under Section III-A, III-B, III-D, or III-F of the Guidelines.
- (c) Biosafety level 1 experiments involving the generation of transgenic rodents in which the animal's genome has been altered by stable introduction of recombinant or synthetic nucleic acid molecules, or nucleic acids derived therefrom, into the germline.

B6.3.1.6

Experiments exempt from the NIH Guidelines that require registration with the IBC but may be initiated immediately (Section III-F):

- (a) Those synthetic nucleic acids that: (1) can neither replicate nor generate nucleic acids that can replicate in any living cell, and (2) are not designed to integrate into DNA, and (3) do

not produce a toxin that is lethal for vertebrates at an LD50 of less than 100 nanograms per kilogram of body weight.

- (b) Recombinant or synthetic nucleic acid molecules that are not in organisms, cells or viruses and that have not been modified/manipulated to render them capable of penetrating cellular membranes.
- (c) Recombinant or synthetic nucleic acid molecules that consist solely of the exact recombinant or synthetic nucleic acid sequence from a single source that exists contemporaneously in nature.
- (d) Those that consist entirely of nucleic acids from a prokaryotic host including its indigenous plasmids or viruses when propagated only in that host (or a closely related strain of the same species), or when transferred to another host by well-established physiological means.
- (e) Those that consist entirely of nucleic acids from an eukaryotic host including its chloroplasts, mitochondria, or plasmids (but excluding viruses) when propagated only in that host (or a closely related strain of the same species).
- (f) Those that consist entirely of DNA segments from different species that exchange DNA by known physiological processes, though one or more of the segments may be a synthetic equivalent. See NIH Guidelines, Appendices A-I through A-VI, for a list of natural exchangers that are exempt from the NIH Guidelines.
- (g) Those genomic DNA molecules that have acquired a transposable element, provided the transposable element does not contain any recombinant and/or synthetic DNA.
- (h) Those that do not present a significant risk to health or the environment as determined by the NIH Director following appropriate notice and opportunity for public comment.
 - i. Recombinant or synthetic nucleic acid molecules containing less than one-half of any eukaryotic viral genome (all viruses from a single family being considered identical), that are propagated and maintained in cell in tissue culture unless they are subject to the guidelines in Section III-B, -C, or -D.
 - ii. Use the following host-vector systems:
 - *E. coli* K12 (with the exception of those experiments listed in Appendix C-II-A of the NIH Guidelines);
 - *Saccharomyces cerevisiae* and *Saccharomyces uvarum* (with the exception of experiments listed in Appendix C-III-A of the NIH Guidelines);
 - any asporogenic *Bacillus subtilis* and *Bacillus licheniformis* (which does not revert to a spore-former with a frequency greater than 10^{-7} may be used for cloning DNA (with the exception of those experiments listed in Appendix C-V-A of the NIH Guidelines); and
 - *Kluyveromyces lactis*, provided laboratory-adapted strains are used, (with the exception of experiments listed in Appendix C-IV-A of the NIH Guidelines),
- (i) Recombinant or synthetic nucleic acid molecules derived entirely from extrachromosomal elements of the organisms listed in Appendix C-VI of the NIH Guidelines (including shuttle vectors constructed from vectors described in Appendix C), propagated and maintained in organisms listed Appendix C-VI of the NIH Guidelines (with the exception of experiments listed in Appendix C-VI-A of the NIH Guidelines).

- (j) Involve purchase or transfer of transgenic rodents for experiments at BSL1 according to Appendix G-III-M of the NIH Guidelines.
- (k) The generation of certain BSL1 transgenic rodents via breeding per Appendix C-VIII of the NIH Guidelines.

B6.3.1.6(l)

While considered “exempt,” the BMBL guidelines still apply to the above-listed experiments. The Biosafety Officer (BSO) a proxy, and/or IBC Chair will review the application form and confirm that the work is classified correctly according to the NIH Guidelines.

B6.4

Human and Non-Human Primate Materials

B6.4.1

Regulations

Work with human material is regulated by the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard, [29 CFR, Part 1910.1030](#). The University uses this standard in conjunction with the BMBL and [TTU OP 60.24](#) to provide a safe working environment for TTU personnel.

Research involving the collection of samples from human subjects likely requires both IBC and IRB approval.

B6.4.2

Training Requirements, Medical Surveillance, and IBC Review

B6.4.2.1

Biosafety and Bloodborne Pathogen training are required for faculty who oversee and personnel who work in environments where human and or non-human primate material is handled.

B6.4.2.2

Individuals who may contact human or non-human primate materials must be enrolled in the OHP and offered the Hepatitis B vaccine series. This serves as the documented offering of the vaccine; the OHP will handle any necessary medical surveillance. The extent of in-laboratory medical surveillance should be discussed between the PI & EHS. Consult EHS if you have questions regarding vaccination or medical surveillance. These measures will be documented on the IBC protocol.

B6.4.2.3

Work with human and/or non-human primate materials requires a certified BSL2 laboratory space and IBC protocol review. In accordance with the BMBL, all human and /or non-human primate material should be presumed infectious and handled using BSL2 work practices and containment; this concept is called “Universal Precautions”.

B6.4.2.4

The use of 10-20% household bleach or a hospital-grade disinfectant, registered with the EPA for effectivity against, common bloodborne pathogens (HIV, HEP-B, HEP-C, and Mycobacterium tuberculosis), is required for areas where human/non-human primate materials are handled.

B6.4.3

Human and non-human primate material includes the following:

1. All fluids and excretions (blood, blood components, urine, saliva, semen, vaginal secretions, cerebrospinal fluid, excrement, synovial fluid, sweat, etc.),
2. Unfixed tissues,
3. Fixed or unfixed brain tissue,
4. Cells (including established cell lines for cell culture), and
5. Any other material of human or non-human primate origin (apart from hair and nails).

Please contact EHS at 806-742-3876 if you have questions regarding a specific material or project.

B6.5

Biologically Derived Toxins

The BMBL requires that all biologically derived toxins be handled at BSL2 or greater containment. Powdered forms of toxins should be replaced with toxins in suspension when possible and always handled within containment (BSC or fume hood) using appropriate PPE to address the toxin. Specific handling, decontamination, and waste procedures will be specified for the toxins used in the IBC protocol.

B6.5.1

BSL2 is the minimum-required biosafety level for research involving biologically derived toxins. Depending on the toxin and quantity, BSL3 containment may be required.

B6.5.2

In all cases of biologically derived toxin-related research, and IBC protocol is required.

B6.6

Prions and Prion-like Proteins

Prions and prion-like proteins are resistant to inactivation by heat and chemicals. Prions are efficiently transmitted within species but can cross species barriers with reduced efficiency. Presently, scrapie and chronic wasting disease are not known to infect humans. Prions are transmissible by inoculation, ingestion, or transplantation of infected tissues or homogenates. Prion infectivity is high in the brain and other central nervous system tissues and lower in lymphoid tissues including the spleen, lymph node, gut, bone marrow, blood, and some special tissues (placenta); at this time, aerosols do not appear to be a *natural* route of transmission but cannot be excluded in a lab setting.

B6.6.1

BSL2 is the minimum-required biosafety level for research involving prions or prion-like proteins. Depending on the nature of the research, BSL3 containment may be required.

B6.6.2

In all cases of prion-related research, including sample screening, an IBC protocol is required.

B6.6.2.1

Principal investigators may request a waiver from the IBC protocol requirement for sample screening purposes. Contact the IBC at ibc.ehs@ttu.edu regarding a waiver.

B6.7

Respiratory Viruses

Work with agents transmitted through respiratory exposure is a serious laboratory hazard. When work involves the use of animals, the hazardous characteristics of zoonotic agents require careful consideration when completing the biological risk assessment. (BMBL Section II – Biological Risk Assessment, pg 13)

Specific considerations for Influenza Viruses

New subtypes can result from reassortment of human, swine, and avian influenza A virus genes. Influenza A viruses of different antigenic subtypes occur naturally in many domestic and wild avian species and have formed sustained lineages in swine, equine, and canine species. Avian origin influenza A viruses also sporadically infect multiple other mammalian species. Interspecies transmission and reassortment of influenza A viruses have been reported to occur among humans, pigs, and wild and domestic fowl. The influenza A viruses responsible for the 1918, 1957, 1968, and 2009 pandemics contained gene segments closely related to those of avian or swine influenza A viruses.

When considering the biocontainment level and practices and procedures for work with influenza recombinant or reassortant viruses, the IBC, will consider but not limit consideration to the following when conducting the protocol-driven risk assessment:

- The gene constellation used;
- Any mutations that are introduced and may result in enhancement of a pathogen's transmissibility and/or virulence;
- Clear evidence of reduced virus replication in the respiratory tract of appropriate animal models, compared with the level of replication of the wild-type parent virus from which it was derived;
- Evidence of clonal purity and phenotypic stability; and
- The number of years since a virus that was antigenically related to the donor of the hemagglutinin and neuraminidase genes last circulated.

If adequate risk assessment data are not available, a more cautious approach to containment, utilizing elevated Biosafety Levels and practices, is warranted.

(BMBL Section VIII-E: Viral Agents, pg 259-263)

Sample screening is subject to B6.2.2 which states, “Initial processing of environmental or “unknown” samples, specimens, and/or identification of isolates shall be done at BSL2 containment unless additional information suggests the presence of an agent of higher risk (thus requiring BSL3 containment) or permission for use of BSL1 containment procedures and practices has been granted by the IBC.

B6.7.1

Propagation of risk group 2 respiratory viruses of human origin or influenza viruses of any origin requires, at minimum, the use of the BSL2-enhanced designation which includes the following protective equipment measures:

1. Inclusion in the EHS Occupational Health Program and laboratory surveillance policies such as fever/symptom watch, and receipt of the seasonal influenza shot.
2. Inclusion in the EHS-OHP respiratory protection program and use of respiratory protection (N-95 or equivalent),
3. Use of either a disposable, barrier-style lab coat or a reusable, barrier-style lab coat that is exclusive to use during respiratory viral work, and
4. Double gloving, including the taping of the inner glove over the cuff of the barrier coat so that the outer glove can easily be changed as needed.

B6.7.3

Work stipulations for non-influenza respiratory viruses of non-human origin will be dictated through biological risk assessment during the IBC review process.

B7 EMERGENCY PROCEDURES

B7.1

Biological Spills

B7.1.1

Spills involving biohazards require immediate and proper response.

A spill of biological materials outside of a BSC is a breach of containment that can result in exposure to personnel directly involved and to others in the lab. The nature of the material, as well as the quantity and location of the spill will affect spill response. Most spills can be managed by laboratory personnel; however, certain situations may require verbal or physical assistance from EHS.

A quick assessment of the spill using these parameters will help determine if and to what degree EHS assistance is needed.

1. Nature of the Biohazard
 - Risk Group
 - Composition (liquid, solid, sample, etc.)
 - Risk of aerosolization
 - Genetic modification
2. Quantity
 - Spill volume
 - Concentration of biohazard (raw sample vs cultured material)

3. Location

- Contained (in a BSC or closed safety cup) vs uncontained
- Equipment considerations
- Lab vs field

B7.1.2

ANY spill of genetically modified and/or RG2 material MUST be immediately reported to EHS.

B7.1.3

Biological Spill Kit

The kit for chemical spills, supplied by EHS, does not meet the requirements for a biological spill kit.

A biological **spill kit** shall be kept in each laboratory where work with biological materials is conducted. The kit(s) are to be kept in an accessible location, preferably where spills are most likely to occur.

B7.1.3.1

It is the responsibility of the laboratory to gather and compile the supplies for the kit according to their individual needs.

If you have access to an autoclave, you should select a leakproof container which is autoclavable for broken glass and/or other materials so that it can be autoclaved immediately after collection.

B7.1.3.2

Basic equipment includes:

- Spill SOP and a Sign** to communicate there is a spill to others who may enter the work area;
- Sorbents** (i.e., large cloth towels, paper towels, pig pads, solidifying powder, consider dams if large volumes of materials are handled);
- PPE** (household rubber gloves, booties, disposable lab coat, etc.);
- Forceps and long tongs** (or other tools) to pick up and collect broken glass and indirectly handle sorbent materials. Wisk brooms should not be used unless a solidifier was used and are either disposed of as biowaste or are suitable for disinfection;
- Biohazard bags and zip ties**; and
- Quick mop**, such as a Swiffer®, to disinfect the outlying spill zone.

While not listed as an element for the kit, fresh disinfectant must always be available while work with potentially infectious material is being conducted in the laboratory.

B7.2

General Spill Cleanup Guidelines for Biological Spill Response

Each laboratory has a unique combination of hazards and thus requires customized laboratory procedures for controlling spills. The guidelines are to develop procedures for managing biological spills in the laboratory. Contact EHS if you are not comfortable addressing a spill.

1. Safety First.

- a. **Alert others working in the area.** This helps prevent spill spreading. Post a sign as appropriate.
- b. **Remove contaminated PPE and garments.** If your lab coat, gloves and/or clothing was contaminated in the spill promptly remove them (decontaminate gloves, removed coat, remove gloves) turning the exposed surface to the inside, place in a biohazard bag and thoroughly wash the affected area(s) with soap and water. Seek immediate medical attention if needed and notify the PI of the incident. Do not launder lab coats or contaminated clothing at home or public facilities. Autoclave or soak coats/clothes in disinfectant solution to decontaminate before laundering. Use a qualified laundry service to launder lab garments. If you wish to autoclave and do not have access to one, contact EHS.

2. Assess and address the spill.

- a. **Identify the spill zone** (3-5ft outward from the smallest visible droplet). Evacuate the immediate area if appropriate, call EHS if needed.
- b. **Don clean PPE** before addressing the spill. Regularly assess PPE during spill cleanup and replace as needed (especially gloves and booties). Wear at least gloves, safety glasses and a lab coat. Booties are highly recommended to prevent contamination to footwear and contain contamination.
- c. **Work from the spill from the outside of the spill inward.** Cover spilled material with towels / paper towels / pig pads. Such materials may be soaked in disinfectant prior to application, or the disinfectant may be poured over the spill after covering the spill. Do not neglect furniture, equipment, and vertical surfaces (cabinets, walls, doors). If biological fluid solidifiers such as BioSorb or SaniSorb are used, follow the manufacturer's instructions.

3. Treat and complete.

- a. **Allow appropriate contact time for disinfectant.** Don fresh PPE as needed.
- b. **Collect absorbent materials;** this waste may be disposed of as municipal waste or as biowaste waste per the lab-specific SOP. Autoclaving spill materials may be contraindicated based on chemical disinfectant used. Contact EHS with questions.
- c. **Use a mop to disinfect spill area again** with prepared disinfectant and allow adequate contact time. Do not neglect vertical surfaces. A quick mop, such as a Swiffer®, makes this easy.

4. Sanitize and SCAN.

- a. **Wash hands with soap and water** when finished. Don clean PPE before continuing work.
- b. **Report the Spill.** Submit a SCAN report using the Quick Link on the EHS website: <http://www.depts.ttu.edu/ehs/about/scan.php> If the spill resulted in an personnel exposure, and incident report should be filed.

B7.2.1

Spill Involving Broken Glass

Do not enter the spill zone to remove glass prior to addressing the spill. Always handle spill materials involving glass indirectly using forceps, tongs or another device. Place glass in a sharps container or other rigid, leakproof container.

It is preferable that contaminated broken glass be disposed of into a sharps container to prevent unnecessary handling of the contaminated glass.

If disinfected, you may transfer glass to broken glass box – again, do not handle glass with your hands. See section B8.11.2 for specific glass disposal details.

Notify the PI and submit a SCAN report regarding the incident:

<http://www.depts.ttu.edu/ehs/about/scan.php>

B7.2.2

Spill of Human Fluids

Follow the guidelines in B7.2 above to address the spill. If bleach is used, avoid autoclaving clean up materials; deadly chlorine gas can be produced and the bleach will corrode the inside of the unit.

Notify the PI and submit a SCAN report regarding the incident:

<http://www.depts.ttu.edu/ehs/about/scan.php>

If the spill resulted in direct exposure of personnel to human materials, try to collect a sample of the material in the event testing is requested by the physician. An incident report needs to be filed with Risk Management. Access to the online form for Risk Management is available on the EHS website at: <http://www.depts.ttu.edu/ehs/about/incident-reporting.php>. Call EHS so that exposed individuals can be evaluated by a physician and prophylaxis can begin immediately

B7.2.3

Spill of a BSL3 material

Follow the protocol in the laboratory-specific safety manual for the materials involved in the spill.

B7.2.4

Spill in a Biosafety Cabinet

- 1. Leave the cabinet turned on** and sash at the working height during clean up.
- 2. Alert others of the spill. If the spill entered the grills of the BSC, contact EHS.**
- 3. Sanitize gloves or remove outer gloves** before exiting the BSC. Remove any contaminated PPE and wash effected areas with soap and water before proceeding.
- 4. Don clean PPE.** Remove any glass as described in B7.2.1. For small spills start at number '5' in section B7.2 above and proceed accordingly. The pour-over method is easier within the BSC. Disinfect the surfaces of materials and equipment within the BSC.
- 5. Repeat disinfection of the spill area again.**

6. **Discard all clean-up materials** into the biohazard waste container within the BSC. Decontaminate and removed outer glove. Wash hands and exposed skin areas with soap and water.
7. **Report the spill to EHS.**
8. **Don fresh PPE before resuming work.**

B7.2.5

Spills in a Centrifuge

1. Alert others to not disturb the unit. Close centrifuge lid and let sit for 20 minutes to allow aerosols within the centrifuge to settle.
2. While you are waiting, disinfect the exterior of the centrifuge by saturating with disinfectant soaked paper towels and allowing appropriate contact time. Follow with water or 70% ethanol/isopropanol.
3. Open the centrifuge. At this point, you can disconnect power or turn off the unit during cleaning if you wish.
4. If you are using safety cups or a sealed rotor, move the rotor to the biosafety cabinet to disinfect. If not, remove rotor and set aside in a leakproof tub for disinfection.
5. Carefully remove any pieces of debris from the centrifuge interior using forceps and place in a biowaste bag or sharps container.
6. Submerge rotor in disinfectant or autoclave if possible; otherwise, cover spill with paper towels. Do not use a spray bottle as this can aerosolize contaminants. Pour disinfectant on towels and remaining interior of centrifuge using a laboratory soak bottle or pour disinfectant. Let disinfectant sit appropriate contact time per the manufacturer.
7. Follow with DI-water then 70% ethanol or isopropanol to remove disinfectant residue.
8. Submit a SCAN report: <http://www.depts.ttu.edu/ehs/about/scan.php>

B7.2.6

Spill of Biological Radioactive Material

Follow procedures in the laboratory-specific manual and Radiation Safety Manual. If you have questions, contact the Radiation Safety Officer at 806-742-3876.

DO NOT USE BLEACH SOLUTIONS ON IODINATED MATERIALS: RADIOIODINE GAS MAY BE RELEASED.

DO NOT AUTOCLAVE CONTAMINATED WASTE UNLESS APPROVED BY THE RADIATION SAFETY OFFICER.

Submit a SCAN report regarding the incident at the EHS website:
<http://www.depts.ttu.edu/ehs/about/scan.php>

B7.3

Illness or Injury Involving Biological Materials

B7.3.1

Severe Injuries

Call 911 for assistance and transportation to the nearest emergency room. Accompany the injured person to the medical facility and provide information to medical personnel about the accident/exposure. Report the accident to the PI and EHS.

An incident report will need to be filed immediately so that the individual is eligible for workers compensation. Access to the online form for Risk Management is available on the EHS website at: <http://www.depts.ttu.edu/ehs/about/incident-reporting.php>. Minor incidents not requiring medical attention should be reported to the PI and then to EHS by using the SCAN system at the following link: <http://www.depts.ttu.edu/ehs/about/scan.php>.

B7.3.2

Contamination to the Body

Immediately remove contaminated clothing and flush skin with water. Wash with soap (work into lather for 30 seconds) and water and flush the area for 5 minutes. Contact the most convenient local emergency room to obtain care if needed. Report the injury to the PI and to EHS and seek additional medical assistance if necessary.

An incident report will need to be filed immediately so that the individual is eligible for workers compensation. Access to the online form for Risk Management is available on the EHS website at: <http://www.depts.ttu.edu/ehs/about/incident-reporting.php>.

B7.3.3

Splash to the Eye

Use the emergency eyewash to immediately flush the eye with a gentle stream of clean, temperate water for 3-5 minutes. Hold the eyelid open. Be careful not to wash the contaminant into the other eye if it was unaffected by the incident. Contact the most convenient local emergency room to obtain care if needed. Report the accident to the PI and EHS and seek additional medical assistance if necessary. NOTE: If chemicals were involved, refer to SDS.

An incident report will need to be filed immediately so that the individual is eligible for workers compensation. Access to the online form for Risk Management is available on the EHS website at: <http://www.depts.ttu.edu/ehs/about/incident-reporting.php>.

B7.4

Fires

1. **Without placing yourself in danger, secure biological materials** by closing the BSC sash or placing them in a closed incubator, fridge, or freezer and proceed with the R-A-C-E process

Remove persons from the immediate area.

Alert others of the situation.

Contain fire and smoke (i.e., shut doors).

Evacuate or extinguish.

2. **You are not required to use a fire extinguisher. Only use an extinguisher if you:**
 - (a) Feel confident and not threatened,
 - (b) Are knowledgeable and TRAINED on how to properly operate a fire extinguisher, and
 - (c) Using the fire extinguisher does not put you in danger.
3. **Activate the building fire alarm and leave the building** at once according to building evacuation procedures.
4. **Meet the fire department outside** and tell them of the fire location and details of any materials potentially involved.
5. **Submit a SCAN or Incident Report** for any fire:
<http://www.depts.ttu.edu/ehs/about/scan.php>

B8 DECONTAMINATION AND DISPOSAL

B8.1

Factors Contributing to the Destruction/Inactivation of Biological Materials

B8.1.1

Biological factors

1. Microbial load (number and variety of organisms present)
2. Organism life cycle (spore former?)
3. Innate resistance to chemical agent or conditions
4. Presence of biofilms

B8.1.2

Physical and chemical factors

1. Temperature
2. pH
3. Presence of organic and/or inorganic matter.
 - Organic matter can create physical barriers reducing contact and bind antimicrobial agents decreasing overall concentration of the effective agent in a solution or cause proteins to agglutinate and protect infectious materials. Inorganic matter can create a physical barrier in the formation of salt crystals.
4. Disinfectant concentration and condition (i.e., expired, mixed with tap water, etc.)
5. Duration of exposure to disinfectant or sterilization process (i.e., contact time).

B8.1.3

Disinfectants must be appropriate for the agent(s) and work.

B8.1.4

Disinfectants must be prepared and used according to the manufacturer's instructions; prepared solutions are marked with the expiration date related to the shelf life of prepared disinfectant per the label.

B8.1.4.1

Bleach solutions are prepared on the day of use unless dictated otherwise in an IBC protocol.

B8.2

Properties of Chemical Disinfectants

There is no such thing as a perfect chemical disinfectant; there are pros and cons to each. Common disinfectant types are discussed below and in Appendix BB. Please note that this is not an exhaustive list of disinfectants.

B8.2.1

Iodophors

Use:

- Recommended dilution is 75-5,000 mg/L (ppm), or approximately 0.5% concentration
- Effective against vegetative bacteria, fungi, and viruses
- Generally safe for stainless steel items and centrifuges
- Some are antiseptics (e.g., betadyne, scrubodyne)
- Some are surface disinfectants (e.g., Wescodyne™ Steris Corporation)

B8.2.1.1

Pros:

- (a) Effectiveness reduced by organic matter (but not as much as with hypochlorites).
- (b) Stable in storage if kept cool and tightly covered. Built-in color indicator; if solution is brown to dark yellow, it is still active.
- (c) Generally non-staining
- (d) Active in hard water
- (e) Relatively harmless to humans
- (f) Not as corrosive as chlorine products; leaves a film of residue which allows for residual antimicrobial activity making it ideal for biosafety cabinets

B8.2.1.2

Cons:

- (a) Can stain and discolor equipment in some conditions
- (b) Can be corrosive to silver, copper, and aluminum but relatively harmless to stainless steel
- (c) Can foam
- (d) Cannot be used above 110°F (iodine vaporizes) and is not as effective in low temperature environments (cold rooms, refrigerators, etc.)
- (e) Cannot be used in conjunction with other products
- (f) Expensive

B8.2.2

Sodium Hypochlorite (household bleach)

Use:

- User dilution is 1:5 to 1:100 in water; 20% to 1% dilution. Contact time varies with agent to be neutralized and concentration of solution. Strips to test ppm free chlorine can be purchased.
- Only Clorox brand bleach has been approved by the EPA as a disinfectant; however, any brand of sodium hypochlorite will meet the requirements of Texas law.
- For chemical disinfection of biowaste a minimum of 1:10 dilution of bleach for no less than 3 minutes is required by Texas law.
- Effective against vegetative bacteria, fungi, most viruses at 1:100 dilution. Contact time varies with agent to be neutralized and concentration of solution.
- Minimum 1:10 dilution is required for BSL2 activities; 1:5 dilution is needed to inactivate Mycobacterium and should be used for human materials.
- Available free chlorine is maximized when the solution is pH 5-7.
- Store prepared solutions in brown plastic bottles to protect from light to extend shelf life of prepared solutions.

B8.2.2.1

Recipe for large quantity ~ 1 % solution with 800 ppm available chlorine:

- (a) 1:64 dilution of Clorox in water (2oz in 1 gallon of water)
- (b) 2oz of 5% distilled white vinegar (cooking vinegar)
- (c) Make daily! (Microbe 6:257, June 2006)

B8.2.2.2

Pros:

- (a) Broad spectrum effectiveness
- (b) Readily available and inexpensive
- (c) High concentrations can kill spores and remove biofilms

B8.2.2.3

Cons:

- (a) Contact times and concentration vary with application and agent
- (b) Very corrosive, especially to stainless steel
- (c) Must be prepared daily for guaranteed ppm of free chlorine
- (d) Rapidly inactivated by organic matter, light, and some metals
- (e) WARNING!!!! Bleach in combination with other cleaners can produce deadly, toxic compounds
 - i. Bleach + 4% phosphoric acid cleaner = chlorine gas
 - ii. Bleach + Ammonia containing cleaner = chloramine vapors and potentially hydrazine

B8.2.3

Alcohols (ethanol, isopropanol)

Use:

- The effective dilution for decontamination is 60-80%; 70% is ideal
- Effective against a broad spectrum of bacteria and many viruses
- Ethanol is preferred to isopropanol given it has a slightly more broad-spectrum kill. Ethanol inactivates all lipophilic viruses and many hydrophilic viruses. Isopropanol is not active against hydrophilic viruses but virucidal against lipophilic viruses.
- Alcohol waste from submersion must be disposed of as chemical waste
- Use the $C1 * V1 = C2 * V2$ formula to calculate the concentration you wish to make

B8.2.3.1

Pros:

- (a) Fast acting and quick drying
- (b) Leaves no residue
- (c) Relatively inexpensive
- (d) Broad spectrum effectiveness against bacteria and viruses
- (e) Maintains activity in presence of organic matter
- (f) Non-corrosive

B8.2.3.2

Cons:

- (a) Not effective against bacterial spores, *C. difficile*, and *Helicobacter*
- (b) Evaporate rapidly not allowing for extended contact time unless an item is immersed
- (c) FLAMMABLE; use only on small surface areas and in well-ventilated areas
- (d) Certain agents require a lengthy contact time (30 minutes or more)
- (e) Weakens acrylic, polypropylene, PVC and polycarbonate plastics and rubber overtime or with prolonged or repeated use
- (f) Coagulates proteins and can attach them to surfaces (i.e., cannot penetrate protein-rich materials (e.g., dried blood/plasma)
- (g) Can compromise latex and vinyl gloves with extended exposure (1 hour)
- (h) Dissolves adhesives in instruments (e.g., microscopes)
- (i) Easily passes through nitrile and can carry other chemicals with it.

B8.2.4

Quaternary ammonium salts/Amines (“Quats”)

B8.2.4.1

Use:

- Dilute according to manufacturer instructions
- Spectrum of effectiveness varies with manufacturer; generally effective against Gram positive bacteria, Gram negative bacteria and enveloped viruses

- Quats sold as hospital-grade disinfectants are generally bactericidal, fungicidal, and virucidal
- Examples include Lysol, BacDown
- 4th generation QUATs maintain effectiveness in the presence of organic material and hard water

B8.2.4.2

Pros:

- (a) Can be used to both clean and sanitize
- (b) Non-corrosive
- (c) Readily available, generally inexpensive
- (d) Low-level human toxicity
- (e) Excellent for walls, furniture, and floors

B8.2.4.3

Cons:

- (a) Non-sporicidal
- (b) Some not effective against non-enveloped viruses, spores or fungi
- (c) Hard water and organic matter can reduce effectiveness
- (d) Cellulose-containing materials can absorb active ingredients
- (e) Some people are prone to allergies and skin-reactivity
- (f) Does leave residue

B8.2.5

Phenolics

B8.2.5.1

Use:

- Dilute according to manufacturer instructions
- Effective against bacteria, fungi, and enveloped viruses
- May be a good choice for decontaminating centrifuges which spin blood products

B8.2.5.2

Pros:

- (a) Tuberculocidal
- (b) Maintain good activity in the presence of organic material and hard water
- (c) Residue has some residual activity after drying (follow with EtOH for sensitive applications)

B8.2.5.3

Cons:

- (a) Ineffective against non-enveloped viruses, spores and some Gram-negative bacteria
- (b) Toxic to infants and the environment
- (c) Prolonged exposure can cause allergies and skin irritation

B8.2.6

Hydrogen Peroxide (3-8%) or Vapor-phase Hydrogen Peroxide (VHP)

B8.2.6.1

Use:

- Surface sterilant
- Broad-spectrum effectiveness
- Requires specialized equipment (VHP)
- Aqueous H₂O₂ concentration 3-8% for spray application and >30% for vaporization
- Vaporization equipment should only be operated by trained personnel. All personnel with access to equipment or laboratory space should understand the hazards associated with VHP and signs of exposure. Following SOPs is critical.

B8.2.6.2

Pros:

- (a) Environmentally safe by-products (H₂O, O₂)
- (b) Rapid kill action
- (c) No disposal issues, odor or irritation when diluted (3-8%)
- (d) Readily available and inexpensive
- (e) Good compatibility with sensitive equipment, electronics and furnishings
- (f) VHP offers low temperature sterilization and is a safer alternative to formaldehyde or ethylene oxide gas
- (g) VHP is cost effective after initial setup

B8.2.6.3

Cons:

- (a) Little penetration
- (b) Concentrations >7.5% can cause discoloration of metal finishes
- (c) Compatibility concerns with brass, zinc, copper, and nickel/silver plating
- (d) Oxidizing capability is rapidly inactivated by organic material; cellulose cannot be processed
- (e) Nylon items can become brittle
- (f) Vapors have no color and are odorless; inadvertent exposure can cause serious health effects
- (g) VHP is expensive to implement

B8.3

Management of Biologically Contaminated Materials and Biowaste

The treatment and disposal of biological waste (i.e., biowaste) is regulated by TCEQ.

B8.3.1

Work areas which generate biological waste must segregate biological waste from other hazardous wastes and general, non-hazardous (municipal) wastes for treatment.

B8.3.1.1

Biologically contaminated materials and biowastes are not transported in public areas without secondary containment (see B8.6.3.1) or left uncontained or unattended prior to initiation of disinfection.

B8.3.2

Collection and/or Disposal Containers

Each PI which produces biowaste is responsible for purchasing appropriate containers in an adequate number and biohazard bags for the collection, containment, and disposal of biological wastes generated.

B8.3.2.1

The number of containers should be such that a container is easily accessible from the immediate workstation so that containers are not moved about the space to accommodate waste.

B8.3.2.1(a)

Sharps Containers

Use FDA-approved sharps containers to dispose of sharps & contaminated glass in biological laboratories. They are available in various sizes and have the following features:

- i. Puncture-resistant rigid plastic
- ii. Red
- iii. Labeled as containing a "Biohazard" and "Sharps"
- iv. Lid design traps items so they cannot be retrieved, is puncture/leak resistant and locks tightly
- v. Have a line that indicates when the container is full.

These containers may be purchased from local sources, including the Physical Plant Central Warehouse, Chemistry Stockroom, and medical supply stores, as well as from laboratory product distributors.

B8.3.2.1(b)

***Do not purchase or use "needle-cutter" devices;* use of such devices can generate aerosols and leaves sharp barbs.**

B8.3.2.2

Biohazard / Autoclave Bags and Holders

Autoclave bags (commonly referred to as "biobags or biohazard bags") can be purchased from laboratory product distributors in a variety of sizes and thicknesses. These bags are tear resistant

but can be punctured; they may also burst in the autoclave when sealed because they are impermeable to steam.

B8.3.2.2(a)

Biobags must be made of polypropylene.

B8.3.2.2(b)

Biobags must have a biohazard symbol; the bag can be purchased in red, orange, and clear.

Avoid yellow biohazard bags; yellow is associated with other types of hazardous waste on campus.

B8.3.2.3

Except for bench-top pipette tip collection bags, biobags must be placed inside a rigid container with closable lid (latching or step can style) labeled with the biohazard symbol while waste is being collected.

B8.3.2.3(a)

If a normal trash bin is used to hold a biohazard bag, the trash bin must: 1) Be labeled with a biohazard symbol, 2) Never used for non-biohazardous waste, 3) and have inner and outer surfaces that are able to be disinfected.

B8.3.2.4

Benchtop biowaste collection must be managed in one of the following ways:

- (a) wire bag holders with or without the optional lid;***
- (b) labeled beaker with appropriately diluted bleach or other EPA-approved disinfectant for the agent(s) that is disposed of at the end of work; and/or***
- (c) beaker or other container that is lined with a biohazard bag. If the container does not allow view of the biohazard symbol on the bag it must be labeled with a biohazard sticker.***

B8.3.2.4(d)

Benchtop biowaste collection must be done using materials that withstand frequent surface disinfection. Biokeeper boxes and similar containers are one-time use and must be closed and disposed of as biowaste once full rather than emptied and reused.

B8.3.2.5

Biowaste must not exceed three-quarters of the volume of the bag and/or container.

B8.4

Treatment of Biologically Contaminated Materials and Biowaste

As stated in B8.3.1, all biological wastes must be segregated from other waste streams and require treatment prior to disposal.

Thus, to facilitate regulatory compliance and consistency of treatment practices, EHS has instituted a waste program that includes autoclave use and monitoring (see section B8.6.4).

Regulations Pertaining to the Treatment of Biowaste

The following is taken directly from the Texas Administration Code (TAC); please refer to [30 TAC §326](#), [30 TAC §330](#) and [25 TAC §1.132](#) for definitions related to the regulations. For example, “bulk” according to the TAC consists of amounts greater than or equal to 100 mL.

Medical waste consists of waste associated with many biological laboratory activities and includes: animal waste, bulk blood, bulk human blood, bulk human body fluids, microbiological waste, pathological waste, and materials listed in [49 Code of Federal Regulations, Part 173, §173.134\(a\)](#). The term does not include medical waste produced on a farm or ranch as defined in [34 TAC §3.296\(f\)](#) (relating to Agriculture, Animal Life, Feed, Seed, Plants, and Fertilizer).

B8.4.1

According to the TAC, “medical waste” (i.e., biowaste) requires treatment prior to final disposal. This treatment may be performed by the generator or transferred offsite and performed by a third party.

B8.4.2

Biowaste to be transferred to a third party for treatment must be properly prepared for transport by the generator (i.e., proper preparation of biobarrels). See Appendix BG.

B8.4.3

Biowaste that is treated by the generator must be treated using a TCEQ-approved method of treatment for the specific type of biowaste. Approved methods are listed in [25 TAC §1.136](#). Methods accessible at TTU include chemical disinfection with an approved disinfectant or steam disinfection (i.e., autoclaving).

B8.4.4

A written SOP for biowaste treatment, including preparation of any chemicals used and preparation of materials for autoclaving, must be in place in work areas treating their biowaste.

B8.4.5

Treatment of all biowaste must be recorded. The biowaste treatment record must be maintained by the generator for no less than 3 years.

Biowaste treatment log pages that meet the state requirements are available in in Appendix BF or can be downloaded from the EHS website: <http://www.depts.ttu.edu/ehs/academicsafety/lab/tools-templates.php>

B8.4.5.1

Record of Biowaste Treatment

Laboratories must maintain a written record that, at a minimum, contains the following information for each batch of waste treated:

- (a) Date of treatment;
- (b) Amount of biowaste treated;

- (c) Method/conditions of treatment;
- (d) The name (printed) and initials of the person(s) performing treatment; and
- (e) The written procedure for the operation and testing of any equipment used and a written procedure for the preparation of any chemicals used in treatment.

B8.5

Regulations pertaining to chemical disinfection of biological wastes

Failure to properly follow TCEQ biowaste regulations can result in fines to the University.

B8.5.1

Only EPA-registered disinfectants approved by the Texas Department of Agriculture or properly diluted household bleach (1:10 household bleach to water minimum) shall be used for chemical decontamination of biological wastes.

B8.5.1.1

Freshly prepared disinfectants are required for chemical treatment of biowastes.

B8.5.1.2

Expired stock or dilutions of disinfectants shall not be used for any purpose.

B8.5.2

Should you choose to decontaminate liquid biowaste by chemical disinfection, a validated standard operating procedure for the specific liquid matrix to be decontaminated must be followed.

B8.5.2.1

The method must be validated by the PI according to [25 TAC §1.135](#).

B8.5.3

All label instructions for dilution and contact time must be followed.

In failing to do so, the PI assumes full liability for any incidents/injuries which result from off-label use and is potentially subject to enforcement action under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

B8.5.4

All stock solutions of chemical disinfectants shall be stored according to the label/SDS. Do not store solutions of incompatible chemicals under sinks (e.g., bleach with ammonia-containing cleaners). Consult the label for disposal. If you have questions, call EHS.

B8.5.5

When diluted household bleach is used for chemical disinfection of biowaste, a 1:10 dilution of bleach to water is freshly prepared (B8.5.1) and items shall be totally immersed for a period of time not less than three minutes or as required by the work-specific protocol – whichever is longer.

B8.5.6

Solid biowaste immersed in a liquid chemical agent must be thoroughly drained before disposal.

B8.5.6.1

Agars and related biological substrates are not considered solid wastes capable of chemical disinfection.

B8.6

Steam Disinfection (Autoclaving)

Autoclaves use pressurized steam to destroy microorganisms and are the most widely used and accepted system available for the decontamination of laboratory biowaste and the sterilization of laboratory equipment, glassware, media, and reagents.

There are four parameters which must be met for effective steam sterilization: steam, pressure, temperature, and time. Should a cycle fall short in reaching the minimum target required in one of these areas, sterilization will not be accomplished.

To ensure consistent sterilization practices, EHS has instituted a program for autoclave use and monitoring. Mechanical, chemical, and biological monitors should be used to evaluate unit performance in accordance with the program and TCEQ regulations.

B8.6.1

Autoclaving should be used, whenever possible, as the preferred means of decontamination of laboratory biowaste. See [B8.6.7.2](#) and [B8.6.7.3](#) for proper autoclaving of bagged biowaste.

B8.6.2

It is the PI's responsibility to ensure operator competence and devise SOPs for the proper methods of cleaning instruments, preparing packages, loading and operating the autoclave, and maintaining an autoclave log that meets the requirements of B8.4.5.1.

B8.6.2.1

Those using building autoclaves are to record biowaste treatment runs in the provided logbooks.

B8.6.3

Equipment Specifications

Pressure-cooker style autoclaves and home-built reactor pressure vessels are not to be used.

B8.6.3.1

Autoclave Pressure Relief Devices

All autoclaves and reactor pressure vessels must be protected with a rupture disc as the primary pressure relief device.

Rupture discs are thin metal discs which are designed to burst at a specific pressure. Spring loaded relief valves may be used as a secondary pressure relief device.

B8.6.3.2

Precautionary notes regarding autoclaves

Many new laboratory pressure reaction vessels will not be stamped with the ASME or CE marking. Choosing manufacturers that are known to follow ASME codes is a way to ensure that pressure vessels meet manufacturing requirements.



Modifications to pressure vessels may impede or impair designed safety features.

B8.6.4

Regulations Pertaining to Steam Disinfection of Biological Wastes (autoclaving)

B8.6.4.1

Biowaste that must be transported outside of the laboratory for autoclaving must be transported in a durable, leak-proof container labeled with the biowaste symbol.

B8.6.4.2

To allow sufficient steam access to and penetration of the biowaste, the biowaste shall be packaged according to the recommendations provided by the manufacturer and loaded into the chamber so as to not exceed the capacity limits as set by the manufacturer.

B8.6.4.2(a)

Bags to be autoclaved must be secured at the top such that steam is able to enter and vent from the bag.

Do not twist, knot, or tape the bag shut in such a way that prevents steam entering/escaping the bag.

B8.6.4.2(b)

Chemical indicators (e.g., autoclave tape) must be used in association with autoclaved biowaste.

B8.6.4.3

For biowaste treatment, the temperature in the chamber of the autoclave must reach at least 121°C and there must be at least 15 pounds per square inch gauge pressure for at least 30 minutes. The 30 minutes does not include unit pressurization and depressurization, only time held at 121°C ([25 TAC §1.133](#)).

B8.6.4.4

The autoclave must be operated according to the manufacturer's instructions.

B8.6.4.5

Any markings that identify the waste as a biowaste (e.g., biohazard symbol) shall be covered with a label that identifies the waste as treated medical waste.

B8.6.4.5(a)

A label that states the contents of the disposable container have been treated in accordance with the provisions of 25 TAC §1.136 must be affixed to the biowaste bag over the biowaste symbol. Contact EHS for labels.

B8.6.4.5(b)

The treated and labeled biowaste bag must be placed in a black garbage bag and disposed of in the municipal waste dumpsters by laboratory personnel.

B8.6.4.5(c)

Treated biohazard bags must be secured in a black bag before final deposition in the building dumpster.

B8.6.4.6

Required Frequency of Biological Testing

B8.6.4.6(a)

For building-supported autoclaves, the department representative or building manager in conjunction with EHS shall:

- i. Demonstrate a minimum four log ten reduction (10^4 log) (as defined in 25 TAC §1.135 (relating to Definitions)) on routine performance testing using a biological indicator containing pertinent Bacillus species (as defined in 25 TAC §1.135).
- ii. Conduct testing on autoclaves which process the quantities listed below at the applicable intervals:
 - For generators of more than 50 pounds but less than or equal to 100 pounds per month, testing shall be conducted at least monthly;
 - For generators of more than 100 pounds but less than or equal to 200 pounds per month, testing shall be conducted at least biweekly; and
 - For generators of more than 200 pounds per month and persons that treat medical wastes off-site, testing shall be conducted at least weekly.

B8.6.4.6(b)

EHS will facilitate annual testing of PI-owned autoclaves. PIs who have autoclaves in their laboratories which process biologically contaminated materials and/or biowaste is responsible for conducting testing at the applicable frequency listed in B8.6.4.6(a)ii as it applies to their waste throughput. Contact EHS for biological indicators.

B8.6.5

Monitoring Autoclave Performance

As indicated above, autoclaves used to decontaminate laboratory biowaste must be tested periodically to assure effectiveness to protect human health and the environment.

B8.6.5.1

Mechanical monitors include thermometers, pressure gauges and displays on the autoclave. Correct readings do not ensure sterilization; but incorrect readings could be an indication of problems.

EHS recommends utilizing the printer for autoclaves as a regular means to monitor and log autoclave performance. A cycle print-out is available on most campus units; printers on these units should be maintained with ink and paper. EHS strongly recommends printers on campus units.

B8.6.5.2

Autoclave performance shall be evaluated with chemical and biological tests. Indicators shall be placed in autoclave locations that are the slowest to heat.

There are two types of tests are frequently used to evaluate autoclave efficacy:

- (a) Chemical indicators
- (b) Biological indicators

Please see the Appendix BE for forms and the SOP for the Autoclave Testing Program. If you need assistance or have questions about monitoring, please contact EHS at 806-742-3876.

B8.6.5.2(a)

Chemical Indicators

As stated in [B8.6.4.2](#) (b), heat-sensitive indicator tape or an equivalent chemical indicator shall be used when autoclaving biowaste materials.

Chemical indicators use temperature-, pressure- and/or vapor- sensitive chemicals to assess physical conditions during autoclaving and are generally inexpensive and easy to use. Multi-parameter and single-parameter chemical indicators are available for autoclaves. Refer to the manufacture for placement of chemical indicators within the load. Heat-sensitive indicator tape is a chemical indicator and should be used on all materials within every autoclave load.

Chemical indicators should be used in conjunction with biological indicators - not replace them. Chemical indicators only assess if the physical parameters of sterilization were met; biological indicators are the only means to prove sterilization has been achieved.

B8.6.5.2(b)

Biological Indicators

Biological indicators contain heat-resistant spores that are destroyed when an autoclave is functioning properly (generally *Geobacillus stearothermophilus* for heat treatment. Other spore types are used for chemical sterilization.). Biological indicators are the most accepted and widely used means of monitoring sterilization processes.

EHS provides biological indicators for state-required testing and assessing autoclaves after repairs. EHS will test all University autoclaves with biological indicators at least annually. Autoclave testing frequency will follow state guidelines at minimum (See [B8.6.4.6\(a\)](#) ii). The procedure and treatment log sheets can be found in Appendices BE and BF.

Biological indicators shall be used when:

- i. The autoclave has been repaired
- ii. New waste cycle parameters (i.e., settings) are set
- iii. Biowaste loading procedures or materials have changed

Biological indicators should also be used when:

- i. A new type of packaging material or tray is used
- ii. New personnel are trained

NOTE: These evaluations fall outside the periodic testing facilitated by EHS and will be at the laboratory's expense.

B8.6.5.2(c)

Failed Indicators

If an autoclave fails a biological test:

- i. Post an "out of service" sign on the unit and contact the appropriate party to initiate a service call.
- ii. Do not use the autoclave until it has been inspected, repaired, and successfully challenged with a biological indicator in 1-3 consecutive "dummy" or non-hazardous loads with control tests for each.
- iii. Off-campus and PI-owned units will need to record and report all results to EHS. Please see the procedure in Appendix BE and contact EHS with further questions.

B8.6.6

Autoclave Container Selection

B8.6.6.1

Polypropylene Containers and Pans

Polypropylene (recycle #5) is a plastic capable of withstanding autoclaving but resistant to heat transfer. Therefore, materials contained in a polypropylene pan will take longer to autoclave than the same materials in a stainless-steel pan.

Do not use polyethylene (recycle #1) or high-density polyethylene (recycle #2) plastics for autoclaving.

B8.6.6.2

Stainless steel Containers, Pans, and Baskets

Stainless steel is a good conductor of heat and is less likely to increase sterilizing time; however, it is more expensive than polypropylene.

B8.6.7

Preparation and Loading of Materials

For efficient heat transfer, steam must flush the air out of the autoclave chamber.

Before using the autoclave, check the drain screen at the bottom of the chamber and clean it if it is blocked. If the sieve is blocked with debris, a layer of air may form at the bottom of the autoclave, preventing efficient operation.

B8.6.7.1

Liquids

- (a) Fill liquid containers only half full. Loosen caps or use vented closures. Avoid large bottles with narrow necks and sealed containers as they may explode.
- (b) Cover bottles without a lid loosely with aluminum foil.
- (c) Place bottles in an autoclavable secondary container to catch spills. Add water to the bottom of the container to reduce the likelihood of cold spots in processing. See section B8.6.6.

B8.6.7.2

Packets and Bags

- (a) Always put bags of biological waste into an autoclavable secondary container to catch spills. See section B8.6.6 for guidance regarding secondary containers.
- (b) Fill bags no more than three-quarters full. Do not over fill bags.
- (c) Position biohazard bags on their sides, with the bag neck closed loosely.
 - i. Use indicator tape or twist ties to loosely secure the top of the bag.
 - ii. Do not overfill bags or twist/knot the tops of bags. This prevents adequate steam entry into the bag and may result in incomplete sterilization of materials.
- (d) In the case of a vial, insert a blunted needle into the septum.
- (e) Place a strip of indicator tape on bag if not otherwise used to secure the top of the bag.
- (f) Add water to the bottom of the bin to facilitate heat
- (g) Packaging materials for packets must allow steam penetration and maintain sterility after processing. There are several methods to accomplish this. Call EHS at 806-742-3876 if you have questions.

B8.6.7.3

Autoclave Loading

B8.6.7.3(a)

Loading procedures must allow adequate steam circulation and will vary with items to be autoclaved and unit configuration. Do not exceed the capacity of the unit. (25 TAC §1.133). Refer to your unit's user guide if you have questions regarding either of these procedures.

B8.6.7.3(b)

Wear lab coat, eye protection, heat-protective gloves, and solid shoes. Carry your lab coat on a cart- do not wear your PPE if you must travel in public corridors to the autoclave.

- i. Select containers with the lowest sides and widest diameter possible for the autoclave.
- ii. Remove container lid if present.

- iii. Leave space around each item.
- iv. Drill a hole inside of container or pour water in the bottom of the tub to facilitate heat transfer, add moisture to dry loads, and eliminate the air gap.
- v. Use perforated trays and/or wire baskets for items that will not generate spills.

B8.6.8

Cycle Selection Guidance

- Use liquid cycle (slow exhaust) when autoclaving liquids, to prevent contents from boiling over.
- Select fast exhaust cycle for glassware.
- Use fast exhaust and dry cycle for wrapped items.

B8.6.9

Time Selection Guidance

- (a) Consider the size of the articles to be autoclaved and the overall amount in the load. For example, a 2-liter flask containing 1 liter of liquid takes longer to sterilize than four 500 mL flasks each containing 250 mL of liquid and 4 flasks containing 1 liter will take less time than 10 flasks containing 1 liter.
- (b) Material with a high insulating capacity, such as animal bedding and high-sided polypropylene containers, increases the time needed for the load to reach sterilizing temperatures thus the load will require extended time to achieve sterilization.
- (c) All biologically contaminated materials should be autoclaved for a minimum of 30 minutes at 121°C and 15 psi. The 30-minute minimum does not include heat and pressurization priming or depressurization; account for these periods separately when calculating total cycle time for your unit if it is not already programmed.

B8.6.10

Removing the Load

- (a) Wear lab coat, eye protection, heat-protective gloves, and solid shoes. Carry your lab coat on the cart - do not wear your PPE if you must travel in public corridors to the autoclave.
- (b) Check that the chamber pressure is zero.
- (c) Standing behind the door while you open it, slowly crack open door to vent steam. Beware of this rush of steam.
- (d) If liquids were processed, open autoclave door and allow liquids to cool for 20 minutes before removing.

B8.7

Summary of Biological Waste Treatment and Disposal by Generators

By law, biowaste is to be treated in accordance with [25 TAC 1.136 \(B8.4.3\)](#). Please contact EHS if you have questions as to how to address your biologically contaminated materials or biowaste.

Steam Disinfection of Solids

- Collect disposable, solid materials contaminated by a biological agent, excluding sharps, into an autoclave bag within an appropriate container.
- When half to three-quarters full, prepare bag as described in [B8.6.7.2](#) and autoclave the bag as described in section [B8.6.4.3](#).
- Allow bag to cool, affix a “treated” sticker to the bag and place autoclave bags in black trash bags. Contact EHS if you need more “treated” stickers (See [B8.6.3.5\(a\)](#)).
- Laboratory staff dispose of treated waste in the building's outdoor dumpster.

Chemical Disinfection of Solids

This method is for reusable laboratory supplies, pipet tips, serological pipets, reusable syringes and items of that nature – not petri dishes with cultures, contaminated food products and similar biowastes. Contact EHS for guidance and if you have any questions about treating your biowaste

- A pre-cleaning step to remove debris may be required for certain items.
- Prepare qualifying disinfectant per the manufacturer’s guidelines or a 1:10 dilution of household bleach and water.
- Fully submerge biologically contaminated materials in solution (i.e., suck solution into pipet tips). All surfaces must have contact with the disinfectant.
- Allow contact time per the manufacturer’s instructions, or if bleach is used, no less than 3 minutes or according to the lab-validated waste disinfection method - whichever is longer. Different agents require different contact times with bleach. Contact EHS if you plan on chemically disinfecting your biologically contaminated materials or biowaste.

Steam Disinfection of Liquids

If liquid biowaste is [mixed waste](#), contact EHS. Autoclaving and chemical disinfection may not be recommended. Contact EHS for the final disposal of your treated liquid waste. Some items are not accepted in the sanitary sewer or can damage plumbing.

- Fill liquid containers only half full. Loosen caps or use vented closures. Avoid large bottles with narrow necks when possible.
- Cover bottles without a lid loosely with aluminum foil.
- Place bottles in an autoclavable secondary container to catch spills.
- Autoclave for at least 30 min at 121°C and 15 psi of pressure on a cycle with slow exhaust. The 30min time point does not include warm up or cool down.
- Allow liquids to cool before final disposal.

Chemical Disinfection of Liquids

Contact EHS if you plan to not use a bleach solution to disinfect your biowaste. Make sure that bleach will not adversely react (e.g., produce chlorine gas) with your biowaste.

Should you choose to decontaminate liquids by chemical disinfection, a validated standard operating procedure for the specific liquid matrix must be followed. Different materials/agents require different bleach concentrations and contact times.

- Add, at minimum, an equivalent volume of freshly prepared 10-20% household bleach solution to the container with the liquid waste. Gently mix.

- Allow contact time per SOP.
- Dispose of solution by pouring down the sink.
- Flush with copious amounts of water to prevent damage to plumbing.
- Wash container as usual and rinse well before further use.

B8.8

Biological Wastes Picked up by EHS

B8.8.1

Sharps Waste

Sharps, according to [25 TAC §1.132](#) include but are not limited to the following when contaminated: hypodermic needles; hypodermic syringes with attached needles; scalpel blades, razor blades, disposable razors, and disposable scissors used in surgery, labor and delivery, or other medical procedures; intravenous stylets and rigid introducers (e.g., J wires); glass Pasteur pipettes, glass pipettes, specimen tubes, blood culture bottles, and microscope slides; broken glass from laboratories; and tattoo needles, acupuncture needles, and electrolysis needles. Regardless of contamination, hypodermic needles and hypodermic syringes with attached needles are considered sharps.

Sharps must be segregated from other wastes.

B8.8.1.1

Safe Disposal of Sharps:

- (a) FDA-approved containers (i.e., puncture-proof and securable) are required for the disposal of sharps.
- (b) Use care and caution when cleaning up after procedures that require the use of sharps.
- (c) Do not recap or remove needles from syringes. Recapping requires an EHS-approved SOP.
- (d) Do not recap or remove scalpel blades by hand.
- (e) Discard needle and syringe as an intact unit immediately after use into puncture-resistant sharps containers.
- (f) Do not overfill sharps containers. Replace when waste reaches indicator line on container or when 3/4 full.
- (g) Dispose of ALL sharps containers through EHS waste disposal. “Biological” is the indicated waste type unless radioactive materials are present.
 - i. Sharps that have contacted radioactive materials require a separate sharps container appropriately labeled for the radioactive hazard. When full, dispose of sharps container through EHS as “Radioactive” waste. See the Radiation Safety Manual for details.

In the event of a sharps-associated injury, notify the PI and/or senior lab personnel and seek treatment if needed. Fill out and turn in an incident report within 24hrs of the injury. Access to the online form for Risk Management is available on the EHS website at:

<http://www.depts.ttu.edu/ehs/about/incident-reporting.php>.

Call EHS if you have any questions at 806-742-3876.

B8.8.2

Biological Waste Barrels (biobarrel)

Biological waste barrels with liners are provided by EHS to laboratories for biological waste disposal in certain cases. Laboratories that may need barrels might include those which:

1. Lack access to an autoclave or the autoclave is out of service;
2. Perform research which periodically generates large amounts of biowaste that is not manageable in available autoclave(s);
3. Perform research which includes inoculated or naturally infected live animals, whole carcasses of unpreserved animals, whole cuts of meat or other dense items which will not autoclave properly.
4. Other special cases as determine by EHS (mixed waste, high hazard, etc.).

B8.8.2.1

Biobarrel Use

Biobarrel use is addressed in [EHS SOP 6.5, Use of EHS-provided Biobarrels](#). Violations of the points below can result in delayed waste pick up or revocation of barrel privileges in locations of *elected* barrel use. See Appendix BG for details.

- (a) Properly segregate biowaste from non-biowaste.***
- (b) Accumulate biowaste in smaller, appropriate biowaste receptacles. Do not place loose materials directly into the biobarrel.***
- (c) Do not place large quantities of liquid biowaste into biobarrels* (e.g., spent cell-culture media, liquid microbial culture media, supernatants, etc.).**
- (d) Secure individual biowaste bags prior to placement in the biobarrel.***
- (e) Tie off biobarrel bag liner when biobarrel is $\frac{3}{4}$ full. Biobarrels cannot weigh more than 40 lbs.***
- (f) Avoid compressing waste in the biobarrel.***
- (g) Biobarrels are to remain closed except when a biowaste bag is actively being transferred to biobarrel.***

B8.8.2.2

Biobarrel Pick-Up

- (a)** Liners must be “tied off” (i.e., knotted – sides pulled up and tied together)
- (b)** Lid must be secured.
- (c)** Weight must not exceed 40lbs.
- (d)** Submit biowaste pick-up request online through the EHS website:
<http://www.depts.ttu.edu/ehs/>.
- (e)** The number of barrels picked up will be the number of barrels replaced. This number can be modified in the comment section of the waste request, but the requested number may not necessarily be granted.

A biobarrel usage poster is available on the EHS website: <https://www.depts.ttu.edu/ehs/academicsafety/lab/tools-templates.php>. You can also contact EHS for a printed copy.

B8.8.3

Multi-hazard or [Mixed Waste](#)

Avoid generating mixed waste; if unavoidable, keep volume of mixed waste to a minimum. Do not steam or chemically disinfect mixed waste without EHS consult.

B8.9

Disposal of Animal Tissues, Carcasses and Bedding

B8.9.1

Disposal of non-farm/agriculture-related animal tissues, unpreserved carcasses and bedding is to be coordinated with EHS and ACS. Freeze / refrigerate tissues and carcasses until pick-up to prevent odor as needed.

B8.9.2

Preserved carcasses, drained of preservatives, can be disposed of as municipal waste.

B8.9.2.1

Collect all liquid preservatives and dispose of them as hazardous waste. Place carcasses in a black trash bag and dispose of it in the building's dumpster.

If you have questions, please call EHS at 806-742-3876.

B8.10

Plant and Seed Devitalization

Genetically modified plants and seeds must be rendered non-viable prior to disposal. Some collaborators or funding agencies may require a maceration step or incineration.

B8.11

Special Considerations for Toxin Neutralization

Neutralization methods must be specific to the toxin and will be described in the IBC protocol.

B8.12

Special Considerations for Prion/Prion-like Protein Neutralization

Neutralization methods must be specific to the prion/prion-like protein and will be described in detail the IBC protocol.

B8.13

Other Waste Issues in Biological Laboratories

B8.13.1

Reusable Labware

Items such as contaminated culture flasks, media bottles, test tubes, instruments, equipment tubing, etc. are decontaminated by lab personnel before washing (and repackaging) by one of two methods:

- Autoclave items that have been collected in autoclavable containers.
- Chemically disinfect items by soaking in a fresh 10% sodium hypochlorite solution for a minimum of 20 minutes before washing. For heavily soiled items, remove as much of the visible contamination as possible over an autoclave bag (for autoclaving or EHS waste collection) then soak in fresh 10% household bleach. Repeat as necessary. Follow disinfectant step(s) with a thorough water rinse. The rinse is especially important for items vulnerable to corrosion and remove bleach residue.

B8.13.2

Glass

B8.13.2.1

Non-contaminated glass waste must be segregated from other solid municipal waste and disposed of in a sturdy, puncture-resistant, closable box labeled as broken glass (CHP, A19.3.4.1).

There are autoclavable, benchtop boxes you can purchase for easy disposal of pipettes, slides and other small glass items (Terminal® Biohazard Benchtop Keeper™ and Terminal® Pipet Keeper™ Containers, Whitney Products).

B8.13.2.2

Full glass disposal boxes should be taped closed and disposed of in a dumpster by the laboratory (i.e., accumulator) (CHP, A19.5.2).

B8.13.2.3

Do not handle broken glass with your hands. Use forceps, tongs, or some other tool to collect and handle broken glass. Decontaminate collection tools after collection of contaminated glass.

B8.13.2.4

Biologically contaminated glassware should be immediately disposed of in a sharps container. This minimizes handling of the contaminated hazard.

If disposal in a sharps container is not possible, glass must be decontaminated before disposal in the glass disposal box (CHP, A19.5.1). Glass can be decontaminated by steam or chemical disinfection. Autoclaving is the recommended decontamination method.

- (a) Autoclave in a puncture-proof, autoclavable container; or
- (b) Place in a wire sieve then soak in freshly prepared 10% household bleach solution or other approved chemical disinfectant solution for the appropriate contact time.

B9 BIOLOGICAL LABORATORY OPERATION

Biological risk management approaches vary with the agent(s), procedure(s), and location(s) associated with the work. Adequate and appropriate risk management is essential to the safe operation of the biological laboratory.

B9.1

Risk Management

Risks must be identified and addressed prior to beginning laboratory work and repeated when any changes are made to the agent, procedure, equipment, employee, or facility.

All biological work carries some level of risk. Worker training and competency are paramount for personnel, laboratory, and environmental safety.

Biological risk assessment (RA) is a continuous and evolving process dependent on the quality and quantity of current information and recommendations of appropriate, realistic methods of **containment**. A RA should be performed by those most knowledgeable of the agent or technique and is thus a pivotal **responsibility of PIs** and is shared and supported by EHS, the IBC, and other Institutional Committees as applicable.

Information identified in a RA will provide a framework for appropriate PPE, laboratory practices, engineering controls and safety equipment to manage the identified risks. The three basic steps to risk management are hazard identification, risk assessment and risk control.

B9.1.1

Identification of Hazards

1. Identify the agent(s) if they are known. Samples of unknown status and environmental samples should be handled with universal precautions at BSL2 unless permission has been granted otherwise by the IBC (see [B6.2.2](#)).
2. Identify all procedures and equipment which will be applied to the agent.
3. Identify the location(s) where work will be done.
4. Identify who will be performing the work.

Identification of the above research elements will help you to properly evaluate the three central components of a RA (agent, environment, and host) which need to be addressed when considering biological risks.

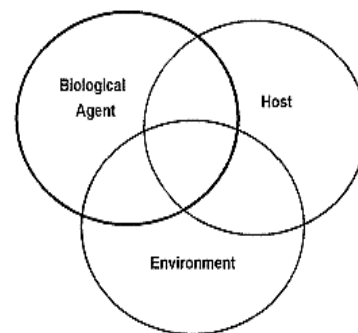
Several factors about each component and relationships between components are evaluated in step 2: Risk Assessment.

B9.1.2

Biological Risk Assessment (RA)

Biological risk assessment is generally not as prescriptive as a risk assessment for a chemical or physical hazard as it involves living organisms that exist in a state of natural variation.

FIGURE1. Risk Assessment Triad



Barbara Johnson, PhD, RBP - Understanding, Assessing, and Communicating Topics Related to Risk in Biomedical Research Facilities, ABSA Anthology of Biosafety IV - Issues in Public Health, Chapter 10 (2001), <http://www.absa.org/0100johnson.html>.

B9.1.2.1

Biological Agent(s)

Given the ubiquitous nature of some microbes, it is important to consider naturally occurring strain variation and the potential for differential expression of virulence factors.

This variation, in conjunction with the dynamics of the host-agent relationship, complicates calculating infectious dose; however, relative estimates can be made regarding the risk an agent poses when the following elements of an agent are considered:

- Pathogenicity and resilience
- Naturally occurring mode(s) of transmission
- Likely mode(s) of transmission in the laboratory
- Natural reservoirs
- Host range (e.g., zoonosis or reverse zoonosis)
- Vectors
- Availability of treatment/prevention measures

See [B6.2](#) regarding risk groups. Risk groups are a starting point for a RA based on what is known about an agent; however, risk group alone is not a substitute for a RA.

B9.1.2.1(a)

Additional Factors to Consider Concerning Biological Agents

- Concentration (natural burden vs lab culture)
- Volume
- Exposure associated with procedures (i.e., aerosolization, injection, involvement of vectors or animals, etc.)
- Life cycle stage(s) to be encountered/manipulated

These factors may increase/decrease the containment level required for an agent regardless of the risk group ([B6.2.1](#)).

B9.1.2.2

The Environment

Environmental factors to be considered in a RA primarily concern agent containment and environmental impact. Environmental factors may include:

- Ventilation and laboratory design
- Laboratory procedures and training
- Containment equipment
- Established and updated operating procedures
- Personal Protective Equipment availability and usage
- Laboratory sanitation and biowaste management
- Use of animals and/or vectors
- Presence of host species and/or agent vectors outside containment

- Field work

B9.1.2.3

The Host

The human factor is the most difficult hazard to control.

Lab personnel are encouraged to alert their PI or laboratory supervisor if they have a health condition that can affect their safety in the lab so that duties can be properly assigned.

Lab personnel are strongly encouraged to inform their personal physician of all hazardous material they handle in the laboratory.

Lab personnel and visitors are to be informed of the hazards to which they may be exposed; this includes potential routes of exposure, symptoms, and treatment options and availability.

B9.1.2.3(a)

The human immune system can be affected by multiple factors that can modify the host response to an exposure; such factors may include but are not limited to:

- Genetic predisposition
- Pregnancy
- Stress and fatigue
- Medications
- Chronic conditions (e.g., diabetes, HIV, allergies, autoimmune disease, etc.)
- Acute conditions (e.g., common cold, open wound/laceration)
- Treatment sensitivities
- Vaccination status
- Age
- Composition of natural flora

B9.1.2.3(b)

Some medications may alter your state of mind leaving you less coordinated, alert, and capable in the laboratory.

B9.1.2.3(c)

You are only as safe as those with whom you work. Behavioral factors that can affect worker safety in the laboratory include:

- Education
- Lack of training or recurrent training or poor training
- Failure to use PPE, use of PPE in poor condition, or improper use of PPE
- Poor or improper laboratory habits (lab-specific safety culture)
- Complacency
- Distractions

B9.1.2.3(d)

The above primarily focuses on humans as a host. Host range (plant species and non-human animal species) must also be explored as it pertains to the agent(s).

B9.1.2.4

Risk Matrices

While assessing risks, it is also important to prioritize the risks you are evaluating and direct attention to those with the greatest probability of occurrence and can cause the most harm. The risk matrices below can help guide prioritization.

The agent risk groups are listed across the top. The hazard level of the procedure to be used is on the far left; procedures that use aerosol-generating equipment or sharps would be considered to have a high probability of an accident/incident occurring.

TABLE 2. Example Risk Matrix Regarding Agent

Probability of accident	RG3	RG2	RG1
High	High	Medium	Low
Medium	High	Medium	Low
Low	Medium	Low	Very low
Negligible	Low	Low	Very low

Table adapted from Biological Safety: Principles and Practices 4th Ed., Fleming and Hunt, ASM Press 2006.

B9.1.3

Risk Control

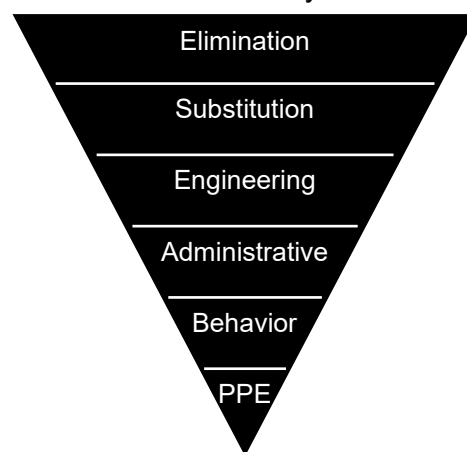
Once hazards are identified and the risk they pose assessed, control measures can be implemented. Hazard controls may be on an administrative, facility, or laboratory level and can range from alternate methodologies or PPE to facility design and biosafety cabinets.

A key element in risk control is the laboratory-specific biosafety manual, also referred to as a Biological Work Area Safety Plan (bioWASP/WASP). This document may either be an amendment to an existing WASP or a stand-alone biosafety-specific document in addition to your general WASP or your IBC protocol.

The (bio)WASP serves as the foundation for administrative risk control measures (**Administrative Controls**) as it addresses laboratory and facility operations, training requirements, application of primary and secondary containment measures, emergency procedures, exposure and health monitoring guidelines and any other necessary materials for a safe laboratory environment.

Additionally, **personal protective equipment** is an essential element in controlling exposure to potentially hazardous biological material. It must be appropriately selected for the task, worn and removed properly, and be in good condition (see section [B9.1.3.2](#)).

FIGURE 2. Hierarchy of Controls



NIOSH, Hierarchy of controls.
<https://www.cdc.gov/niosh/topics/hierarchy/default.html>

B9.1.3.1

Biological Work Area Safety Plan

B9.1.3.1(a)

A laboratory-specific biological work area safety plan (Bio-WASP) is required for work with biological materials at any containment level.

B9.1.3.1(b)

The bio-WASP will be reviewed as part of the IBC review/approval process.

B9.1.3.1(c)

The bio-WASP must be available & accessible in the work area.

B9.1.3.1(d)

The bio-WASP shall be reviewed at least biennially and updated necessary when new biological materials, equipment, or methods are introduced.

B9.1.3.1(e)

The Biological Work Area Safety Plan (bio-WASP) should cover the items outlined below and be specifically tailored to the needs of the individual work area and research.

- i. General operations** – Laboratory access and guidelines for workers/non-workers; entry/exit procedures; procedures for identifying, reporting, and correcting problems; facility procedures; pest management; general laboratory safety guidelines; lab notebook.
- ii. Safety equipment and personal protective equipment** – PPE requirements; proper donning and doffing procedures for PPE; maintenance and decontamination of reusable PPE; use, decontamination, and maintenance of equipment (BSC, autoclaves, eyewash, showers, etc.).
- iii. Emergency procedures** – Accidents: spill, release, exposure, fire, etc.; documentation and reporting requirements; terrorist threat; etc. See section [B.7](#) for compliance requirements and procedure guidelines.
- iv. Training** – Documented understanding of the bio-WASP manual; notification of the risks associated with the materials to which workers may be exposed; frequency of in-lab proficiency testing and other trainings/assessments; etc.
- v. Practices and procedures** – Safe handling, storage, and decontamination of biological materials; handling of frozen samples; use of secondary containers; transporting samples; aseptic technique and proper hand washing; management of sharps; waste handling and disposal; facility decontamination and housekeeping; etc.
- vi. Standard operation procedures (SOPs)** are required for all laboratory functions (CHP, A12.1) and must be reviewed and approved by the supervisor/PI (CHP, A12.2). Use of images, pictures and flowcharts in SOPs is helpful. Written procedures should include the information outline sections A12.1.1-A12.1.11 of the CHP.
- vii. Health and medical monitoring** – Signs/symptoms of exposure for all materials; fever monitoring; [OHP enrollment](#); vaccination requirements and or titer testing if required; etc.

- viii. **Biosecurity** – Security measures taken to protect and control the use of biological materials and research-related information (e.g., doors remaining locked, restricted access, materials secured at the close of the workday, locking freezers, inventory and material management procedures, adequate documentation, etc.); measures to assess personnel are at the discretion of the PI, the granting agency, and/or the institutional Facility Security Officer (in ORS).

Please contact EHS at 806-742-3876 or email lab safety at ehs.lab.safety@ttu.edu if you have questions about bio-WASP content or for a review of your bio-WASP.

B9.1.3.2

Personal Protective Equipment (PPE)

Personal protective equipment includes all clothing and work accessories designed to serve as ‘the last line of defense’ against work hazards.

PPE should be dedicated to a specific work area and not moved among work areas; this is a requirement for all areas operating at level 2 containment (i.e., ABSL2, BSL2, ACL2, etc.). If you need PPE in another location (i.e., autoclave), carry it with outside surfaces folded inward or place it on a cart.

Proper [laboratory attire](#) and PPE requirements for laboratory spaces are addressed in section A4.3 of the CHP and shall be followed unless specific guidance pertaining to biosafety is addressed in this section (B9.1.3.2), [B9.2.2](#), or elsewhere in the biosafety manual.

B9.1.3.2(a)

Gloves

Disposable gloves are commonly used in laboratories and are required for working with chemical and biological materials. Double gloving may be recommended or required with certain materials or procedures.

Nitrile gloves are recommended for working with chemicals; most glove manufacturers have done performance test data for common chemicals. You are encouraged to research the protection offered by your glove selection. Glove producers like Kimberly-Clark and Ansellpro offer glove selection tools to help select proper gloves for your hazards.

Proper use of gloves includes the following:

- i. Wash hands prior to donning gloves to remove lotions which may compromise glove integrity.
- ii. Glove cuffs should be worn OVER lab coat cuffs.
- iii. When double gloving, the following tips can help:
 - a. Use different colors for inner and outer gloves.
 - b. Use extend-cuff gloves for the outer glove.
 - c. Turn the inner glove inside out to assist in donning the outer glove.

- d. Use 1.5 inch blue painter's tape to secure inner glove to lab coat or Tyvek sleeve. Tab the end of the tape to facilitate easy removal of the inner glove. Taping the inner glove facilitates easy removal of the outer glove as needed during work.
- iv. Avoid touching your face, eyewear, personal items (e.g., cell phone) with your gloves.
- v. Gloves shall be removed in such a way as to not contaminate the wearer or aerosolize material on the gloves.
- vi. Used disposable gloves shall be discarded immediately after removal and never reused.
- vii. Gloves should be changed frequently and between procedures. Gloves shall be changed when they are visibly contaminated and when integrity has been compromised.
- viii. Frequent decontamination of gloves with 70% ethanol is encouraged in biological applications.
- ix. Gloves are not to be worn outside the workspace or common areas.
- x. In general, gloves worn in biological laboratories are disposed of as biowaste.
- xi. Hands should be washed anytime gloves are removed. Hands must be washed before leaving the laboratory/work area. Camp sinks should be used for field work where facilities are unavailable.
- xii. Be aware of the use of laboratory chemicals that may breakdown a glove's integrity (e.g., ethanol). Ethanol's effect on glove integrity is generally not a concern unless other chemicals which present a health hazard are being handled.
- xiii. Specialty gloves (natural rubber, cryogenic, neoprene, thermal, PVC, Silver Shield®, etc.) may be needed for certain procedures. Such PPE must be available, in good condition and specified in the written procedure when required.

B9.1.3.2(b)

Eye and Face Protection

Proper use eye and face protection includes the following:

- i. Body and eye protection must be worn when biological hazards are not behind a physical barrier (e.g., closed cabinet, closed refrigerator, closed drawer, closed incubator, etc.).
- ii. Regular prescription glasses are not a substitute for safety glasses.
- iii. Over-the-glasses safety glasses should be available on-hand for workers who wear glasses. Contact lenses may or may not be worn at the PIs discretion.
- iv. The type of eye and face protection needed for a certain laboratory may vary with procedure and must be ANSI-certified for the hazards encountered (i.e., impact, splash/spray, UV light, lasers, etc.).

A brief description of common laboratory eye protection is below.

Safety glasses – Protective eyeglasses with impact-resistant lenses and safety frames constructed of metal or plastic; primarily provide impact protection and should be used in conjunction with a face shield or splash shield if splashes or sprays are likely; some provide UV protection.

Goggles – Tight-fitting eye protection that completely covers the eyes, eye sockets and the facial area immediately surrounding the eyes. Some goggles may only offer impact-only protection and are not designed to offer protection against splashes and sprays. Splash goggles are specifically

designed to protect against splashes and sprays and must be worn when working with chemical / biological agents or procedures that present a splash hazard.

Laser safety glasses/goggles – Provide protection from laser light; make sure your eye protection addresses your laser class.

Face shields – Headgear providing a transparent sheet of plastic covering the entire face. They protect against nuisance dusts and some splashes or sprays of hazardous liquids but may not provide adequate protection against impact or splash hazards and are to be worn with eye protection (i.e., safety glasses or goggles).

B9.1.3.2(c)

Body Protection

Different types of body protection (e.g., coats, coveralls, scrubs, gowns, and aprons) provide different types of protection based on the design and material composition. Some may be particle resistant, waterproof, flame resistant, and/or chemical resistant.

Proper use of body protection includes the following:

- i. Lab coats must fall below the waist; knee-length is recommended.
- ii. The lab coat selected shall address the hazards in the laboratory.
 - A barrier coat is strongly recommended in containment level 2 work areas or for those working in biosafety cabinets; this coat has knit cuffs and snaps up to the neck to prevent exposure to potentially infectious materials.
- iii. Laboratory coats should be comfortable and well-fitting; an improper fit may endanger the user.
- iv. Reusable body protection must be laundered when soiled and at regular intervals (e.g., monthly) to minimize contamination. Be sure the laundry service used is qualified to manage the potential exposure to whatever may be present on the coats. Autoclaving or bleaching coats prior to laundering is prudent but only necessary in the event of a spill or other visible contamination.
- v. Used laboratory coats shall not be stored in non-laboratory areas. Freshly laundered, unused, laboratory coats may be stored in passageways if absolutely necessary.
- vi. Body protection from containment level 2 work areas is work-area specific and shall not be worn outside the work area or taken to other work areas. If needed for use of a communal autoclave, they shall be transported on a cart with the materials to be autoclaved. Ideally a designated coat is set aside for this purpose.
- vii. Consider sleeve covers, protective suits, booties, aprons etc. as needed for hazards associated with your work.
- viii. Consult EHS if you have questions about PPE or if you feel respiratory protection is needed.

B9.2

Working with Biological Materials

Federal and state regulations and guidelines govern laboratory safety to protect personnel, the public, and the environment from biological hazards. Many granting agencies, including NIH, require that grant recipients certify that they adhere to these guidelines and regulations. Failure to provide evidence of adherence, if requested, can result in suspension and/or withdrawal of funds from the University.

B9.2.1

The IBC Protocol Application

The principal investigator is responsible for the preparation and submission of the IBC Application Form to the IBC for any project involving the items stated in [B4.2.9](#) (restated below). Approval is required before work begins in most cases.

Principle Investigators are required to submit work for IBC review for any of the following:

- Recombinant and/or synthetic nucleic acid (rNA/sNA) activities;
- Materials or agents *potentially* infectious to humans, plants, and/or animals – including the storage or concentration of any potentially biohazardous materials;
- Except for general surveillance, arthropods that serve as vectors of disease to humans, plants, or other animals, and arthropods that are considered an environmental hazard;
- Use of soil seed, plants, plant pathogens (e.g., bacteria, viruses, fungi, or parasites) or other material received under a USDA APHIS compliance agreement or permit;
- Use of potentially infectious human and/or non-human primate materials;
- Use of cell lines that pose a danger to humans, animals, and/or plants, and/or those immortalized by means that render them dangerous to humans, animals, and/or plants;
- The use of biologically derived toxins;
- Work involving prions or prion-like proteins;
- Any Select Agent or Toxin as listed in [7 CFR 331](#), [9 CFR 121](#), and/or [42 CFR 73](#).
- Necropsy of animals not under the care of the University Veterinarian; necropsy that includes hands-on student involvement; and necropsy of animals with unknown health status and/or animals reasonably suspected or known to be infectious;
- Other work as deemed necessary for review by the Biological Safety Officer; and/or
- Work with other potentially biohazardous materials conducted at, or sponsored by the University for compliance with the guidelines in the CDC/NIH Biosafety in Microbiological and Biomedical Laboratories (BMBL) and approve those research projects that meet or exceed the requirements in the BMBL.

The IBC protocol review is facilitated through the Cayuse Hazard Safety module. This is a cloud-based platform for IBC protocol management and maintenance. No other form of application or application amendment will be accepted.

EHS is available to consult and answer questions regarding form completion and any other pertinent documentation prior to IBC review.

B9.2.1.1

Documents Required for Application Submission

The following documentation must be attached to your protocol in Cayuse:

- (a) Safety plans (i.e., bio-WASP, field safety plan);
- (b) Signed Personnel Assurance sheet for the personnel listed;
- (c) State and/or federal permits for research materials on your protocol;
- (d) Co-PI forms for Co-PIs listed on the protocol;
- (e) Supporting documents such as SOPs, MOUs, or literature cited on your application; and
- (f) OHP clearances from the occupational health provider (when required).

B9.2.1.2

Steps for Protocol Registration

These steps and links are available on the [IBC Protocol Registration Page](#):

<https://www.depts.ttu.edu/ehs/academicsafety/Biosafety/protocolregistration-bio.php>.

- (a) Register yourself and lab members to be listed on your protocol in Cayuse using the online [Cayuse Personnel Description Form](#):
<https://www.depts.ttu.edu/ehs/academicsafety/Biosafety/ibccayuse-personnel.php>.
- (b) Complete and Submit your Protocol in Cayuse.
 - A [Researcher Toolbox](#) has been created that has work aids for completing and managing your protocol in Cayuse. The Toolbox is located at:
https://www.depts.ttu.edu/ehs/forms/TTUIBC_ResearcherToolbox.php
 - You can view the status of your protocol at any time in Cayuse.
 - Co-PIs and lab managers can create and amend a protocol on behalf of a PI, but only the PI of record can submit the protocol.
- (c) The Review Process.
 - The PI submits the completed IBC application and attaches any associated documents as those outlined in B9.2.1.1 within the Cayuse Hazard Safety module. These include: the WASP, Other supporting documentation (i.e., SOPs, federal permits, literature, etc.), OHP clearances, and Personnel Assurances and Co-PI Forms.
 - The IBC Office may review the submission for completion and request changes prior to forwarding the application to the committee.
 - The protocol is distributed to the IBC committee members for review. Committee member comments (if any) are collected by the IBC Office and sent back to the submitting PI.
 - If severe concerns are expressed by the committee or the protocol is called for full committee review, the IBC may invite the PI to attend the upcoming meeting to discuss their proposed work in-person.

B9.2.1.3

Conditions of Approval

- (a) ***The laboratory spaces where work is to be conducted must meet the biocontainment requirements for the work to be performed as determined by the IBC.***
- (b) ***Requested clarifications or changes to the IBC Application by the IBC must be addressed by the PI.*** The PI must either submit answers or a rebuttal to all committee member comments no less than 5 days before the upcoming meeting to have the final

review of their application on the meeting agenda. A list of meeting dates is on the [IBC homepage](https://www.depts.ttu.edu/ehs/academicsafety/icc/ibc.php): <https://www.depts.ttu.edu/ehs/academicsafety/icc/ibc.php>.

- (c) **Protocols are discussed and approval granted at the monthly IBC meetings.** In special situations, approval may be granted outside of the formal meeting.

B9.2.1.4

Post-Approval Requirements

Print your protocol and associated attachments in hard copy and have lab members listed on the document review. Maintain a copy of your current protocol in the work area. A dedicated binder for this purpose will be provided by EHS at PI request.

B9.2.1.4(a)

Required Renewal and Annual Updates

PIs must submit an annual continuing review to the IBC and renew active protocols every three years. If a protocol is completed prior to the continuing review or 3-year renewal period, please contact the IBC Office by email at ibc.ehs@ttu.edu.

B9.2.1.5

Amending the IBC Application

All protocol amendments, including personnel amendments, are performed in Cayuse.

B9.2.1.5(a)

Amendments to the IBC Application are required when there are modifications to any of the following:

- i. PIs;
- ii. Personnel;
- iii. Research locations;
- iv. Materials (e.g., vectors, gene targets, organisms, cell lines, tissues, disinfectants, etc.);
- v. Methods; and /or
- vi. When new hazards are introduced and not otherwise addressed in the protocol.

B9.2.1.5(b)

Amendments are subject to the conditions of approval in [B9.2.1.3](#).

B9.2.1.5(c)

Certain amendments such as personnel and facilities are approval administratively through the IBC Office. Changes to materials and methods are only administratively approved when there is no change in the risks or objectives associated with the work previously approved by the IBC. This is at the discretion of the Biosafety Officer or their proxy and may or may not include the IBC Chair or Associate IBC Chair given the nature of the amendment.

B9.2.2

Licensing of a Lab Space

B9.2.2.1

The following is required for laboratory work to be performed using BSL1 containment.

Laboratories working at BSL1 must:

- (a) A lockable door which remains closed at all times;
 - i. A self-closing door is ideal.
- (b) Have a sink for handwashing;
- (c) Have an eyewash;
- (d) Have adequate illumination;
- (e) Have screens for windows, or seal windows, when windows are present;
- (f) Have an integrated pest management plan;
- (g) Have appropriate signage on the door;
- (h) Have access to a copy of the most current edition of the CDC document [Biosafety in Microbiological and Biomedical Laboratories \(BMBL\)](#);
 - i. Electronic access must be independent of the internet and not tied to a specific computer (i.e., flash drive or equivalent external storage device) that is accessible in the lab.
- (i) Have access to a copy of the most current edition of the [NIH Guidelines for Research Involving Recombinant DNA Molecules](#) if a laboratory is doing rNA/sNA work;
 - i. Electronic access must be independent of the internet and not tied to a specific computer (i.e., flash drive or equivalent external storage device) that is accessible in the lab.
- (j) Post emergency numbers in a visible location preferably on the door, near the phone or both;
- (k) Properly manage biowaste from generation to disposal (See section [B8.3.](#));
- (l) Have appropriate, labeled biological waste containers readily available (See section [B8.3.2.3.](#));
- (m) Have waste segregation procedures and disposal plans in place for general waste, liquid biological waste, solid biological waste, sharps, glass, etc.;
- (n) Follow the practices outlined in [B9.2.3.9](#) regarding the use of sharps;
 - i. An SOP guides the use and disposal of sharps in the work area.
 - ii. Mechanical means are readily available and used to replace blades on reusable sharps.
- (o) Use plasticware as a substitute for glass when possible;
- (p) Have mechanical means to handle broken glass (i.e., tongs, forceps, dust broom, etc.);
- (q) Have a hard copy of the current (bio)WASP available and accessible in the laboratory;
- (r) Document worker understanding of the (bio)WASP and that they have been informed and understand the hazards associated with their work;
- (s) Have hard copies of EHS-required training certificates for all personnel;

- i. A sign indicating the location of training records must be in the laboratory if these records are stored in a different location.
- (t)** Have personnel complete rNA/sNA training when recombinant or synthetic nucleic acid methodologies are used;
- (u)** Provide specific, in-laboratory training regarding duties, potential hazards, manipulations of infectious agents, necessary precautions to minimize exposures, and hazard/exposure evaluation procedures (e.g., physical hazards, splashes, aerosolization) are provided to all personnel.
 - i. This training is documented, and proficiency level(s) are checked.
 - ii. Annual updates and additional training are required when equipment, procedures, or policies change.
 - iii. EHS can work with the PI to facilitate this as needed.
- (v)** Put procedures in place to minimize the creation of aerosols;
- (w)** Post spill protocols;
- (x)** Don appropriate PPE at all times;
 - i. Gloves must be worn when working with biological materials or agents or may come in contact with contaminated surfaces or equipment. (See [B9.1.3.2\(a\)](#) for specifics.)
 - ii. Long hair is secured.
 - iii. Skin below the waste is covered as appropriate for laboratory and field environments.
 - iv. Solid shoes are worn.
 - v. Eye, face, and body protection is appropriate to the work being conducted. (See [B9.1.3.2\(b\)](#) and [B9.1.3.2\(c\)](#) for specifics.)
- (y)** Wash hands before leaving the laboratory;
- (z)** Routinely decontaminate reusable PPE, the laboratory, and equipment within the laboratory;
- (aa)** Immediately decontaminate surfaces, areas, and PPE after all splashes and spills;
- (bb)** Have a biological-specific spill kit and fresh disinfectant readily available at all times while work is ongoing;
- (cc)** Not allow animals and plants that are not associated with the work being performed to be present in the laboratory;
- (dd)** Use an overflow flask in-between suction flask and pump / building vacuum line when suctioning potentially infectious substances;
- (ee)** Advise all persons entering the facility of the potential hazards, instruct them on the appropriate safeguards, and require them to read and follow instructions on practices and procedures.
- (ff)** Remove PPE in a manner that minimizes personal contamination and transfer of infectious materials outside of the areas where infectious materials are manipulated.
- (gg)** Place all biological materials/agents in a durable, leak-proof container during collection, handling, processing, storage, or transport to and within the laboratory.
- (hh)** Consumables and personal use products are kept outside of the work area (i.e., food, drink, vapes, cosmetics, etc.).

- (ii) Mouth pipetting is prohibited. Mechanical pipetting devices are used.
- (jj) Cleaning equipment (i.e., brooms, mops, buckets, etc.) is dedicated to the work area.

When a biosafety cabinet (BSC) is present, the following applies:

- (kk) Locate the BSC away from doors, room ventilation, heavily traveled areas, and other disruptive equipment so as to not disturb airflow within the BSC;
- (ll) Certify the BSC annually (i.e., within the past 12 months); and
 - i. If the BSC's certification is expired, a sign is posted indicating the cabinet must not be used.
 - ii. If the BSC has malfunctioned, a sign is posted indicating the cabinet must not be used.
- (mm) Use the BSC appropriately as outlined in [B10.1](#).

When a laminar flow hood (clean bench) is present, the following applies:

- (nn) Use a laminar flow hood appropriately as outlined in [B10.2](#).

B9.2.2.2

The following is required in addition to B9.2.2.1 for a laboratory to be licensed as BSL2 space and maintain that laboratory designation.

Laboratories working at BSL2 must meet BSL1 (B9.2.2.1) and:

- (a) Preferably locate a sink near the exit;
- (b) Have self-closing doors;
- (c) Have personnel complete Biological Safety training;
- (d) Have personnel complete Bloodborne Pathogen training and [OHP enrollment](#) when human materials are used;
 - i. OHP enrollment is facilitated by EHS
- (e) Have restricted access to the lab;
 - i. Untrained persons who must enter the laboratory must be escorted at all times. In general, minors, custodial staff, and maintenance workers are not allowed in the laboratory. See section [B9.2.4](#) for more details.
- (f) Secure laboratory work, and decontaminate lab work surfaces at the end of each workday;
- (g) Evaluate the need for medical surveillance, OHP enrollment and immunization requirements and implement as appropriate:
 - i. Dependent on materials or agents to be used.
 - ii. Evaluated in conjunction with IBC review.
- (h) Place biohazard signage on lab equipment that contacts biological agents/materials;
- (i) Maintain a log of the routine decontamination of laboratory equipment;
- (j) Decontaminate the general laboratory area (including floor) weekly unless work variability warrants a less-rigorous disinfection schedule as determined by the IBC.

- (k) Conduct all aerosol-generating procedures that involve the manipulation of potential infectious materials in a biosafety cabinet or other physical containment device when possible.
 - i. In instances where a biosafety cabinet is not feasible, additional PPE may be used as determined by the risk assessment done in conjunction with IBC review.
- (l) Incorporate an in-line HEPA filter between the overflow flask and vacuum source when suctioning potentially infectious substances.
- (m) Test PI-owned autoclaves within the laboratory that are used for biowaste at the applicable frequency described in [B8.6.4.6\(a\)](#).

B9.2.2.3

Prior to BSL2 work, a survey is needed to confirm a work area meets the criteria for BSL2.
If you have questions about these requirements, please contact EHS at 806-742-3876.

After inspection, once all criteria are met, a sign designating the lab space as BSL2 will be provided and affixed to the outside door by EHS.

B9.2.2.4

New laboratories/work areas must be commissioned prior to work being conducted regardless of the containment level.

B9.2.3

Special Considerations for Certain Research Foci

B9.2.3.1

Animal Use Considerations

The following is required for animal work to be performed using ABSL1 containment.

Laboratories working at ABSL1 must meet BSL1 and:

- (a) Have exterior doors that are self-closing;
- (b) Have exterior doors that are self-locking;
- (c) Have windows that are resistant to breakage;
- (d) Have a sink for handwashing located at the exit of are areas where infectious agents are handled or where animals are housed;
- (e) Have a safety shower;
- (f) Have internal facility fixtures (e.g., light fixtures, air ducts, and utility pipes) and penetrations in floors, walls, and ceiling surfaces (including openings around ducts, doors, doorframes, outlets, and switch plates) installed to facilitate cleaning and minimize accumulation of debris and fomites;
- (g) Have interior surfaces that are water, slip, and chemical resistant;
- (h) Have floors with drains sloped toward the drain;
- (i) Have traps on drains filled with water, appropriate disinfectant, or sealed;
- (j) Have ventilation that meet the standards of the Guide for the Care and Use of Laboratory Animals;

- (k) Have ventilation systems able to withstand high heat and moisture loads produced from cleaning;
- (l) Have the facility maintained to facilitate cleaning and housekeeping;
- (m) Have furniture minimized and able to withstand anticipated loads and uses;
- (n) Maintain a log of access to the facility;
- (o) Include animal specific policies regarding biosafety, biosecurity, emergencies and animal disposition during emergencies in the (bio)WASP;
- (p) Have medical staff informed of the animal specific occupation hazards within the facility involving research, animal husbandry, care, and manipulation;
- (q) Include animal allergy prevention as a part of medical surveillance;
- (r) Have PPE (i.e., gowns, uniforms, scrubs, laboratory coats, or other PPE) available in areas where animals are housed or animal manipulation areas;
- (s) Have eye protection disposed of with other contaminated waste or decontaminated after each use;
- (t) Not allow protective outer clothing to be worn outside of areas where infectious materials and/or animals are housed or manipulated;
- (u) Not allow gowns and uniforms to be worn outside of the facility;
- (v) Have the final rinse temperature of cage washers be 180 °F;
- (w) Have PPE that is appropriate for large animal use;
- (x) Have bite or scratch resistant gloves for animal work when appropriate;
- (y) Remove or recap needles following approved methods;
- (z) Have male and female animals separated with double barriers or measures to prevent reproductive transmission except where needed for experimentation;
- (aa) Have genetically engineered neonates permanently marked within 72 hours of birth;
- (bb) Have transgenic animals contain distinct, biochemically stable, and assayable DNA sequences for identification from among non-transgenic animals;

B9.2.3.2

The following is required for animal work to be performed using ABSL2 or ABSL2-Ag containment.

Laboratories working at ABSL2 must meet BSL2 and:

- (a) Have a sink for handwashing available at the exit of each segregated area, if the segregated area is where infectious agents or animals are manipulated or housed;
- (b) Have an autoclave available;
- (c) Have inward airflow;
- (d) Discharge exhaust air outside without recirculation to other rooms;
- (e) Have ventilated cage systems designed for microorganisms containment;
- (f) Have HEPA filters and housing certified annually on actively ventilated cage systems;
- (g) Have sealed exhaust plenums, and failure alarms for actively ventilated cage systems;
- (h) Have primary containment equipment appropriate for the animal species in containment, such as solid walls and bottoms in cages or housing areas, or microisolator lids;

- (i) Transport biological materials from animal containment in non-breakable, sealed primary containers which are enclosed in non-breakable, sealed secondary containers;
- (j) Disinfect all transport containers prior to removal from the facility;
- (k) Decontaminate cages prior to washing where infected animals were housed;
- (l) Use alkaline digestion or incineration for decontamination and disposal of carcasses;
- (m) Maintain a log of decontamination process routine verification;

In addition to ABSL2, areas working at ABSL2-Ag must:

- (a) Have entrances through a series of barriers or procedures that provide a distinct separation between containment and non-containment areas;
- (b) Have a boot wash at the entry/exit of the animal room or containment barrier;
- (c) Replace boot wash disinfectant solution according to the manufacturer's instructions;
- (d) Have floors, ceilings, and walls of animal rooms made from monolithic materials that are durable and resistant to disinfection which may include pressurized sprays, hot water, steam, or chemicals;
- (e) Have air handling services where large animals are housed or manipulated that are capable of minimizing emissions and particulates in addition to meeting animal welfare requirements;
- (f) Have electrical wiring and equipment that are installed in wet or hazardous locations sealed and grounded with animal welfare considered;
- (g) Have pens, gates, and/or animal restraint systems appropriate for the animal species with consultation from veterinary staff;
- (h) Have equipment that is sealed or coated such that it is resistant to disinfection and cleaning or is completely disassembled for complete decontamination;
- (i) Have equipment that is free of pinch points and sharp edges that could injure animals or personnel;
- (j) Have equipment for cold storage and decontamination of large animal carcasses and solid/liquid waste;
- (k) Have policies integrated into the (bio)WASP to limit contact between containment staff and susceptible animals to the outside of the containment area;
- (l) Have all staff trained to handle time-sensitive emergencies involving personnel pinned or entangled by animals or equipment;
- (m) Establish systems for a minimum of two workers to be present in the containment area at all times (i.e., a "buddy system"), or have another means of monitoring worker safety in containment.
- (n) Have agent or infected animal manipulations performed exclusively in a BSC, or if not possible due to animal size limitations, another primary containment device;
- (o) Have contaminated effluent collected for decontamination and validated for inactivation before discharge into drainage systems;

B9.2.3.3

Arthropod Use Considerations

The following is required for arthropod work to be performed using Arthropod Containment Level 1 (ACL1).

Laboratories working at ACL1 must meet BSL1 and:

- (a) Have exterior doors locked at all times;
- (b) Have door openings covered (i.e., rigid panels, glass, screens, plastic sheets, or cloth) so that they minimize the escape and entrance of arthropods;
- (c) Have windows that prevent escape by smallest of arthropods contained within as well as prevent the entry of wild arthropods;
- (d) Have interior walls that are light colored;
- (e) Have interior floors that are light colored, smooth, and uncovered;
- (f) Have electrical boxes, lighting, switches, wiring, conduit, and other penetrations sealed with caulk, foam, or other appropriate material able to withstand disinfection;
- (g) Have work surfaces and laboratory furniture that are white or light gray, water resistant, impervious to arthropods, and resistant to disinfection and heat;
- (h) Have benches, cabinets, and equipment easy to inspect for escapees;
- (i) Locate furniture and incubators containing arthropods such that accidental contact and release are minimized (i.e., out of the flow of general traffic, avoiding hallways, or in closets);
- (j) Reduce harborage and breeding areas;
- (k) Maintain a log of escapees;
 - i. If exotic arthropods are in use, maintain a log of exterior escapees;
 - ii. If escapees are found, review work practices before continuing work;
- (l) Wear clothing that minimizes exposed skin;
- (m) Wear laboratory coats, gowns, and uniforms that are white;
- (n) Not allow the entry of overcoats, hats, purses, or other personal items into the containment area;
- (o) Have cages that hold arthropods effective at preventing the escape of all life stages;
- (p) Label containers and cages that hold arthropods with the species, strain/origin, date of collection, and responsible investigator;
- (q) Clean cages and other culture containers to prevent arthropod survival and escape (e.g., heated to, or chilled below, lethal temperature);
- (r) Kill all life stages of arthropods with hot water or freezing before disposal;

B9.2.3.4

The following is required for arthropod work to be performed using Arthropod Containment Level 2 (ACL2).

Laboratories working at ACL2 must meet BSL2 and:

- (a) Have doors that have physical barriers (i.e. overlapping sheets and screens) or air curtains;
- (b) Have a contiguous double-door vestibule that prevents flying and crawling arthropods from escaping as the entrance;
- (c) Have the doors of the entrance not opened simultaneously;
- (d) Have doors that are windowless, or block the windows of interior doors, seal the windows, and use break resistant materials;

- (e)** Have internal doors that open outward or are sliding, and are closed at all times when arthropods are present;
- (f)** Have downdraft fans in the vestibule and internal corridor to help prevent flying arthropod escape;
- (g)** Have ceilings that are as low as possible;
- (h)** Minimize light fixtures, pipes, ducting, electrical boxes, switches, wiring, conduit, and other penetrations and seal them with caulk, foam, or other appropriate material able to withstand disinfection;
- (i)** Have light fixtures that are flush to the ceiling;
- (j)** Eliminate harborage and breeding areas;
- (k)** Have equipment that may store or accumulate water, such as a humidifier, screened or chemically treated to prevent arthropod access or breeding;
- (l)** Have a negative pressure gradient into the containment area;
- (m)** Have ventilation systems with filters or barriers that prevent the escape of arthropods;
- (n)** Have vacuum systems with filters or barriers that prevent the escape of arthropods;
- (o)** Have floor drains and other plumbing features covered by appropriately sized mesh or filters to prevent arthropod escape;
- (p)** Have a communication and/or a computer system that allows for communication and data transfer between the interior and exterior of the facility;
- (q)** Have an autoclave available in rooms where arthropods are present;
- (r)** Maintain an annual log of facility inspections to ensure maintenance and alterations have not compromised containment;
- (s)** Maintain a logbook of visitors;
- (t)** Use vacuum devices dedicated to a single facility;
- (u)** Manipulate non-flying arthropods in a dedicated area within a BSL2 space using a moat system if a dedicated insectary is not available;
- (v)** Store all supplies for insect maintenance in a designated area in cabinets or drawers that are tight fitting;
- (w)** Store arthropod diet in sealed containers;
- (x)** Have cages that are shatter-proof and screened to prevent escape during holding, removal, and introduction;
- (y)** Transfer arthropods between holding and manipulation areas in non-breakable, secure containers;
- (z)** Have cages or containers clearly labeled to distinguish infected and uninfected arthropods;
- (aa)** Have all infectious or potentially infectious samples labelled;
- (bb)** Have infected or potentially infected arthropods autoclaved after being rendered non-viable;
- (cc)** Open packages with foreign sourced materials in a BSC;
- (dd)** Have vector packing materials autoclaved immediately after removal of cultures and specimen from the package;

B9.2.3.5

Plant Research

Permits from the USDA must be obtained for the inter- and intrastate movement of certain plant and soil materials.

The following is required for plant work to be performed using Plant Containment Level 1 (PCL1).

Laboratories working at PCL1 must meet BSL1 and:

- (a) Adhere to all USDA-PPQ requirements;
- (b) Sterilize or disinfect all incoming material to prevent entrance of external vectors;
- (c) Not allow overcoats, hats, backpacks, purses and other personal objects in the containment areas;
- (d) Maintain a log of in progress experiments;

For PCL1 work in greenhouses:

- (e) Have doors between the greenhouse and the facility that close completely and seal to their frames;
- (f) Have audible alarms on emergency exits that activate when opened;
- (g) Have floors constructed of materials impervious to the organisms and that can withstand repeated disinfection;
- (h) Have translucent materials strong enough to guarantee security and frames to support the walls and ceilings;
- (i) Have weatherproof electrical boxes, receptacles, light fixtures, and switches;
- (j) Maintain a log of leak testing;

B9.2.3.6

The following is required for plant work to be performed using Plant Containment Level 2 (PCL2).

Laboratories working at PCL2 must meet BSL2 and:

- (a) Have exterior doors locked at all times;
- (b) Have windows, penetrations, and translucent panels sealed to the frame with caulk or other appropriate materials;
- (c) Not allow drop in ceilings when BSCs are not used for containment;
- (d) Have connections in air ducts, plenums, and vents sealed with caulk or other appropriate materials;
- (e) Have outlets and inlets (i.e., external exhaust, outside air intake, and internal air diffusers, sewer drains, traps & vents, etc.) filtered with appropriately sized mesh or filters;
- (f) Have HEPA filters changed annually or when the maximum resistance is met, and have them recertified annually or when they are changed;
- (g) Have an autoclave available;
- (h) Use a BSC to work with pathogenic bacteria, nematodes, fungi, and viruses;
- (i) Sterilize filters before disposal;

- (j) Autoclave or incinerate contaminated organisms as soon as they are detected, even if that requires destruction of a beneficial culture;
- (k) Autoclave or incinerate packing materials after the removal of specimen and cultures;
- (l) Autoclave laboratory coats, coveralls, and other clothing before removal from the facility;
- (m) Not allow offices within containment areas;
- (n) Open foreign sources packages in a BSC or in one enclosed space that is easy to disinfect;
- (o) Maintain a log of experimental plants, microorganisms, and/ or animals when they are brought into the facility or removed;

For PCL2 work in greenhouses:

- (p) Use one primary entry/exit;
- (q) If detached from the main facility, have interlocking vestibules at each door with 6 feet between the doors from threshold to threshold;
- (r) Emergency doors are not used as an entrance, have external handles removed, and have internal hinges;
- (s) Have airlock, directional airflow, filtration, and ventilation that prevent organism escape from containment;
- (t) Have electrical boxes, lighting, switches, wiring, and conduit sealed with caulk, foam, or other appropriate material capable of withstanding disinfection;
- (u) Have a communication system between the interior and exterior of the facility to prevent organism escape from containment;

B9.2.3.7

Collection and Manipulation of Human Material

Resources used as standards for the collection and manipulation of human materials:

[CLSI GP41: Collection of Diagnostic Venous Blood Specimens](#)

[CLSI GP44-A4: Procedures for the Handling and Processing of Blood Specimens for Common Laboratory Tests; Approved Guideline – 4th Ed.](#)

[WHO guidelines on drawing blood: best practices in phlebotomy](#)

[AABB: Fundamental Standards for Blood Collection and Transfusion 1st Ed.](#)

B9.2.3.7(a)

The reuse of “stress ball” style squeezing devices is not allowed for blood collection. Use a racquet ball or other device that can easily be decontaminated.

B9.2.3.8

Basics to Aseptic Technique (reference EHS SOP 3.2)

Proper aseptic practices are an essential tool in biological research.

Aseptic techniques will vary by laboratory and task, only general concepts are addressed below.

- (a) Zone workspaces within the area from clean to dirty, with the most contaminated or risky work being performed as far away from egress locations as possible. Perform sensitive tasks that do not involve biological materials in a laminar flow hood (i.e., media prep, equipment assembly, etc.).
- (b) Manipulation of biological material should be done in a BSC when feasible, this is especially important when force is applied to a material as aerosols may be produced.
- (c) Use laminar hoods and BSCs correctly. Misuse can contaminate you, your product, and the environment.
- (d) Keep work surfaces uncluttered and free of non-essential materials.
- (e) Arrange workflow from clean to dirty to avoid passing contaminated material over non-contaminated material.
- (f) Decontaminate work area before beginning work.
- (g) Regularly decontaminate equipment.
- (h) Change gloves frequently and practice good hand hygiene. Disinfect the outer surface of gloves with 70% ethanol or other disinfectant regularly.
- (i) Wear proper, well-fitting PPE. Lab coat/gown shall be buttoned all the way and glove cuffs should cover coat or gown cuffs.
- (j) Work vigilantly and deliberately when handling materials.
- (k) Work near a proper flame when working on an open bench top, if work requires. A proper flame has a bright, inner pale blue cone surrounded by a more translucent outer cone.
- (l) Avoid placing caps/covers on the work surface, and when you must, place them face down on the work surface.
- (m) Use tools (forceps, tube openers, etc.) to open and close tubes containing biological material and decontaminate them between samples.
- (n) Clean up spills appropriately and immediately.

B9.2.3.9

Proper Use of Sharps (reference EHS SOP 4.1)

Disposal of sharps is in section [B8.8.1](#).

- (a) Avoid using sharps whenever possible; use blunted needles and plastics instead.
- (b) Use devices with safety features to isolate sharps and be familiar with function and features prior to use.
- (c) Use disposable sharps instead of reusable sharps to avoid hazards associated with decontaminating the items.
- (d) Be prepared to use the device the moment the sharp is exposed and secure or discard immediately after use.
- (e) Stabilize hands or use a one-handed technique when uncapping devices to prevent recoil injuries.
- (f) When drawing solutions from a vial, immobilize the syringe on the hypothenar eminence located at the base of the hand and insert the vial on the needle.
- (g) Do not bend, break, or otherwise manipulate needles by hand.

- (h) Do not remove needles. Discard needles and syringes as an intact unit immediately after use into an FDA-approved sharps container.
- (i) Do not recap needles or other sharps. If needles must be recapped a valid written reason for recapping, as well as a protocol must be submitted to and approved by EHS. Appropriate documented training must be given to each individual and a documented demonstration of proficiency must be recorded.
- (j) Use care and caution when cleaning up after procedures that require the use of sharps.
- (k) Reusable sharps must be placed in a closable, rigid container for transport, decontamination, and storage. The sharp end of items must be secured in such a manner as to prevent accidental injury.
- (l) Sharps containers shall be immediately accessible. Locate sharps containers in areas in which needles are commonly used.
- (m) Do not hand-pass exposed sharps. Place sharps in a predetermined neutral zone to pass objects to others.
- (n) Do not overfill sharps containers. Remove from service when at the fill line (e.g., 3/4 full), close, autoclave if desired, and dispose of in accordance with University Operating Policy 60.10.

In the event of a needle stick or other sharps-related injury: Expose the wound; express the wound, cleanse the wound, and then bandage the wound. Notify the PI and seek follow up treatment as needed. An incident report must be filed with EHS within 24 hours of the event.

Access to the online form for Risk Management is available on the EHS website at: <http://www.depts.ttu.edu/ehs/about/incident-reporting.php>.

Near misses should be reported to EHS by submitting a SCAN form on the EHS website <https://www.depts.ttu.edu/ehs/about/scan.php>.

B9.2.4

Entry Procedures for Non-Laboratory Personnel into Containment Level 2 Laboratories

As described in section [B9.2.2.2\(e\)](#), only authorized personnel are allowed in Containment Level 2 laboratory spaces; however, at times, entry of non-laboratory personnel may be necessary.

B9.2.4.1

Occasions of Entry by Custodial Personnel

Custodial Services can be reached during university business hours at 806-742-9777. A red dot will be placed on the door by custodial staff as a signal not to enter the laboratory space. This is a requirement for Containment Level 2.

B9.2.4.1(a)

Once a laboratory is designated as containment level 2 the PI or laboratory manager must notify custodial services that they are not to enter the laboratory.

B9.2.4.1(b)

General laboratory wastes (non-contaminated waste) shall be placed outside the laboratory for custodial pick up.

B9.2.4.1(c)

Arrangements can be made with custodial for semiannual/annual floor waxing.

The laboratory must be properly disinfected prior to custodial entry, all chemical and biohazardous materials must be stored.

While in the laboratory, custodial personnel must:

- i. Don clean PPE upon entry into the laboratory; PPE is supplied by the PI.
- ii. Be escorted by laboratory personnel at all times.
- iii. Wash their hands prior to leaving the laboratory.

B9.2.4.2

Occasions of Entry by Maintenance Personnel

B9.2.4.2(a)

If maintenance workers must enter a laboratory space, they first must notify the PI or designated emergency contact. Experiments in progress should be secured and suspended if possible.

B9.2.4.2(b)

While in the laboratory, maintenance personnel must:

- iv. Don clean PPE upon entry into the laboratory; PPE is supplied by the PI.
- v. Be escorted by laboratory personnel at all times.
- vi. Wash their hands prior to leaving the laboratory.

B9.2.4(c)

Should maintenance workers enter a lab space for emergency purposes outside of business hours, they must notify the PI or emergency contact prior to entry and still follow B9.2.4.2(b).

B9.2.4.3

Occasions of Entry by Others

Entry into laboratory areas by non-laboratory personnel is addressed in A6 of the University Laboratory Safety Manual. The expectations for notification and communications of visitors to the lab should be outlined in the bioWASP or IBC protocol. The following outline additional requirements for Containment Level 2 research areas:

- (a) Visitors must be escorted at all times by lab personnel with the approval of the PI.
- (b) Visitors shall be notified of the hazards present in the laboratory and wear the same PPE as workers are required to as stated in A6.2. If PPE is refused or clean PPE is unavailable, then entry into the laboratory shall be denied.
- (c) Hands must be washed after PPE is removed, prior to leaving the laboratory.

- (d) Minors under the age of 16 are not permitted in Containment Level 2 spaces under any circumstances.
- (e) Minors ages 16-17 may work in accordance with the specifications of section A8.3.1 of the University Laboratory Safety Manual unless the building or laboratory-specific manual is more restrictive.

B10 COMMON LABORATORY EQUIPMENT USEAGE

SOPs are required for all laboratory equipment. See LSM A12.1.

B10.1

Biosafety Cabinets

The biosafety cabinet (BSC) is designed to provide protection to the user and the environment when appropriate practices and procedures are followed; certain BSC classes also protect the materials within the cabinet. The three types of BSCs (Class I, II, III) are described in Appendix BD. The common element to all classes of biosafety cabinets is the high efficiency particulate air (HEPA) filter. This filter removes particulates of 0.3 microns with an efficiency of 99.97%; however, particles both larger and smaller than 0.3 microns are removed with increased efficiency.

B10.1.1

Chemical and Radioactive Materials in the BSC

Based on the unit's design, work with chemicals or radioactive materials may require special measures, or such work may be prohibited within the BSC. EHS approval is needed before work with chemical or radioactive materials occurs within the BSC.

While the HEPA filter can protect the worker from most biological hazards when used properly, it does not remove radiation, hazardous chemicals, vapors, or gases. A brief outline of common limitations according to the BMBL is below. If you have questions regarding what type of BSC you have or if your work can be done safely within your BSC, please contact EHS at 806-742-3876.

1. Flammable or otherwise volatile chemicals are not used in a Class II, Type A BSC. Limit the use of ethanol to decontamination of gloves and surface decontamination of the BSC. This cabinet generally exhausts HEPA filtered air back into the workspace and recirculates the remainder. The electrical systems of Class II BSCs are not spark-proof. Thus, this practice creates an avoidable hazardous situation which may result in fire or personnel exposure to toxic chemical vapors; however, many liquid chemicals, including nonvolatile antineoplastic agents and chemotherapeutic drugs can be safely handled within Class II, type A and B BSCs.
2. BSCs should not be used for labeling biohazardous materials with radioactive isotopes. Hard-ducted, ventilated containment devices incorporating both HEPA and charcoal filters in the exhaust systems are necessary for the conduct of this type of work.
3. Work with chemical carcinogens and other toxic substances within a Class II BSC requires additional treatment measures for the exhausted air. Careful evaluation must be made of potential problems associated with decontaminating the cabinet and the exhaust system in this case. Air treatment systems, such as a charcoal filter in a bag-in/bag-out housing may be required so that discharged air meets applicable emission regulations.

For these reasons, a chemical fume hood is to be used for procedures using volatile, toxic or carcinogenic chemicals.

B10.1.2

Biological Materials

Certain biological materials and procedures may require the use of a BSC. The requirement for a BSC at BSL2 is determined by a risk assessment during IBC review.

A biosafety cabinet should be used to protect you and the environment in the following conditions:

1. When performing procedures with a high potential for creating aerosols or those that might cause splashing, spraying or splattering of droplets of biological materials.
 - (a) Any procedure that imparts energy to a liquid sample or microbial suspension such as centrifuging, grinding, blending, vortexing, sonicating, vigorous shaking/mixing/pipetting, opening containers of materials whose internal pressures may be different from ambient pressures (e.g., cryovials, lyophilized samples, fermenters, etc.), and inoculation and tissue harvest procedures involving inoculated animals.
2. When large quantities or high concentrations of organisms are used.
3. For processing of human materials or samples where disease status is unknown.

This is not an exhaustive list, only a collection of general guidelines. When in doubt, use the BSC or call EHS with your questions 806-742-3876.

B10.1.3

Handling and manipulation of BSL3 agents is ALWAYS performed in a BSC. Additional PPE, including respiratory protection, may also be required.

B10.1.4

Installation, Maintenance and Certification

1. BSCs should be installed away from the lab entry in an area with restricted foot traffic and little equipment which creates air movement that may disrupt the protective air curtain of the BSC. The overall air balance of the laboratory and adequate clearance for air intake, work, and ducting are also considerations when selecting your cabinet and its location. Consult EHS for assistance in determining your BSC's location.
2. Biosafety cabinets are highly customizable; however, certain features are prohibited or not recommended.
 - (a) Sinks are not allowed in BSCs.
 - (b) Ultraviolet (UV) lamps are not recommended in BSCs. If installed, lamps must be properly maintained and never used as the sole source of decontamination.
 - Check manufacturer guidelines for maintenance and frequency of replacement. BSC UV lamps must be properly maintained and never used as the sole source of hood decontamination.

General maintenance includes:

- i. Cleaning bulbs weekly to remove dust and debris which may lessen effectiveness of UV light.
 - ii. Checking bulb regularly with a UV meter to ensure a germicidal intensity of UV light is being emitted.
 - iii. Closing the sash when the lamp is on and turning off the lamp when room is occupied.
3. Biosafety cabinets require regular maintenance and certification by a professional technician to assure that it protects you, your experiments, and the environment.
- (a) Each cabinet must be certified when it is installed and annually after installation.
 - (b) Moving the cabinet or repairs made to the cabinet void any current certification such that if the cabinet is moved from the original place it was installed and certified, or if any repairs are made, recertification is required before use is resumed.
 - (c) If a cabinet needs repairs to plenums of the unit, it must be fumigated by a third party prior to repairs.
 - (d) Switches and repairs of that nature can be completed in-house by qualified lab personnel, a third party, or the physical plant so long as the BSC plenums are not accessed or compromised.
4. Annual BSC certification is the PI's responsibility to coordinate and is completed by a third party (not TTU-EHS); please call EHS if you need a list of vendors.

Call EHS for assistance with cabinet selection and installation guidance.

B10.1.5

Guidelines for Operation of a Class II Biosafety Cabinets

Proper PPE is required while working in the BSC. At minimum, a fastened lab coat, gloves, and safety glasses are required. Glove cuffs should cover jacket cuffs, especially when handling sensitive materials or potentially infectious agents. Additional PPE requirements are necessary for handling and manipulation of BSL3 agents.

B10.1.5.1

Preparation

- (a) Prepare a checklist to minimize arm movements in and out of the BSC which disrupts the delicate protective air curtain.
- (b) Check certification date on BSC. Certification must be within the past 12 months. If certification has expired, DO NOT USE THE BSC.
- (c) Turn on fluorescent light and turn off the UV light if in use.
- (d) Ensure the sash is in the appropriate position. Turn on the blower fan. If blower was off, allow at least 5 minutes before beginning cabinet disinfection.
- (e) Compare the pressure reading on the magnehelic gage to the certification sticker. If the gage reads at or within 10% greater pressure than the inspected value, the BSC may be used. If the gage reads lower than the inspected reading or more than 10% greater, then do NOT use the BSC. Post an out of order sign and call a vendor for repairs.

- (f)** Check gauges/monitors to ensure the unit is functioning properly. Do not work in a BSC while a warning light or alarm is signaling.
- (g)** Disinfect the interior surface of the sash, interior walls, then work surface with a disinfectant determined by the risk assessment to address the particular agent.
 - i.** Do not raise the sash beyond operable height.
 - ii.** Ethanol may not be adequate as the sole disinfectant for the interior surfaces of the BSC. Contact time is abbreviated within the cabinet while the blower is running thus appropriate contact time may not be met.
 - iii.** Bleach should be used with caution to disinfect BSCs given its corrosivity. If used, follow with an ethanol or sterile water rinse to avoid corrosion of the stainless-steel.
- (h)** Plastic-backed absorbent liners may be used so long as they do not obstruct the front or rear grille openings. Use of this material facilitates clean up and reduces spatter in the event of a spill. Liners must be decontaminated or placed in a closed autoclave bag within the BSC before removal from the BSC. It can be folded – absorbent side together, plastic backing out - and placed in a biowaste bin after a spill or when work is complete.
- (i)** Disinfect the surfaces of all materials to be placed in the cabinet with 70% ethanol or other disinfectant – allow adequate contact time. Only the items necessary for the immediate work should be placed in the BSC.
 - i.** Keep the front and rear grills clear. Place materials on metal risers or shelves to help reduce disturbance to the grill area.
 - ii.** Arrange workflow should be clean to dirty.
 - iii.** Extra supplies (gloves, extra tips, etc.) should be stored outside the BSC. Keep the work area free of unnecessary equipment/supplies which may affect proper airflow and subsequently, your protection.
 - iv.** Bulky items should be placed to the rear and to one side of the work surface.
 - v.** Place supplies, especially aerosol-generating equipment such as vortexes, as far back as possible in the cabinet.
 - vi.** Biowaste must be contained or decontaminated within the cabinet. Movement of hands in and out of the cabinet to discard pipettes and other materials creates turbulence that disrupts the air barrier which maintains sterility inside the cabinet and protects the worker. Taking exposed contaminated materials outside the BSC unnecessarily introduces contamination to the environment outside the BSC. Only horizontal pipette discard trays should be used. A shallow pan filled with a disinfectant suitable for biowaste treatment (i.e., not ethanol) is a good option. Contact EHS if you have questions.
 - vii.** Include disinfectant and paper towels in your supply list to manage spills quickly if they occur.
- (j)** Use a surface-decontaminated tub to move materials in groups into and out of the BSC to minimize disruptions to the air curtain.
- (k)** Locate liquid waste traps with disinfectant inside the cabinet and use a hydrophobic filter to protect the vacuum lines. If traps must be located on the floor outside the BSC, place them in a secondary container to prevent spilling.

- (l) Place the sash at the proper height for operation. Keep your head out of the hood; adjust your chair so that your face is above the sash opening. The BSC is now ready for biological materials.

B10.1.5.2

Working in the BSC

- (a) Once arms are in the BSC, delay work by 1 min to allow the air curtain to stabilize.
- (b) Work as far to the back (beyond the grille) of the BSC workspace as possible.
 - i. Work at least 6 inches beyond the front grille.
 - ii. Move smoothly and deliberately in and out of the BSC, perpendicularly to the unit – avoid side-to-side, sweeping movements.
 - iii. Do not rest your arms on front grille.
- (c) Always use good aseptic and microbial technique when working in a BSC.
 - i. Use mechanical pipetting aids.
 - ii. Keeping clean materials away from aerosol-generating activities to minimize cross contamination.
 - iii. Work with sensitive materials in the air split.
 - iv. Keep open tubes/bottles in a vertical position and do not place lids on the work surface.
 - v. Hold the lid above the sterile surface of petri or tissue culture dishes.
 - vi. Recap or recover items as soon as possible.
- (d) The agent is the last item added to the BSC.
- (e) Remove outer glove if double gloving or decontaminate gloves before entry into and removal from the BSC.
- (f) Open flames shall not be used inside a BSC. Flames disrupt the airflow and contribute to the heat load inside the BSC. Flames have also burned holes through HEPA filters and caused explosions in BSCs.
- (g) Disposable sterile loops/needles should be used in place of metal loops or needles to avoid incinerator or bead bath use.
- (h) Follow spill protocols in the event of a spill (see section [B7.2.4](#)). Leave the BSC running while you are cleaning up the spill. If you are uncertain on how to manage a spill, please call EHS for assistance at 806-742-3876.
- (i) When work is completed with the BSC still running, first contain, surface disinfect, and remove the agent. Contain and remove the agent, then proceed to decontaminate the surfaces of supplies and equipment and remove them from the cabinet – working clean to dirty and using the tub in-tub out method. Wipe down the interior surface of the sash, interior walls, and the work area with a disinfectant determined by the risk assessment. Remove all materials from the BSC (except for pipettors if you choose). Close the sash if desired and turn off the BSC unless laboratory protocol states the BSC is to be kept running.
- (j) If a UV light is used in the BSC, it may be turned on at this point if others are not working nearby. UV radiation shall not take the place of chemical disinfection in the cabinet interior.

B10.2

Laminar Flow Hood

A laminar flow hood or "clean air bench" is not a BSC. In these units, HEPA-filtered air is discharged horizontally across the work surface and toward the user, or vertically, downward onto the work surface ultimately exposing the user to the contents. Laminar hoods only provide product protection. They can be used for certain clean activities, such as dust-free assembly of sterile equipment or electronic devices, media dispensing, and most nucleic acid work.

Laminar hoods do not require annual certification; however, EHS recommends they be certified annually to protect the integrity of your work.

B10.2.1

Laminar hoods shall never be used as a substitute for a BSC. The following materials are not to be used in laminar flow hoods:

1. Flames;
2. Any viable organism / material including cells for cell/tissue culture;
3. rNA/sNA work if the host-vector system is classified as RG2, is self-replicating, or has the capability to insert itself into DNA; and/or
4. with any other potentially infectious / hazardous materials.

B10.3

Centrifuge Containment and Safety

B10.3.1

When centrifuging materials:

1. Examine centrifuge tubes and bottles for cracks or stress marks before using them;
2. Use the proper size of rotor or bucket for your tubes/bottles/plates;
3. Never overfill centrifuge tubes since leakage may occur when tubes are filled to capacity;
4. Fill centrifuge tubes no more than 3/4 full; and
5. Use a tube/plate/bottle with an equivalent amount of water as a balance when odd numbers of items are centrifuged.

B10.3.2

Centrifuge safety buckets and sealed rotors protect against the release of aerosols and are required for the centrifugation of RG2 material.

B10.3.3

When centrifuging potentially infectious material, delay the opening of the centrifuge at least 5 minutes or open safety buckets/rotor within a BSC.

B10.4

Vacuum Lines

B10.4.1

All vacuum lines used to aspirate supernatants, tissue culture media and other liquids that may contain potentially infectious or genetically modified materials must be protected from contamination using a collection flask and overflow flask containing a disinfectant.

B10.4.1.1

Collection and Overflow Flasks

Collection tubes should extend at least 2 inches below the sidearm of the flask. Locate the collection flask inside the biosafety cabinet instead of on the floor so the liquid level can be seen easily, and the flask emptied before it overflows. The second flask (overflow) may be located outside the cabinet.

B10.4.1.1(a)

If flasks are used at floor level, place them in a sturdy leak-proof container to prevent breakage and spills. In BSL2 or BSL3 laboratories, the use of Nalgene flasks is strongly recommended to reduce the risk of breakage associated with infectious materials.

B10.4.2

Vacuum Line Filter

A hydrophobic filter will prevent fluid and aerosol contamination of central vacuum systems or vacuum pumps. The filter will also prevent microorganisms from being exhausted by a vacuum pump into the environment. Hydrophobic filters or Vacushields™ are available from several scientific supply companies (e.g., EMD Millipore Millex™ Filters: Inlet and Outlet for Latex Tubing or Vacushield™ Vent Device, Pall® Life Sciences).

B10.4.2.1

When working with agents that require Containment Levels 2 & 3, a hydrophobic in-line vacuum filter shall be used.

B10.4.2.2

Vacuum line filters are disposed of as biological waste and require treatment prior to disposal.

B11 DECONTAMINATION AND DECOMMISSIONING OF LABORATORY EQUIPMENT

B11.1

General Information

This is not an all-inclusive list of hazards and equipment. It is the responsibility of the PI to ensure that all equipment is properly and adequately decontaminated. Check with the equipment manufacturer for recommendations regarding decontamination procedures.

B11.1.1

Regular decontamination of equipment is required in any biological laboratory. Decontamination logs are required at Containment Level 2 or greater.

B11.1.2

Equipment in need of repairs, maintenance, or removal from areas where rNA/sNA and/or potentially infectious materials are stored and/or manipulated must be autoclaved or thoroughly chemically decontaminated then cleared by EHS prior to repairs, maintenance or removal.

B11.1.3

The Equipment Decontamination Form is to be filled out and submitted to EHS if the equipment is to be sent for repairs/maintenance or otherwise removed from the laboratory. This form is available on the [EHS website](#).

B11.1.4

It is the responsibility of the PI to contact the manufacturer to address additional considerations. Should further questions regarding decontamination exist, please contact EHS.

B11.1.5

Decontaminate all interior and exterior surfaces of the equipment – do not neglect tubing and other accessories or components.

B11.1.6

Personnel shall always wear appropriate PPE while performing decontamination; at minimum, gloves, lab coat, and protective eye wear should be worn.

B11.2

Hazard Assessment

Additional hazards may be associated with the equipment (i.e., chemical and/or radioactive). If other hazards are present, contact EHS.

B11.2.1

Biological Hazard

Disinfect all surfaces with an appropriate chemical agent, or if possible, autoclave parts or equipment that can withstand autoclave conditions using a biowaste setting (30 minutes @ 121°C, 15 psi). Contact EHS if other hazards are present.

B11.3

EHS Clearance of Decontaminated Equipment

B11.3.1

It is the laboratory's responsibility to ensure that equipment is thoroughly decontaminated.

Once the equipment has been decontaminated, the PI or lab supervisor will need to fill out and submit the Equipment Decontamination Form. Upon receipt of the form, EHS will come to inspect the equipment.

B11.3.2

Equipment shall not be removed from the laboratory for repairs, surplus, disposal, etc. until EHS has cleared the equipment.

B11.4

Considerations for Common Equipment

This is a guideline – it is not an exhaustive list of equipment, nor may it cover all features of the equipment listed.

Biological contamination is addressed here. Autoclave items when possible and allow allotted contact time for disinfectant used during the decontamination process when chemical disinfection is used. If an item was used for chemical or radioactive storage and/or manipulation, refer to the CHP or Radiation Safety Manuals as applicable to the equipment and hazards.

B11.4.1

Refrigerators and Freezers

Remove all contents and either appropriately store or dispose of them. Defrost the equipment if necessary. All liquid should be collected and treated as biohazardous waste. Decontaminate all surfaces with appropriate chemical disinfectant.

B11.4.2

Incubators

Follow manufacturer's guidance. Remove thermometers; properly secure any mercury thermometers. Drain and collect water from water-jacketed incubators for disinfection. If water doesn't have a disinfectant present already, disinfect water by autoclaving or chemically by adding enough bleach to achieve a 10% solution; allow bleach solution to sit for at least 20 minutes then pour down a drain. If water was visibly contaminated, fill the water jacket with disinfectant. After the allotted contact time, drain and flush with copious amounts of DI water.

Some incubators have a sterilization cycle. Disinfect all interior surfaces based on the risk assessment then run the sterilization cycle. Follow with 70% ethanol if a different disinfectant was used to remove any residue. Some disinfectants can leave residues that can be absorbed by media and be cytotoxic.

For incubators without a sterilization cycle, autoclave the removable parts able to withstand autoclave conditions using biowaste settings unless otherwise specified by the manufacturer. Chemically decontaminate the remaining surfaces.

B11.4.3

Biosafety Cabinets

Biosafety cabinets require decontamination by a third party before the cabinet is removed from a lab or repaired ([B10.1.4.3\(b\)](#)). Decontamination requires fumigation with formaldehyde, chlorine dioxide or vapor phase hydrogen peroxide. The company contracted shall provide a certificate of decontamination once completed. The BSC will require recertification prior to use.

B11.4.4

Laminar Flow Hood

Laminar flow hoods should not need fumigation to disinfect as only non-hazardous items *should* have been handled in them and the HEPA filter only filters lab air. Decontaminate all surfaces with 70% ethanol or other desired disinfectant.

B11.4.5

Centrifuges

Remove tube adaptors and the rotor if possible. Autoclave rotors when indicated by manufacturer; otherwise, soak snap-on lids, adaptors, and rotors in a manufacturer-approved disinfectant appropriate for agent(s) for appropriate contact time. Rinse with DI/RO water, dry, and follow with 70% ethanol or isopropanol. Disinfect the exterior of the centrifuge in the same manner.

B11.4.6

Water baths

Disinfect water chemically by adding enough bleach to achieve a 10% solution. Scrub inside of water bath to release any biofilms/mold/algae and allow to sit for 20 minutes. Dispose of water in drain and chemically disinfect the lid and outside of the bath. Rinse to remove bleach.

B11.4.7

Balances/Scales

Remove parts that can be removed. Disinfect with appropriate disinfectant, follow with 70% ethanol or water if needed.

B11.4.8

Automated Liquid Handling systems

These systems should have decontamination instructions from the manufacturer. In the absence of instructions, drain and capture any liquids from the system and autoclave or chemically disinfect collected liquid by adding enough bleach to achieve a 10% solution, allow contact time and discard.

Flush system with a 10% bleach solution; follow with a copious amount of DI or RO water. After the water rinse, flush the system with 70% ethanol (trap waste for EHS disposal) and flush system with sterile DI or RO water.

B11.4.9

General Reusable Laboratory Supplies

Items such as pipettes, serological pipetting devices, hot plates, stir plates, vortexes, chairs, furniture, storage cabinets, glassware, etc. should be sanitized with an appropriate disinfectant to neutralize any agents to which these items have been exposed. Check with the manufacturer regarding the potential for autoclaving an item. Disassemble equipment where possible, allow adequate contact time for disinfectant to work and be sure to clean corners, crevices, and crannies that are hard to reach.

B12 DECOMMISSIONING A LABORATORY SPACE

B12.1

General Information

This requirement is designed to assist PIs who are vacating a laboratory space at the University for any reason. These guidelines ensure that the laboratory space will be cleared of hazardous materials so as to protect contractors and other personnel and to expedite laboratory assignment to new occupants. Also see LSM A25.

The PI is to notify EHS that the laboratory will be vacated 30 days prior to departure or when known. Upon notification, EHS will inspect the laboratory to identify the hazards that must be addressed before the PI departs. The laboratory will be inspected again prior to PI departure to ensure that all hazards are addressed and to verify the clearance of the laboratory space.

If a PI departs before the laboratory is decommissioned, the department assumes the responsibility of the laboratory and its contents unless otherwise indicated below.

B12.2

Decontamination

The entire laboratory and its contents shall be decontaminated or neutralized prior to the PI departing the laboratory.

Certain equipment may require decontamination by a third party. Appropriate disinfectants must be used to address the agent(s) that have been stored and/or manipulated in the laboratory. Allow adequate contact time for disinfectants and autoclave when possible.

Refer to sections [B8](#) and [B11](#) for more information on disinfectants and decommissioning of laboratory equipment, respectively.

B12.2.1

All laboratory benches, equipment, glassware, storage areas, shelves, fixtures, and furniture must be decontaminated with an appropriate disinfectant for agents present in laboratory.

B12.2.2

Leave hazard labels in place on equipment.

B12.2.3

Fume hoods, glove boxes, and BSCs must be decontaminated. BSCs require a third party for decontamination if they are to be removed from the work area.

B12.3

Packing and Moving

B12.3.1

Laboratory personnel are responsible for moving the laboratory. Consult the [Lab Move guidelines](#) on EHS's webpage for guidance.

B12.3.2

Assume all chemicals, biological materials, and gases are regulated. Contact EHS with questions regarding the transportation of any hazardous materials.

B12.3.3

A PI may transfer biological materials to an existing PI; however, the PI receiving the materials is responsible for attaining an IBC protocol and containment level for the received materials when required. See section [B4.2.9](#) for project types that require IBC review and receive approval before a transfer is made. Contact EHS if you have any questions at 806-742-3876.

B12.3.3.1

Any biological materials that require an IBC protocol that are not transferred to a new PI and covered with a protocol become the property of EHS and will be destroyed.

B12.4

Waste Disposal

All chemical, biological, and radioactive waste must be disposed of in their respective waste streams. See A25.1.1.2.

B12.4.1

Biological Waste

All biological materials must be appropriately destroyed, transferred to a new PI or moved/shipped to their new location in a DOT/IATA-compliant manner. Contact EHS regarding the transportation of biological material.

B12.4.1.1

Prior to the PI departing the laboratory, all sharps and other biohazardous waste shall be disposed of in accordance with Section 8 of the Biosafety Manual.

B12.4.2

General Waste

Any waste (boxes, trash, broken glass, etc.) shall be properly disposed of prior to the PI departing the laboratory.

B13 TRANSPORT AND SHIPMENT OF BIOLOGICAL MATERIALS

B13.1

Transport of Biological Materials on or to Texas Tech University Property

The following procedures are to be followed when transporting biological materials to or between laboratories on Texas Tech properties.

Please call EHS at 806-742-3876 if you have any questions regarding the transport of materials on or to TTU property. The use of personal vehicles is discouraged and done at the owner's risk.

University vehicles are encouraged for all transport, and as stated in LSM A20.1.5, transport of DOT-regulated materials on public roadways requires the use of a University vehicle.

B13.1.1

Conditions

B13.1.1.1

Do not take biological materials to non-lab areas or leave items unattended during transport.

B13.1.1.2

The destination lab must be the same containment level and classification/level as the materials being transported.

B13.1.1.3

Materials must be properly packaged as outlined in B13.1.2.

B13.1.1.4

The package is not to be opened in transport between laboratories for any reason.

B13.1.1.5

If traveling, have a biological spill kit with you in case of a spill. In the event of a spill, submit a SCAN. If a spill occurs between laboratories on campus, notify EHS immediately at 806-742-3876.

B13.1.2

Packaging

B13.1.2.1

For RG1 or materials that require Containment Level 1 biological materials or specimens that may potentially contain such materials:

- (a) Primary specimen container shall be leak-proof, sealed, and labeled with the following information: Name or initials, date, identifying number, name, or other information.
- (b) Primary specimen containers shall be wrapped in absorbent material (if liquid in nature) and placed in a rigid secondary, leak-proof container with a locking lid.

B13.1.2.2

For RG2 or materials that require Containment Level 2 biological materials or specimens that may potentially contain such materials:

- (a) Primary specimen container shall be leak-proof, sealed, and labeled with the following information: Name or initials, date, identifying number, name, or other information
- (b) Primary specimen container shall be wrapped in absorbent material (if liquid in nature) and placed in a secondary sealed, leak-proof container (e.g., Ziploc bag).
- (c) The packaged material should then be placed in a rigid transport container, such as a cooler, labeled with biohazard stickers and the name of the PI.

B13.2

General Shipping Information

Shipping and receiving of infectious agents, biological products/specimens, clinical specimens, and other potentially hazardous substances is controlled by multiple agencies. Regulations are not always uniform, and permits are often required. These regulations are continually modified, and new ones are added across regulating entities.

Non-compliance with regulations can result in financial penalties to the shipper and potentially to the University. Even with training, EHS recommends that the shipper check with applicable regulatory agencies prior to shipping potentially hazardous materials. See LSM A20.

B13.2.1

Shippers or employees handling hazardous goods (chemical or biological) are required to take Hazardous Shipper Training pertinent to their duties.

B13.2.1.1

The training must be renewed every two years so long as duties regarding shipping are ongoing.

B13.2.2

The Department of Environmental Health & Safety is to be notified of all shipments of biological materials initiated by TTU personnel 2 business days before the shipment is to occur.

B13.2.3

A copy of all shipping documents must be submitted to EHS for regulated materials before the shipment departs.

Please contact EHS at 806-742-3876 to schedule your training prior to your shipment. Once training is complete the certificate is current for 2 years.

B13.3

Permits and Documentation

When applicable, the responsible party (i.e., PI or lab supervisor) must secure permits for transport prior to shipment and the permit(s) must accompany the shipment and/or transport.

Permits take time to process. Be proactive in obtaining proper permit(s) for materials you plan on shipping or receiving well in advance (several months). While it may not take that long to obtain a permit, allowing ample time will ensure materials can be transported on the desired schedule. Items that do not require a permit to ship and/or receive may still require special packaging.

B13.3.1

CDC Import Permits

The Centers for Disease Control and Prevention's Import Permit Program (IPP) regulates the importation of infectious biological agents, infectious substances, and vectors of human disease into the United States. Inter-state transfer of previously imported materials also requires the receiving party to obtain a permit.

Prior to issuing an import permit, IPP reviews all applications to ensure that entities have appropriate safety measures in place for working safely with the imported materials; anticipate an inspection by the CDC if you obtain an import permit. More information regarding CDC permits can be found at: <https://www.cdc.gov/cpr/ipp/index.htm>.

B13.3.1.1

The CDC Import Permit Program (IPP) sites 42 CFR 71.54 to address the import regulations for infectious biological agents, substances, and vectors. See their website for the most current information: <https://www.cdc.gov/cpr/ipp/regulations.htm>. They also have a decision tool available to help you determine if an import permit: <https://www.cdc.gov/cpr/ipp/etool.htm>, as well as, an FAQ page: <https://www.cdc.gov/cpr/ipp/faq.htm>

B13.3.2

USDA permits

APHIS or APHIS-PPQ issues permits for export and import for, intra-/inter-state transit of, and release within the United States of regulated animals/animal products, veterinary biologics, plants/plant products, pests, organisms, soil, and genetically engineered organisms. See the APHIS website for more information: <https://www.aphis.usda.gov/aphis/resources/permits>.

Animal materials (especially food animal-related materials) whether offered for import, export, or interstate transport, require evaluation through the [USDA-APHIS Veterinary Services Permitting Assistant](#). Should your animal materials not be subject to a permit, in most cases, a Letter of Conditions will be automatically generated for the materials. This letter must accompany the shipment. If a permit applies, you will be routed to the permitting application. There is a "Guide Me" function for assistance with the permitting assistant or you can reach out to EHS by phone (806.742.3876) or email ehs.lab.safety@ttu.edu.

B13.3.2.1

Animal and animal products - Includes live animals, semen, embryos, and materials derived from animals or exposed to animal-source materials such as animal tissues, blood, cells or cell lines of livestock or poultry origin, RNA/DNA extracts, hormones, enzymes, microorganisms including bacteria, viruses, protozoa, and fungi. In addition, animal materials including dairy products (except butter and cheese), and meat products (e.g., meat pies, prepared foods) from countries with livestock diseases exotic to the U.S.

B13.3.2.2

Veterinary Biologics - Includes vaccines, bacterins, antisera, diagnostic kits, and other products of biological origin.

B13.3.2.3

Biotechnology products - Includes genetically engineered organisms considered to be regulated articles.

B13.3.2.4

Plants, Organisms, and Soil

Organism and Soil Permits: Include plant pests such as arthropods and mollusks (insects and snails); plant pathogens such as fungi, bacteria, nematodes, mycoplasma, viroids and viruses; biological control agents, bees, Plant Pest Diagnostic Laboratories, Soil Microbe Isolation Laboratories, Federal Noxious Weeds and Parasitic Plants.

Plants and Plant Products Permits: Include Plants for Planting such as nursery stock, small lots of seed, and Postentry; Plant Products such as fruits and vegetables, timber, cotton and cut flowers; Protected Plants and Plant Products such as orchids and Threatened and Endangered plant species; Transit Permits to ship regulated articles into, through, and out of the U.S.; and Controlled Import Permits to import prohibited plant materials for research.

Transit Permits: Required by the Animal and Plant Health Inspection Services (APHIS) in advance of arrival for the unloading, landing or other movement of plants, plant products, plant pests, or soil in cargo through the United States.

Permit Website: <https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits>

B13.3.3

FWS Permits

U.S. Fish and Wildlife Service permits are required for certain live animals, including bats. Please call 1-800-344-WILD or go to <https://www.fws.gov/permits/?ref=topbar> for further information. Check with the individual states' wildlife service about permits as well.

B13.3.4

Select Agent Transport

Importation of select agents or biological toxins requires the intended recipient to be registered with the Select Agent Program and submit required paperwork to obtain approval to import the select agent or toxin prior to each importation event (see 42 CFR 73 and/or 9 CFR 121). Select agents are listed online: <https://www.selectagents.gov/SelectAgentsandToxins.html>. Please contact EHS at 806-742-3876 if your work includes any of the agents listed.

B13.3.5

Export Control

If you plan to export biological materials, contact EHS for guidance.

The export of a wide variety of microorganisms and toxins of human, plant, and animal diseases may require a license from the Department of Commerce, Bureau of Industry and Security. Further information may be obtained by calling the Department of Commerce, Bureau of Industry and Security at 202-482-4811 or through the internet at <https://www.bis.doc.gov/Licensing>.

Other agencies such as the FDA or DEA may regulate the goods you wish to transport. Please consult the FDA and DEA regulations for guidance related to the item you wish to export and do not rely solely on the Export Administration Regulations for information about other agencies' export control requirements.

B13.3.5.1

All products and technology that leave the country are subject to [TTU OP74.10](#). Before you travel or ship items outside the country, consult the TTU Export Control webpage: <https://www.depts.ttu.edu/research/integrity/export-control/> or contact Export Control directly with questions by email to Allie Matviko, amatviko@ttu.edu.

B13.3.6

Additional Documentation

The shipper is required to initiate and secure all applicable non-permit documentation prior to transport of the materials. Letters of disclosure, material transfer agreements, SDS sheets, packing lists, customs declaration forms, hazard declaration forms and other documentation may be required to successfully complete your shipment.

Additional documentation is often needed in the transfer of scientific materials to and from the University. Contact EHS at 806-742-3876 if you have questions regarding the documentation needed for your shipment.

A Material Transfer Agreement (MTA) is required if the biological material was developed or recovered at Texas Tech University/Texas Tech University Health Sciences Center as it is considered the proprietary property of Texas Tech University/Texas Tech University Health Science Center. The MTA form is available on the Office of Research Services website at: <http://www.depts.ttu.edu/research/ors/preaward/forms-boilerplates.php>. Questions regarding the need for an MTA can be addressed by Cui Romo: cui.romo@ttu.edu.

B13.4

Packaging

Items are required to be properly identified, packaged, marked, and labeled for shipment.

Various agencies such as the International Air Transport Association (IATA) and the Department of Transportation (DOT) have developed guidelines and procedures to facilitate the safe shipment of potentially infectious substances and other hazardous materials.

As previously mentioned, these regulations are frequently updated. It is important to check with the carrier you have chosen (and country of destination if shipping internationally) to determine their specific requirements for shipping the material(s) in question.

B13.4.1

Permitting is not associated with the need for, or lack thereof, special packaging and labeling requirements. Call EHS at 806-742-3876 if you have questions about a shipment and/or to schedule your training prior to your shipment.

Reuse of packaging is discouraged; consult EHS prior to re-use of packaging.

B13.4.2

Shippers are responsible for procuring appropriate packaging for their shipment.

Texas Tech University

Radiation Safety Manual

(POLICIES AND PROCEDURES)

Reviewed/Updated: January 2021

Implemented: December 1999

[Chemical Hygiene Plan](#)

[Biosafety](#)

[Laser Safety](#)

[Field Safety](#)

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SECTION I – MANAGEMENT OF BROAD LICENSE

Introduction

The purpose of this manual is to provide users and non-users of radioactive material, and radiation producing equipment the more significant facts and figures about radiation. Overviews of state regulations, and direct Policies and Procedures concerning different areas of radiation use at Texas Tech University are covered. The Regulations, Policies and Procedures, etc. set forth in this guide have one single straight forward purpose, to protect Texas Tech University faculty, staff, students, and visitors against unnecessary and potentially harmful radiation exposure.

A DEFINITIONS OF KEY TERMS AND ACRONYMS

Agency - means the Bureau of Radiation Control, Texas Department of Health.

ALARA - means “as low as reasonably achievable”.

BRC - means the Bureau of Radiation Control, Texas Department of Health.

License - means Texas Radioactive Material License No. L01536, issued by the Agency.

Registration - means Texas Registration of Radiation Producing Machines No. R00574.

RSC - means the Radiation Safety Committee of Texas Tech University.

RSM - means TTU's Radiation Safety Manual.

RSO - means the Radiation Safety Officer

RSS - means the Radiation Safety Specialist.

RST - means the Radiation Safety Technician

TAC - means the Texas Administrative Code.

TRCR - means the Texas Regulations for Control of Radiation.

US NRC - means the United States Nuclear Regulatory Commission.

US DOT - means the United States Department of Transportation

B RADIATION PROTECTION PROGRAM

B1

Objective

This program is designed to limit occupational and public doses of radiation to “as low as reasonably achievable” to protect the staff, employees, and students of Texas Tech University (TTU); to protect members of the general public; and to comply with 25 TAC §289.202(e) [Texas Regulations for Control of Radiation (TRCR) 21.101].

B2

Method

Texas Tech University (TTU) has established this Radiation Safety Manual (RSM) to provide safety guidance to its staff and students when working with radioactive material, x-ray producing devices, and lasers.

B3

Date of Implementation

December 1, 1999, upon approval by the RSC.

B4

Review

This program will be reviewed no later than the anniversary month of its inception, each year.

B5

Program Elements

B5.a

Personnel Monitoring Requirements and Dose Limits: Specific procedures are provided in II.G. of the RSM. Specific ALARA procedures are addressed in II.B.19 of the RSM. Both areas have steps listed in various general procedures. If this program is adhered to, the limits specified in 25 TAC §289.202(f) through §289.202(o) [TRCR 21.201 through 21.302] should not be exceeded.

B5.b

Radiation surveys: Radiation surveys are discussed in II.H.6. of the RSM.

B5.c

Access Controls for Radiation Areas: Access to the radiation areas is controlled by II.J. of the RSM. In addition, certain elements of storage, use, and maintenance/service procedures contain steps which specifically address access controls.

B5.d

Respiratory Protection: Addressed in II.J. of the RSM.

B5.e

Security of Radiation Sources (Storage/Use): Specific procedures for storage security are addressed in II.H.1. of the RSM and provides for security during certain activities (storage, use, and transport) as procedural steps.

B5.f

Posting of Areas and Rooms: II.H.1. of the RSM provides for posting of warning signs.

B5.g

Labeling of Containers: II.H.1. of the RSM provides procedures for labeling of containers.

B5.h

Receipt of Packages Containing Radioactive Material: Radioactive material receipt procedures are specified in II.H.3.b. of the RSM.

B5.i

Waste Storage, Processing, Transfer and/or Disposal Procedures: Transfer/waste procedures are specifically addressed in II.H.14 of the RSM and transport procedures are addressed in II.H.4.

B5.j

Management of Required Records: Records management procedures are addressed in II.H.2. of the RSM.

B5.k

Reports of Incidents: The RSO is responsible for reporting incidents. The specific procedures are found in Section V of the RSM.

C ALARA PROGRAM – General

C1

Maximum permissible dose: A sub-licensee (TTU) may not permit an individual in a restricted area to receive a total effective dose equivalent greater than that permitted under II.G. of the RSM. There should not be any situations at TTU where dose equivalents for external and internal exposures exceed those listed in II.G. of the RSM.

C2

Individual's Dose Assessment: Before any initiating work in a restricted area, the RSO shall make a determination of the total effective dose equivalent for each individual, in accordance with TAC §289.202(j).

C3

Prohibition: No sub-licensee or employee shall possess, receive, use, or transfer radioactive material in such a manner as to cause an individual in a restricted area to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Table II of subsection TAC §289.202(ggg)(2).

C4

Prohibition of Use by a Minor: There shall be no use of radioactive material or radiation producing equipment by employees under 18 years of age (minors), pregnant females, or females suspecting pregnancy at Texas Tech University. However, exceptions may be granted by the RSC, following the requirements of TAC §289.202.

D RADIATION SAFETY MANAGEMENT

The TTU radiation safety program is controlled by the RSC and radiation safety is monitored by TTU's Radiation Safety Office which is directed by the RSO. Should an operation be presenting a threat to the staff or students of TTU, or to any member of the general public, the RSO has the

authority to cause any radiation user of radiation sources to cease and desist from operations until such time as the radiation threat is removed or mitigated.

E RADIATION SAFETY COMMITTEE

E1

Purpose and Structure

The RSC is composed of a group of administration, faculty, and staff appointed by the Executive Vice President and Provost to establish policies and regulations governing the use of ionizing and non-ionizing radiation. The president has designated the Office of the Associate Vice President for Operations as his duly authorized representative on matters relating to Radiation Safety.

E2

Duties (RSC Charge)

The RSC will:

E2.a

establish policies and procedures, as well as provide administrative advice regarding radiation and laser safety;

E2.b

approve or disapprove all applications, amendments, and renewals relating to the use of radioactive materials, lasers, or radiation producing equipment;

E2.c

receive and review reports from the RSO on monitoring, surveillance, and personnel exposure;

E2.d

monitor procurement, use, and disposal procedures;

E2.e

take appropriate corrective action on radiation/laser incidents, including administrative guidance and license suspension or revocation;

E2.f

provide a representative to the University Safety and Health Committee; and

E2.g

serve as an avenue of appeal in cases of dispute and exception to actions by the RSO.

E3

Radiation Safety Committee Membership

The committee shall be composed of:

E3.a

Three faculty members who regularly uses radioactive materials;

E3.b

Two faculty members who regularly uses lasers;

E3.c

At least one faculty member who regularly uses radiation producing equipment;

E3.d

At least two faculty/staff members who are non-users of radioactive materials, lasers, or radiation producing equipment;

E3.e

Vice Provost for Research or designated representative;

E3.f

RSO (Ex-Officio); and

E3.g

Associate Vice President for Operations, (Ex-Officio).

E4

Radiation Safety Committee Appointment

The members of the committee will be appointed by the Executive Vice President and Provost. Members of the committee, other than those specified by virtue of their position, will be nominated by the committee chairperson and the Associate Vice President for Operations. The RSO will serve as Executive Secretary to the committee. Each member will serve a term of three years except when lesser terms may be required to maintain balanced membership and continuity of committee operations. Reappointments are permissible.

E5

Radiation Safety Committee Operating Procedures

E5.a

The RSC shall schedule a regular meeting for each month of the year. Additional meetings may be called as necessary. The RSO will prepare and distribute a written agenda to committee members at least one day before each scheduled meeting.

E5.b

A quorum, at least one-half of the voting members, is required to conduct official business. The RSO, Chairperson, and Vice Provost for Research (or designated representative) must be present to constitute a quorum.

E5.c

Sub or ad hoc committees may be appointed by the Chairperson as needed.

E5.d

If a committee member is unable to continue serving on the committee for any reason, the member shall notify the Chairperson so that a replacement may be appointed promptly.

E5.e

If a committee member fails to attend three consecutive meetings or one-half of the called meetings in a twelve-month period, without just cause, the Chairperson will contact that member to determine if that person should be replaced. If so, the Chairperson will ask the Associate Vice President for Operations to arrange for a replacement under the appointment procedures of the committee.

E6

Radiation Safety Committee Responsibilities

The RSC shall:

E6.a

Establish policies regarding radiation and laser safety;

E6.b

Provide administrative advice to the RSO on matters regarding radiation and laser safety;

E6.c

Receive, review, and act on all applications for the use of radiation sources in any areas used by TTU personnel;

E6.d

Receive and review periodic reports from the RSO on monitoring, contamination, and personnel exposure;

E6.e

Periodically review the overall use of radiation and laser sources at TTU from the standpoint of operational hazards;

E6.f

Receive and review all reports from the RSO concerning radiation and laser incidents at TTU;

E6.g

Conduct necessary investigations, hearings, and/or appropriate corrective action on any radiation or laser over-exposure or spill occurrence at TTU;

E6.h

Meet at least monthly during the academic year;

E6.i

Perform an annual audit of the Radiation Safety Program; and

E6.j

Upon committee action, issue sublicenses which will be duly signed and approved by the Chairperson of the RSC.

F RADIATION SAFETY OFFICER

F1

Responsibilities

The Radiation Safety Officer (RSO) will be a trained health physicist who is responsible for TTU-wide compliance with these policies and the regulations. The RSO will also provide a variety of technical services necessary to maintaining radiation safety and compliance with regulatory requirements.

F2

RSO Duties

The duties of the RSO include:

F2.a

Overseeing all operating, safety, emergency, as low as reasonably achievable (ALARA) procedures, and health physics procedures and activities, including both personnel and environmental monitoring, and reviews them annually;

F2.b

Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection, including instruction of radiation safety classes;

F2.c

ensuring that required radiation surveys and leak tests are performed and documented in accordance with TAC §289.252 and the Radiation Safety Manual, including any corrective measures when levels of radiation exceed established limits;

F2.d

Receiving, delivering, and shipping all radioactive materials coming to or leaving TTU property;

F2.e

Monitoring all accelerators and other machines capable of producing penetrating radiation;

F2.f

Distributing and processing personnel monitoring equipment including maintaining records of internal and external personnel exposure, notifying individuals and their supervisors of exposures approaching the maximum permissible limits, and recommending appropriate remedial action;

F2.g

Investigating the circumstances and causing a report to be submitted to the agency for each known or suspected case of radiation exposure to an individual or radiation level detected in excess of limits established by TAC §289.252 and each theft or loss of source(s) of radiation, to determining the cause(s), and to taking steps to prevent recurrence;

F2.h

Investigating the circumstances and causing a report to be submitted to the agency for each known or suspected case of release of radioactive material(s) to the environment in excess of limits established by TAC §289.252;

F2.i

Instructing personnel in proper procedures for the use of radioactive materials;

F2.j

Supervising and coordinating the waste disposal program, including keeping of waste storage and disposal records;

F2.k

Storing of all licensed radioactive materials not on sub-licenses;

F2.l

Ensuring the proper storing, labeling, transport, and use of sources of radiation, storage, and/or transport containers;

F2.m

Performing and/or supervising all in-house sealed source leak tests;

F2.n

Maintaining an inventory of all radioactive materials, radiation producing equipment, and lasers on TTU property;

F2.o

Supervising decontamination of radioactive material accidents;

F2.p

Maintaining a continuous program of environmental radiation hazard evaluation through routine lab inspections and hazard elimination;

F2.q

Maintaining radiation safety program records in the Radiation Safety Office;

F2.r

Reporting regularly to the RSC;

F2.s

Maintaining a thorough knowledge of management policies and administrative procedures of TTU;

F2.t

Prohibiting and preventing, by immediate suspension or termination if necessary, any unsafe or illegal use of radioactive material, radiation producing equipment, or lasers.

F2.u

Maintaining files on each sub-licensee in the Radiation Safety Office, and providing each sub-licensee with a copy (and updates) of the "Radiation Safety Manual - Texas Tech University Policies and Procedures for Radiation Safety"; and

F2.v

Performing other tasks requested by the RSC.

G RADIATION SAFETY OFFICE

The Radiation Safety Office conducts operations and services to support TTU's radiation safety program.

G1

The Radiation Safety Office will be under the supervision of the RSO and will be staffed with at least one trained and qualified radiation safety technician, one trained and qualified radiation/laser safety specialist, and with part/full time clerical staff as necessary to fulfill the duties and obligations of the radiation safety program.

G2

The Radiation Safety Technician will support the RSO and the RSC by performing assigned routine safety functions which include, but are not limited to:

G2.a

Performing and documenting radiation surveys of radiation levels in TTU facilities;

G2.b

Performing and documenting radiation surveys of contaminated, or potentially contaminated, surfaces and areas in TTU facilities;

G2.c

Placing, or verifying the correct placement of, required warning labels and signs on containers, room entrances, and areas according to the requirements of this manual;

G2.d

Controlling movement and storage of packages and containers of radioactive materials and wastes;

G2.e

Performing and documenting leak tests of sealed sources;

G2.f

Inspecting radiation survey instruments to assure current calibration;

G2.g

Testing fume hoods to assure proper operation;

G2.h

Performing calibration of radiation survey instruments according to the procedures listed in Appendix C of this manual; and

G2.i

Other duties as assigned by the RSO or RSC or directed by the TTU Administration.

G3

The Radiation/Laser Safety Specialist will support the RSO and the RSC by performing assigned routine safety functions which include, but are not limited to:

G3.a

Processing and approving orders of radioactive materials;

G3.b

Receiving and delivering all incoming radioactive materials;

G3.c

Maintaining the inventory of all radioactive materials;

G3.d

Performing inspections, surveys, and audits;

G3.e

Ordering, delivering, and retrieving dosimetry badges and maintaining the dosimetry program;

G3.f

Assisting with the radioactive waste program;

G3.g

Maintaining records for the above functions; and

G3.h

Other duties as assigned by the RSO or RSC or directed by the TTU Administration.

G4

Radiation Safety staff will coordinate with the sub-licensee prior to entering any area under the sub-licensee's supervision or control.

H PERSONNEL MONITORING PROCEDURES

Introduction

This section will give direct information regarding the initiation, requirements, use, and termination of the personnel monitoring service for radiation exposure at Texas Tech University.

H1

Requirements

The regulations require that personnel monitoring devices (i.e. film badges) be provided and records be kept for an individual who receives, or is likely to receive, a dose in any calendar year in excess of 10% of the values discussed in II.G. Exemptions may only be granted by the Bureau of Radiation Control (BRC) of the Texas Department of Health (TDH).

H2

Method

The radiation reaching the badges, being worn for monitoring, exposes the badge or chip. Special filters in the badge holder allow distinguish between varying degrees of radiation penetration, thus indicating the exposure received by the person wearing the badge. The only purpose of the badge is to record the exposure of an individual. The badge does not protect an individual from radiation.

H3

Monitoring periods

Monitoring periods vary according to badge type and use. Each individual should check to see the length of the monitoring period they will be following. A general rule to follow will be: film badge - monthly, TLD badge - quarterly. ANY individual not returning a badge of any type will be subject to a dose assessment in accordance with TAC §289.202 and BRC Regulatory Guide 5.7. The dose assessed could result in the maximum permissible exposure for that time period, possibly resulting in the loss of the right to work with radioactive material and/or radiation producing equipment.

H4

Procedures

H4.a

Requests for Dosimetry

H4.a.1

ALL personnel working with radioactive material or radiation producing equipment will be required to file a "Request for Dosimetry Service". The RSO will make a determination from the

information given on the "Request" as to the type of monitoring needed for that particular individual. Personnel exempted from badge-type dosimetry will be those who work only with pure alpha emitters, or beta emitters having a maximum energy of less than 0.2 MeV, in which case an internal dosimetry program is required if the committed effective dose equivalent exceeds 10 percent of annual limits of intake (ALI) as listed in Columns 1 and 2 of Table I of TAC §289.202(ggg)(2). The RSO will determine who will be issued badge-type dosimetry.

H4.a.2

Any person filing a "Request for Dosimetry" that has worked with radioactive material, radiation producing equipment, or has been previously monitored for radiation exposure at a previous institution(s) will be asked to fill out the information needed on the "Request for Dosimetry" form and the "Previous Exposure History Request".

H4.a.3

After receiving the "Request" the RSO will order the dosimetry (if needed). No use of radioactive material or radiation producing equipment will be allowed until confirmation from RSO or dosimetry has been received.

H4.b

Termination of Service

The following rules should be followed for dosimetry service termination:

H4.b.1

Individual user should give a minimum 30 day notice of his/her intent to be deleted from the service. This should be done in advance of a new monitoring period, therefore allowing enough time to ensure that deletion will be completed without a new badge being issued.

H4.b.2

Individual user will return badge to sub-licensee or RSO upon completion of work with ionizing radiation or before leaving Texas Tech.

H4.b.3

All individuals are urged to request their permanent exposure history from TTU. The Radiation Safety Office will forward permanent exposure histories in accordance with TAC §289.202. Please allow enough time for final badge to be developed, interpreted, and results sent to Texas Tech.

H4.c

Procedures for Wearing of Badges

Rules regarding the wearing and use of personnel monitoring devices:

H4.c.1

Attach the badge holder to the area of your garment most likely to be exposed to the radiation.

H4.c.2

When not in use, leave the badge in a radiation free area. DO NOT take the badge home, leave it in your car, or other areas subject to exposing the badge to significant changes in heat, humidity, or light, unless on official business for TTU involving ionizing radiation.

H4.c.3

NEVER wear another person's badge.

H4.c.4

Report the loss of a badge or holder to the RSO immediately.

H4.c.5

NEVER put a badge in a situation where it could become contaminated by radioactive material or exposed to unnecessary radiation. Specifically, never wear ring badges on the outside of gloves, never leave badges lying near radioactive material or radiation producing equipment, even for short periods of time.

H4.c.6

THE BADGE ISSUED TO YOU IS YOUR RESPONSIBILITY.

H4.c.7

Take care not to send your badge to the laundry with your lab coat.

H4.c.8

NEVER puncture, remove, or alter in anyway the badge holder or its contents.

H4.c.9

REMEMBER - A rule cannot be written to cover every possible situation, use COMMON SENSE when no rule is available.

H4.c.10

Reports of exposure to ionizing radiation are kept by the Radiation Safety Office. Any individual may request (in writing) top review his/her exposure reports at any time. However, the request should indicate the report(s) needed for review.

I BIOASSAY PROCEDURES

I1

Requirement

Staff and students must submit to the appropriate bioassay procedure if indicated by any of the conditions described below. It is conceivable, although not likely, that a person not involved in any operation using radioactive materials might be exposed. In that event, those individuals must also have the appropriate bioassays performed.

I2

Urinalyses

I2.a

Any person who uses 8 mCi (millicuries) or more of hydrogen-3 (tritium) in any single operation or within a one (1) week period will submit to a urinalysis. Urine samples will be taken before work begins and weekly during use. Results will be provided to the person, regardless of outcome.

I2.b

Any person who uses 20 mCi (millicuries) or more of carbon-14 in any single operation will submit to a urinalysis. Urine samples will be taken before work begins and weekly during use. Results will be provided to the user, regardless of outcome.

I3

Thyroid counts

Thyroid scans will be conducted on any individual that handles, in open form, volatile Iodine-125 in amounts greater than:

I3.a

0.1 mCi: when the procedure or set of procedures is performed in an open area and NOT within a fume hood; and/or

I3.b

1.0 mCi: when the procedure or set of procedures IS performed within a fume hood.

- Note 1: the RSO must be contacted if amounts greater than 10 mCi of Iodine-125 are to be handled.
- Note 2: All procedures involving greater than 1.0 mCi of volatile Iodine-125 will be performed within a fume hood. Refer to PPRP Section VI (A.7,A.11,J.6). Thyroid scans will be performed prior to handling volatile Iodine-125 in the amounts indicated above and between 6 hours and 72 hours after the procedure or set of procedures. Contact the RSO to set up the thyroid scans.
- Note 3: Reference "Regulatory Guide 8.2 - Applications of Bioassay for I-125 and I-131", U.S. Nuclear Regulatory Commission or applicable guides approved by the Bureau of Radiation Control.

I4

Additional Requirements

I4.a

Periodic bioassays may be necessary for any individual who is suspected of having ingested, inhaled, or absorbed any radioactive material. The type of bioassay will be determined by the RSC upon consultation with appropriate regulatory agencies or health physics consultants, if necessary.

I4.b

In Vitro bioassays, other than urinalysis, will be performed when determined by the RSC, after consultation with appropriate regulatory agencies or health physics consultants.

I5

Records

All results of bioassays will be recorded and filed in the individual's personnel monitoring file.

END OF SECTION

SECTION II – SUB-LICENSE PROGRAM SAFETY

Introduction

This section will detail the procedures and requirements for obtaining a sub-license for radioactive material, radiation producing equipment, and lasers. Also included will be procedures for renewals and amendments.

A DEFINITIONS

Broad License – the specific radioactive materials license issued to TTU by the Bureau of Radiation Control of the Texas Department of Health. This license authorizes all radioactive materials use programs to be conducted at the discretion of the RSC.

Sub-license – an authorization issued by the RSC to use radiation sources.

Sub-licensees - Authorized users, usually faculty members, whose training and experience are such that they have been sub-licensed by the RSC to use ionizing and/or non-ionizing radiation in their research and educational activities.

B SUB-LICENSE APPLICATION PROCEDURES

B1

Qualifications for Sub-License

B1.1a

The applicant must have sufficient training and experience in the use of the radioactive material, radiation producing equipment, or laser(s) requested to ensure that proposed work is conducted and/or supervised in a safe manner.

B1.1.b

The applicant must submit an application for the particular sub-license needed, and a resume of use and experience within the area of interest shown by the application. This resume may include papers written referencing the use of that particular material or instrument, and/or any formal training courses or continued education.

B1.1.c

The applicant must specify on the application the types and amounts of radioactive materials or radiation producing machines to be licensed as well as the procedures involved.

B1.1.d

The RSC will authorize issuance of the sub-license if it determines that all requirements have been met.

B1.1.e

The RSC may require an applicant to attend the TTU Radiation Safety Shortcourse and/or obtain experience by working under an active sub-license for a specified period.

B1.1.f

Requirements for Individuals Working Under an Applicant's Sub-license:

B1.1.f.1

Workers (technicians, students, graduate assistants, post doctorals, etc.) must attend the local Radiation Safety Shortcourse.

B1.1.f.2

The shortcourse will be four hours for workers who can prove by appropriate certificate that prior radiation safety training was completed within the last five years.

B1.1.f.3

The shortcourse will be eight hours for workers who have finished at least two years of college but have not had prior training within the last five years.

B1.1.f.4

For workers who have not had prior training and have completed less than two years of college education, 24 hours of training will be required.

B2

Procedures for Obtaining a Sub-license

B2.a

The RSO will first review all applications.

B2.b

If an application (for amendment or renewal only) is properly completed by the applicant or authorized user and a qualifying inspection (for new laboratories) or a recent inspection of the laboratory by the TTU Radiation Safety Office shows that the laboratory is in compliance with state and local regulations, interim approval not to exceed 30 days may be granted by the RSO.

B2.c

Final approval of all applications is required by the TTU RSC at its regular monthly meeting.

B2.d

To be considered for final approval all applications including amendment and renewals must be submitted at least two working days before the next regularly scheduled meeting.

B2.e

All applications must be filled out completely and signed by the applicant. All applications not filled out completely and correctly will be returned to the applicant for re-submission.

B3

Sub-license Renewal and/or Amendment

B3.a

Term of Sub-license

Texas Tech University sub-licenses remain in effect for two years from date of issue.

B3.b

Renewal

Although the Radiation Safety Office will generally remind sub-licensees of a pending expiration, it is the sole responsibility of the sub-licensee to submit the renewal application timely to avoid expiration of a sub-license before receipt of renewal application by the Radiation Safety Office.

B3.c

Actions or activities requiring an amendment to a sub-license:

B3.c.1

If there is a change in the terms and conditions of sub-license or if procedures authorized by it change] (personnel, lab relocation, etc.);

B3.c.2

If an increase in maximum allowable activity is expected or needed;

B3.c.3

If a different isotope is needed;

B3.c.4

If isotope(s) on sub-license are no longer needed;

B3.c.5

If there is a change in equipment (X-ray or Laser inventory);

B3.c.6

If there is a significant change in submitted Operating Procedures.

B3.c.7

If significant changes occur in the normal operation of sub-license procedures, for example, the use of animals, increased waste disposal, etc.

B3.c.8

Application forms for license renewal or amendment are available from the Radiation Safety Office or may be found in this manual.

C ABSENCE OF SUB-LICENSEE FROM CAMPUS

A sub-licensee who expects to be absent from the campus for a time period of greater than three weeks must:

C1

Suspend or terminate the use of radionuclides or radiation producing equipment.

C2

Notify the RSO as to the responsible individual (another sub-licensee) who will take over supervision of the use of the various radionuclides or radiation producing equipment to be used. This sub-licensee must be competent in the use and regulations concerning the radionuclides to be used or the radiation producing equipment to be used.

C3

Should arrangements for either 1 or 2, above, NOT be made, the RSC, with may 1) suspend the sub-license or 2) revoke the sub-license, and 3) name a responsible sub-licensee to act for the absent sub-licensee.

C4

A sub-licensee leaving the campus for a visiting professorship at another institution:

C4.a

May transfer the radioactive material to that institution pending notification of approval by the Radiation Safety Offices of both institutions;

C4.b

Transfer the radioactive material to another TTU sub-licensee pending approval of the RSO;

C4.c

Placed the radioactive material in storage with the RSO; or

C4.d

Dispose of the radioactive material.

D PROCEDURE FOR TERMINATION OF A SUB-LICENCE

Procedure for Termination of a Sub-license - The following procedure shall be used should a sub-licensee desire to terminate his/her radioactive material or radiation producing equipment sub-license.

D1

A letter of intent to terminate the sub-license will be submitted to the RSO. This letter will include:

D1.a

The date of termination.

D1.b

The listing of the sub-licensee's authorized laboratories, including storage and waste areas. A diagram of all these areas should accompany this letter of intent.

D1.c

A statement that all radioactive materials, and radioactive wastes used and/or stored will be removed. They must be transferred either to the RSO for storage or disposal, or properly transferred to another sub-licensee who is properly authorized to possess the materials and activities under

consideration, without exceeding his/her limits, or makes application to amend the radionuclides and activities to his/her sub-license. NOTE - This would also apply to radiation producing equipment.

D1.d

The terminating sub-licensee will provide copies of the results of an IN DEPTH contamination survey on the laboratories, equipment, storage and waste areas authorized on his/her sub-license. If contamination levels greater than those listed in TAC §289.202(ggg)(6) are found, the contaminated areas and/or equipment will be decontaminated until allowable limits are reached.

D1.e

Upon receipt of the letter of intent, the RSO will conduct a close-out survey of the affected areas and equipment.

D1.f

Based on a review of the letter of intent, the results of the close-out survey, and the disposition of the radioactive material or radiation producing equipment, the RSO will make his recommendations to the RSC at its next monthly meeting, which in turn will consider and vote on the request to terminate the sub-license.

D1.g

Upon termination, all signs and labels, indicating that the areas were authorized for use of radioactive material, shall be removed by radiation safety personnel. The areas are now considered for unrestricted use. Areas with radiation producing equipment may or may not qualify for unrestricted use.

D1.h

ON TERMINATION, FURTHER USE OF RADIOACTIVE MATERIAL BY THE SUB-LICENSEE AND INDIVIDUAL WORKERS OF THAT SUB-LICENSE IS STRICTLY PROHIBITED.

D1.i

All equipment and personnel monitoring devices (i.e. survey meters, shielding, film badges, etc.) not owned by the terminating sub-licensee must be returned to the radiation safety office or to owners of the equipment at this time.

D1.j

Should a sub-licensee permanently leave TTU and neglect to officially terminate his/her sub-license, the RSO upon notification will contact the absent sub-licensee's Department Chairperson. The Department Chairperson will be responsible for initiating the sub-license termination procedures as outlined above.

E SUB-LICENSEE INSPECTION / MONITORING PROGRAM

Sub-licensee Inspection/Monitoring Program- The following procedures outline the TTU inspection/monitoring program conducted for evaluation of programs operated under sub-licenses.

E1

General

A radiation program the size of TTU requires periodic monitoring, inspection, and evaluation. It is the responsibility of each sub-licensee to ensure his/her monitoring is complied with by performing required radiation surveys. It is the responsibility of the RSO to make periodic inspections and surveys of each sub-licensee to ensure he/she is in compliance with all state and local regulations.

E1.a

The entire program at TTU is periodically evaluated by the TTU-RSC and by the Texas BRC for compliance.

E1.b

This system of "checks and balances" assures TTU and the general public that the radiation program at TTU operates safely and efficiently.

E2

Frequency of Inspections

E2.a

The RSO shall make inspections of radioactive material sub-licensees on a quarterly basis.

E2.b

The RSO shall make inspections of radiation producing equipment sub-licensees on an annual basis.

E2.c

Sub-licensees who have had their area deactivated do not have to be inspected.

E3

Inspection Policy/Responsibilities

E3.a

The RSO shall inspect facilities for compliance with all applicable regulations - state, federal, and local.

E3.b

The RSO shall make a record of each inspection and keep those on file in the Radiation Safety office.

E3.c

The RSO will forward a formal report of inspection (Form RS-24) to each sub-licensee within two weeks of final evaluation of his/her inspection results, noting corrective action needed.

E3.d

Each sub-licensee will revise or correct his/her individual program as noted in the report under "Corrective Actions". Questions or problems should be addressed to the RSO or the RSC.

E3.e

The RSO will report all major deficiencies as well as any instance of non-compliance for a sub-licensee, applicable rules, or statutes, to the RSC.

E3.f

The RSO shall make follow-up inspections of all sub-licensees having deficiencies deemed serious by the RSC within 60 days of report.

E3.g

All inspection statistics should be evaluated by the RSC.

E3.h

Sub-licensees having repeated deficiencies (same deficiency during two consecutive inspections) will be reported to the RSC and the RSC will issue written notice.

E3.i

Sub-licensees found to repeat a deficiency a third time (same deficiency during three consecutive inspections) will be reported to the RSC. The RSC will issue a written notice and require the sub-licensee to meet with the committee during next scheduled meeting to explain their actions.

E3.j

The RSC may terminate a sub-license if serious deficiencies are continued.

F SUB-LICENSE PROGRAMS AND PROCEDURES

F1

Sub-Licensee/Authorized User Responsibilities

F1.a

Each authorized user has the following obligations:

F1.a.1

Ensuring that the individual user responsibilities are discharged by those under their control and supervising their work;

F1.a.2

Working within the limits of the User's sub-license;

F1.a.3

Instructing those employees for whom they are responsible in the use of safe techniques and in the application of approved radiation safety practices and ensuring attendance in required radiation safety courses;

F1.a.4

Furnishing the RSO with information concerning individuals and activities in their areas;

F1.a.5

Ensuring that all surveys and safety checks required for their particular area of interest are carried out and recorded properly;

F1.a.6

F1.a.6

Contacting the RSO whenever major changes are anticipated in operational procedures, new techniques, alterations in physical plant, or when new operations that might lead to personnel exposure;

F1.a.7

Complying with the regulations governing the use of radioactive materials, radiation producing equipment, or lasers, as established by the Texas Regulations for Control of Radiation, Texas Regulations for Control of Laser Radiation Hazards, and Texas Tech University Policies and Procedures for Radiation protection;

F1.a.8

Keeping stocks of stored radioactive material to a minimum;

F1.a.9

Complying with proper procedures for termination of equipment, or termination of sub-license involving the use of radioactive material, radiation producing equipment, or lasers;

F1.a.10

Complying with the proper procedures for handling radiation incidents;

F1.a.11

Obtaining prior approval, by completing and submitting an application for amendment/renewal form, for the addition/deletion of rooms, radioisotopes, or personnel, for the increase/decrease of radioactive material, or for additions or changes to procedures.

F1.b

Responsibilities of Authorized Users - Authorized users (workers, employees, etc.) faculty, students, other professionals, as well as technical and other workers engaged in education, laboratory research, and research support activities which involve actual use and handling of materials and devices producing ionizing and non-ionizing radiation. These personnel will work under the immediate supervision of a sub-licensee.

G MAXIMUM PERMISSIBLE DOSES, DOSE LIMITS

G1

Like other materials with potential health hazards, regulatory control is applied to exposures involving radiation workers throughout the nuclear industry as well as medical and research facilities. Workers exposed to ionizing radiation as part of their normal duties assume an

occupational risk and therefore are regulated under a "maximum permissible dose". The Texas Regulations for Control of Radiation and Title 10 Code of Federal Regulations Part 20 currently accepts the following as "maximum permissible dose":

G2

No sub-licensee or employee shall possess, use, receive, or transfer sources of radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from all sources of radiation a total occupational dose in excess of the limits specified as follows:

G2.a

The annual occupational dose shall not exceed the more limiting of:

G2.a.1

The total effective dose equivalent being equal to 5 rems (0.05 sievert); or

G2.a.2

The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 sievert).

G2.b

The annual occupational dose to the lens of the eye, to the skin, and to extremities will not exceed:

G2.b.1

an eye dose equivalent of 15 rems (0.15 sievert), and

G2.b.2

a shallow dose equivalent of 50 rems (0.5 sievert) to the skin or to any extremity.

G2.c

The annual occupational dose to minors will not exceed 10 percent of the limits specified in (a.) and (b.) above [reference TAC §289.202(l)].

G2.d

The annual occupational dose to an embryo or fetus during the entire pregnancy of a declared pregnant woman will not exceed 0.5 rem (0.005 sievert). Refer to TAC §289.202(m).

G2.e

The total effective dose equivalent to individual members of the public will not exceed 0.1 rem (1.0 millisieverts) in a year, and that the dose rate in any unrestricted area from external sources will not exceed 0.002 rem (0.02 millisieverts) in any one hour.

H POLICIES AND PROCEDURES FOR RADIOACTIVE MATERIAL USE

This section will give specific Policies and Procedures for the use of radioactive material. Pertinent facilities, record keeping, handling of radioactive material, radiation contamination

surveys, custodial service for radioactive material areas, neutron meters, radioactive material in animals and radioactive waste.

H1

Facilities

H1.a

Work areas(s) (benches, hoods, trays, etc.) will have a non-absorbent surface.

H1.b

Laboratories will have wall coverings of a washable, hard, heat-chemical resistant paint (i.e. epoxy).

H1.c

Laboratories will have protective floor coverings and ventilation capable of handling and storing the isotopes and activities being requested. (reference CRC Handbook of Laboratory Safety, p. 437-439)

H1.d

Storage areas, work areas, refrigerators, freezers, fume hoods, and lab entrances will be posted with the correct warning signs. (signs available from Radiation Safety)

H1.e

Storage areas (cabinets, refrigerators, freezers, fume hoods, laboratories, etc.) will be secured to prevent unauthorized removal of radioactive material.

H1.f

Storage containers will have radioactive material labels with date, type, and activity of isotope(s). This will apply to any container with radioactive material that will be in use more than one (1) working day.

H1.g

Work area air levels shall be kept below 10% of those limits given in TAC (§289.202(ggg)(2). If circumstances require concentrations in air to exceed 10% of the above, then the RSO will need to be notified.

H1.h

All signage (sub-license, Notice to Employees, emergency numbers, etc.) shall be posted in prominent view.

H1.i

Remote handling devices will be used when handling energetic beta or gamma sources. In general this refers to sources above approximately two-tenths of one MeV (0.2) that might be indirectly unshielded or potentially contaminated. If a person is unsure as to the proper action to take consult the RSO.

H1.j

Each laboratory will have a [calibrated] survey meter capable of detecting radioactive material(s) used in that particular laboratory if the radioisotopes and activities of those isotopes are detectable with a meter. This survey meter is not to be used for actual contamination surveys, only for dose level surveys, spot contamination surveys, and personnel exit surveys.

NOTE - All costs for procurement, calibration (annually), and repair will be assumed by the sub-licensee. Survey meters are available (limited number) from Radiation Safety for short-term loan. Also the calibration of certain types of survey meters is available through the radiation safety office.

H1.k

Work areas may need a fume hood in order to comply with regulatory limits. The following lists some minimal features the fume hoods should have:

- **NOTE** - Fume hoods should be used anytime a person is handling unsealed, potentially volatile forms of radioactive material. Operations involving the use of more than 0.1 millicuries of Iodine-125 or Iodine-131 in volatile form shall be conducted within a properly operating fume hood.

H1.k.1

Fume hoods shall be labeled if radioactive materials are to be used or stored in the hoods.

H1.k.2

The velocity of the air flow shall be such that there can be no escape of air into the work place from the fume hood under normal conditions, including opening of doors and windows, suction of other fume hoods, and air conditioning systems. The velocity of the air flow shall be no less than 80 lfpm and no more than 120 lfpm.

H1.k.3

The gas, water, and electrical appliance should be operable from the outside of the fume hood.

H1.k.4

The fume hood shall have a counter-balanced sash made of tempered safety glass.

H1.k.5

The fume hood should have a layer of absorbent paper with water-proof backing covering the entire work surface.

H1.k.6

The inspections shall be conducted by the Department of Environmental Health and Safety.

H2

Record Keeping

H2.a

Wipe survey results

Survey records shall be continual, observing no stops in record keeping and according to TAC requirements. Surveys shall be in proportion to isotope use, hence the records shall be the same.

H2.b

Isotope Use Forms - All isotope use forms (Form RS-14) shall be kept by the sub-licensee. The use forms shall be separated by those in use and those exhausted. The Radioisotope Use Form is a 3 part form used to indicate, and verify the sub-licensee's use and disposal of radioactive material. At such time when the radioactive material is no longer useful or is exhausted, the total amount used, disposed, or released to atmosphere must be written on the "use form".

H2.c

Request for Radioactive Waste Disposal

All Requests for Radioactive Waste Disposal (Form RS-14A) shall be kept by the sub-licensee. Form RS-14A is a multi-part form used for waste identification, disposal information, and hazard identification. The form is used to comply with Texas Regulations for Control of Radiation, Dept. of Transportation Regulations, Code of Federal Regulations Part 49, Environmental Protection Agency Regulations, Texas Water Commission, and Disposal Site Regulations.

H2.d

Inventory

All sub-licensees will keep a copy of the most recent semi-annual radioactive material inventory.

H2.e

Inspection Reports

All sub-licensees should keep their semi-annual inspection reports (Form RS-24).

H2.f

Amendment and Renewals

All sub-licensees should keep a copy of their amendments and renewals.

H2.g

Organization

All survey records shall be kept in format so as not to confuse routine inspections or audits. Records shall be sectioned so as to separate use forms, inventories, survey records, etc. Use forms should be separated by isotope and kept in chronological order by date received.

H2.h

Availability

Records shall be kept in an area of the laboratory free of contamination and shall be available during routine monitoring of the lab by Radiation Safety personnel and/or regulatory agencies.

H3

Control of Radioactive Material

H3.a

Ordering Radioactive Material – General Procedure

H3.a.1

Requestor calls the Radiation Safety Office at 742-3876

H3.a.2

The requestor shall have the following information for Radiation Safety:

- Sub-licensee
- Isotope
- Activity (in millicuries ONLY)
- Chemical form
- Requestors phone number
- Local point of contact
- Vendor
- Account Number
- Total dollar amount

H3.a.3

The Radiation Safety Office will:

- check the sub-licensee's current inventory to verify that the isotope and requested activity does not exceed the sub-licensee's limit.
- check the TTU Broad License to verify that the isotope and requested activity do not exceed the TTU Broad License Limit.
- check the compliance, records, and violations of the sub-licensee.

NOTE - Should the purchase exceed either the sub-license or Broad License limits the RSO will call the requestor and ask him/her to amend the order to an acceptable limit or amend his/her current inventory by resubmitting of Radioactive Material Inventory.

H3.a.4

The Radiation Safety Office will call Purchasing and provide the needed information. The buyer will give the Radiation Safety Office the P.O. number.

H3.a.5

The buyer will then verify the account funds and call the requestor, giving him/her the P.O. number. Requestor calls the vendor providing the needed information.

H3.a.6

ALL radioactive material shipments must be shipped to the following address:

ATTN: Radiation Safety Officer
Administrative Support Center
2903 4th Street, Room 122
Texas Tech University
Lubbock, Texas 79409

H3.a.7

Requestor will then complete the regular purchase order form. The requestor shall type or write (legibly) the words "Radioactive Material" on the purchase order form.

H3.b

Receipt and Accountability of Radioactive Material

H3.b.1

Receipt

- The receipt of all radioactive material shipments should be during normal business hours, unless special arrangements have been made with the Radiation Safety Office. When ordering radioactive material, the requestor should emphasize this to the vendor and make sure the vendor will ship accordingly.
- Upon receipt, the package(s) will be monitored in accordance with TAC §289.202(ee).

H3.b.2

Accountability

A "Radioactive Material Use Form" (Form RS-14) will be prepared and issued to sub-licensee upon his/her receiving the shipment.

- The "Radioactive Material Use Form" is a 3 part form used to document a sub-licensees use and disposal of that particular shipment. When the material is no longer useful or exhausted the sub-licensee will verify that all use and disposal (dry, liquid, atmosphere, etc.) has been recorded on the form. It shall be the responsibility of the sub-licensee to apply mathematical decay calculations in order to determine the amount used and/or disposed.

NOTE - Only sub-licensees or personnel named on the sub-license will be allowed to sign for and receive the shipment.

- Upon final use (described above) the sub-licensee shall verify the aforementioned, then date, sign and return the YELLOW copy to the Radiation Safety office.
- After receiving the yellow copy the Radiation Safety Office will audit the "use form" and if filled out correctly will delete the shipment from the sub-licensee's inventory and the TTU Broad License.

H3.b.2.1

Semi-annual radioactive material inventories are required of all sub-licensees. Sub-licensees will submit the inventory as requested by the RSO.

Remember - It is the responsibility of the sub-licensee to apply any mathematical decay calculations.

H4

Transfer and Shipping of Radioactive Material

H4.a

Transfer

There shall be no transfer of radioactive material from one sub-licensee to another sub-licensee, nor outside of TTU, without the approval of the RSO.

H4.b

Shipping

- If radioactive material is to be shipped from TTU, the shipper must notify the Radiation Safety Office.
- The RSO will then assist the shipper in preparing the package for shipment according to Department of Transportation Regulations, Texas Regulations for Control of Radiation, and Nuclear Regulatory Commission (NRC) Regulations.

NOTE - The recipient of any regulated radioactive material to be shipped from TTU must provide evidence of an NRC (or agreement state license) by furnishing a copy of his/her license to the Radiation Safety Office. This must be done prior to shipment.

H5

Storage of Radioactive Material

H5.a

Radioactive material shall be stored only in approved areas.

H5.b

The storage container shall be of such construction to prevent unneeded external exposure to radiation present therein. Furthermore, the container shall be "double-contained" meaning the container shall be able to hold/or absorb twice the volume of the material therein.

H5.c

Storage of radioactive material, animal containing radioactive material and parts thereof shall be such as to prevent unauthorized removal.

H5.d

All refrigerators and freezers for storage of radioactive material shall be equipped with hasps and combination locks. A copy of the combination shall be forwarded to the Radiation Safety Office.

H6

Radiation Surveys

H6.a

Each sub-licensee shall perform or have performed by individuals listed on sub-license, laboratory surveys where radioactive material or radioactive waste is being used or stored.

H6.b

These surveys shall be performed in direct proportion to isotope use. Surveys shall be continual, even during periods of inactivity.

H6.b.1

Using filter paper (Whatman 1-4.25cm or equivalent), wipe an area of 100 cm².

NOTE: Using an "S" motion of about 12-16 inches will give approximately this area. Although there is no set minimum or maximum for the number of wipes for a laboratory, one should make sure the number of wipes taken show radioactive material use areas, radioactive material storage areas, rad-waste storage areas, and heavy traffic areas (door knobs, floors, phones, cabinets, etc.).

H6.b.2

Count the wipes with a radiation detection system capable of monitoring the desired radiation energy and type. NOTE - Survey meters are not capable of being used for quantitative analysis (i.e. counting purposes). They should only be used for routine surveys, personnel lab exit surveys, and contamination location.

H6.b.3

Results of the smear surveys should be corrected for efficiency and reported in units of activity (i.e., dpm, Bq, etc.).

H6.b.4

The following shall be maintained in the survey log book:

- survey date and name of surveyor
- counts per minute
- results in units of activity
- map of laboratory
- swipe locations
- efficiency of counter

H6.b.5

All results shall be recorded whether positive or negative.

H6.b.6

If results show removable contamination of more than 1000 dpm for beta emitters (Hydrogen-3, Carbon-14, Phosphorus-32, Phosphorus-33, Sulfur-35, Calcium-45, Zinc-65), or 200 dpm for Iodine-125, notify the Radiation Safety Office and begin decontamination procedures.

NOTE: be sure to always do a background count with each survey and indicate on your machine copy results which sample is the background count

H6.b.7

Equipment in a radiation laboratory shall not be removed from that laboratory until demonstrated by the RSO to be free of radioactive contamination.

H6.b.8

Equipment to be repaired by persons outside the laboratory shall be demonstrated to be free of radioactive contamination by the RSO. Emergency equipment repair by outside personnel shall be supervised by the RSO. It is the responsibility of the laboratory personnel to request this supervision from the Radiation Safety Office.

H6.b.9

Routine surveys by the Radiation Safety Office in no way release a sub-licensee from his/her obligation to their surveys.

H6.b.10

In general, NO radioactive contamination can be tolerated. Exceptions to this will include certain hood trays, dry boxes, stainless steel trays, absorbent paper, or other equipment which is used frequently for active work and which will be clearly marked with standard radiation caution signs and stickers. However, these items shall be decontaminated or disposed of after experiment or use and before deactivation or termination of sub-licensee.

H6.b.11

Decontamination

ALL decontamination will be carried out by the sub-licensee responsible for the contamination under the supervision of the RSO. All costs for decontamination shall be assumed by the sub-licensee.

H7

Deactivation/Reactivation of Radiation Use Areas

Should a sub-licensee foresee a period of time in which he/she does not plan to use radioactive material or radiation producing equipment in a particular laboratory(s) the affected laboratory(s) may be deactivated, though maintaining a valid sub-license, by meeting the following criteria:

H7.a

A letter of intent to deactivate an authorized radiation use area will be submitted to the RSO. This letter will include:

- The room number(s) and diagram of the laboratory(s) to be deactivated.
- A statement that all radioactive materials used and/or stored in the affected laboratory(s) will be removed.
- If radiation producing equipment is involved then the statement shall be that all involved equipment in the affected laboratory(s) will be secured against any use.

NOTE - The radioactive material may be transferred either to the RSO for storage or disposal, or transferred, upon coordination through the RSO, to another sub-licensee who is authorized to possess the materials and activities under consideration, without exceeding his/her sub-license limits, or makes application to the RSC to amend the isotopes and activities.

H7.b

The sub-licensee will provide copies of the results of an IN-DEPTH contamination survey of the laboratory's, equipment, storage and waste areas to be deactivated. If excessive contamination levels are found, the contaminated areas and/or equipment will be decontaminated until allowable limits are reached.

H7.c

Upon receipt of the letter of intent, the RSO will perform a close-out survey of the affected areas and equipment.

H7.d

Based on a review of the letter of intent, the results of the close-out survey, and the disposition of the radioactive material or radiation producing equipment, the RSO will make his recommendations to the Chairperson of the RSC who, in turn, will authorize deactivation of the laboratory(s).

H7.e

Upon deactivation, all signs and labels, indicating that the areas were authorized for use of radioactive material, or radiation producing equipment shall be removed. Areas with radiation producing equipment may or may not qualify for unrestricted use, if equipment is still in use that produces ionizing radiation.

H7.f

At this point, further use of radioactive material and/or radiation producing equipment is strictly prohibited.

H7.g

All equipment and personnel monitoring equipment (i.e. survey meters, shielding, film badges, etc.) not belonging to the deactivating sub-licensee will need to be returned at this time.

H7.h

The term of deactivation of an authorized radiation use area will be a MINIMUM OF SIX (6) MONTHS AND A MAXIMUM OF UP TO TWO (2) YEARS (or until the sub-license is due for renewal). At the end of a deactivation period the sub-licensee may request, in writing, to renew the deactivated status of the laboratory(s) for another term.

H7.i

During the period in which a radiation use area is deactivated, the sub-license will remain in an active status. If all laboratories of a sub-license have been deactivated, the sub-license will require only minimal maintenance, i.e., periodic renewal and changes in radiation worker status. If there are still active laboratories on the sub-license, all current rules, regulations and policies governing that sub-license (relative to the active laboratories) remain in effect. Since deactivated

laboratories are no longer considered radiation use areas, the requirements for periodic surveys no longer apply. However, the sub-licensee is still responsible for the retention of ALL records and files which were generated for that laboratory(s) while it was an active radiation use area.

H7.j

A sub-licensee may REACTIVATE a laboratory(s) any time he/she desires AFTER the initial six month period if the following criteria are met:

H7.j.1

A written request to reactivate a radiation use laboratory(s) must be made to the RSO.

H7.j.2

A diagram of the laboratory(s) must accompany the request, indicating radiation work areas, storage areas, waste container location, "hot sinks", etc. A laboratory will be reactivated ONLY under the initial conditions and configuration at the time of its deactivation. Any changes in work areas, storage areas, etc. must be made by amendment application AFTER the laboratory has been reactivated.

H7.j.3

The RSO will review the request and inspect the laboratory area(s) and make his recommendations to the Chairperson of the RSC.

H7.j.4

After the Chairperson has approved the reactivation of a radiation use area it will, again, be subject to the posting, required records, safety procedures, and survey/safety check requirements as stipulated by state, federal, and Local TTU regulations and policies.

H7.j.5

At this time, radioactive materials and/or radiation producing equipment may again be used and stored in that particular laboratory(s). However, the radiation producing equipment will be subject to a survey conducted by the RSO to ensure the unit(s) meet all state and local requirements for radiation levels.

H8

General Services for Radiation-Use Laboratories

All laboratories must be surveyed (wipe tests and visual inspection) for any possible radioactive contamination within 24 hours of the scheduled cleaning or other services. The lab shall remain clean until after the services, and it is the responsibility of the sub-licensee to assure this. Records of these surveys must be kept. Unacceptable removable contamination or radiation exposure rates will result in the suspension of general services. Supervision by the sub-licensee, a worker on that sub-license, or radiation safety personnel is required during all services with the exception of after hours, routine, custodial services.

H8.a

Any laboratory found (during routine inspections) not to be performing required periodic surveys will be suspended from general services.

H9

Custodial Service for Radiation Use Areas

H9.a

To obtain special custodial service (i.e., scrubbing, stripping, and finishing floors), call Custodial Services (744-1866).

H9.b

Prior to scheduling the cleaning, the following preparations must be made:

- The floor must be cleared of all obstacles such as boxes, books, containers, and radiation-labeled items. This must be done by authorized personnel. Visual surveys of the lab must accompany the wipe tests.
- Custodial Services will schedule the work and call to confirm the date with the requester.
- The custodians will leave a checklist in the laboratory. The checklist must be completed and signed by the lab personnel.

H9.c

Radiation laboratories requesting cleaning service will be furnished with a Request for Custodial Service door card. The door card must be signed by the sub-licensee or RSO, and left on the outside of the door on the day the work is to be accomplished.

H9.d

The sub-licensee or a worker on that sub-license IS required to be in the lab during the cleaning.

H9.e

To obtain routine custodial service, call Custodial Services (744-1866) to receive a door card. Routine custodial service includes only sweeping floors, empty trash containers, and replace paper in paper dispensers.

H9.e.1

The Sub-licensee will simply complete, sign and date a door card.

H9.e.2

Place the card on the outside of the laboratory door before 6:00 PM on the day of the routine cleaning. These cards are only good for one day. These cards assure the custodians that there are no radioactive items with which they might come in contact.

H9.e.3

The sub-licensee or a worker IS NOT required to be in the lab during the routine cleaning. Routine cleaning will probably be scheduled between 6:30 PM and 8:00 PM.

H10

Building, Maintenance and Construction (BM&C) Services

H10.a

The RSO or sub-licensee can give clearance for BM&C to perform work in an authorized use/storage area. The laboratory must be surveyed within 24 hours of the scheduled work.

H10.b

All “hot” items (marked with rad-tape) to be serviced must be surveyed and cleared prior to the requested work to be done. The items must be released by the RSO, or documented and released by the Sub-licensee.

H10.c

The sub-licensee or a worker IS required to be in the lab during the BM&C services.

H11

Other Services

H11.a

Departmental technicians can occasionally enter and perform routine duties provided they do not handle “hot” (labeled with radiation tape) items, and provided they are granted permission by the Sub-licensee.

H11.b

Company technicians and servicemen servicing or checking items in authorized it must have the permission of the RSO. The Sub-licensee will be required to the lab surveyed within 24 hours of their visit. All “hot” items that will be serviced must be checked, and cleaned and rechecked if necessary. Records of these surveys must be kept.

H11.c

The sub-licensee or a worker IS required to be in the lab during the services.

H12

Portable Moisture Density Gauges

(neutron probe; often referred to as Neutron Meters, Neutron Probes, PMDG's, etc.)

H12.a

These policies and procedures shall apply to all portable devices using the thermalization of neutrons to measure water contents of porous materials or gamma rays for density measurement of specific materials.

H12.b

In addition to the Texas Regulations for the Control of Radiation, the following policies and procedures will apply to the TTU license:

H12.b.1

Each PMDG located at TTU will have a designated authorized user who is responsible for safe storage, scheduling and preventive maintenance. Hereafter, this individual is known as the primary authorized user.

H12.b.2

Subject to the discretion and scheduling of the primary authorized user, other as to isotope and activity.

H12.b.3

The primary authorized user should establish a log to be kept at the location for permanent storage of the specific PMDG.

H12.b.4

It is the responsibility of the authorized user to:

- (a) enter notations in the PMDG log as to the date, time of day, the authorized users name and destination. Date and time will be logged upon return of the PMDG to permanent storage.
- (b) determine that the individual user has been approved for using that type of radiation equipment by the TTU Radiation Safety Office.
- (c) determine that the PMDG is in operating condition before it is removed from the vicinity of the permanent storage area. If the PMDG should become inoperable while it is in the custody of an authorized user, it is that user's responsibility to repair the PMDG expeditiously.
- (d) assure all necessary paper work such as a Bill of Lading, etc. accompanies the PMDG during transport. All paper work must be in the cab of truck, or glove box of car, NOT in the PMDG transport box.

H12.b.5

PMDG's may be temporarily transferred from other agencies for use by TTU personnel on TTU property. However, the transfer must be coordinated in advance through the RSO.

H12.b.6

The PMDG will always be stored and transported in its DOT approved storage box. When transporting the probe on public highways in the open beds of pickups and trucks, the case will be anchored securely.

H12.b.7

Personnel monitoring badges shall be worn during transport and use of the PMDG.

H12.b.8

The RSO shall be notified before any PMDG is released for repair.

NOTE - Should the PMDG become lost, stolen, lodged in a monitoring tube, etc., notify the RSO immediately. If lodged, DO NOT try to retrieve the probe, wait for RSO supervision.

H12.b.9

All PMDG's are required to have semi-annual leak tests and are to be included in semi-annual radioactive material inventories.

H12.c

These procedures do not change the responsibilities either for the authorized or individual users, as outlined in other sections of this guide to Policies and Procedures for Radiation Protection at TTU.

H13

Radioactive Material in Animals

The following procedures are to be used by researchers using radioactive materials in animals.

H13.a

Prior approval to use animals in research shall be obtained by application or amendment through the RSC. Procedures must be outlined in detail showing activities, disposal procedures, surveys, potential problem areas, etc.

H13.b

Policies concerning animal use:

H13b.1

Animal cages are to be labeled with warning stickers.

H13b.2

After sacrificing the animal, the researcher or his technician shall wrap the animals in some type of absorbent paper, the animals shall then be placed in double bags (provided by RSO).

H13b.3

All bedding and food shall be placed separately in double bags.

H13b.4

The bags should be sealed with yellow tape and SHALL BE labeled with the following information:

- (a) Isotope
- (b) Total microcuries
- (c) Date of administration
- (d) Total gram weight

NOTE: Bags and tape shall be kept near animal housing.

H13b.5

The animal carcasses, bedding, and food shall be stored in a freezer until Radiation Safety Personnel receive it for disposal.

H13b.6

At least 24 hours notice shall be given to Radiation Safety for a pick up time.

H13b.7

Contaminated cages, feeders, and water bottles must be washed separately from normal cleaning. If a suspended rack is used then the entire unit must be cleaned.

NOTE: Gloves are to worn during cleaning operations and disposed of as radiation waste.

H13b.8

Surveys shall be performed and recorded in accordance with Item D of this section.

H13b.9

All cages, feeders, racks, and water bottles must be demonstrated to be free of contamination, by the researcher, to the RSO.

H14

Radioactive Waste Disposal Program

H14.a

General

Radioactive waste materials which includes solid, bulk liquid, liquid scintillation vials, and animal carcasses resulting from the use of radioactive material in laboratories shall be stored in designated containers and retained for collection by the RSO.

All radioactive wastes shall be disposed of in such a manner as to prevent the occurrence of a hazard to the health of TTU personnel, to the value of property, and to the welfare of the public.

Final disposal of all radioactive wastes, with the exception of trace amounts through the sanitary sewer system, will be accomplished by the RSO.

H14.b

Waste Types

There are basically four types of waste generated at TTU: dry solid, bulk liquid, liquid scintillation vials (LSV), and animal carcasses. Although some predetermined operations may develop gaseous wastes.

H14.b.1

Dry solid wastes containing radioactive materials are nonhazardous or hazardous. Dry solid radioactive waste that contains a hazardous component (mixed waste) cannot be generated without permission from the RSC. Otherwise, all dry solid waste must be in the chemical form that is nonhazardous and acceptable for disposal in the Lubbock Municipal Landfill.

H14.b.2

Liquid wastes are separated into two categories: (1) aqueous bulk liquids and (2) mixed waste (organic) bulk liquids.

H14.b.2.a

Aqueous liquids are bulk liquids with a pH between 5 and 9, and which contain no biological, pathogenic, or infectious material, and have no hazardous characteristic. Aqueous biodegradable scintillation cocktails fall within this category. NOTE: Organic non-biodegradable scintillation fluids, hazardous liquids, as well as oils, other organic fluids, strong acids and bases are NOT considered aqueous fluids and should never be mixed with them.

H14.b.2.b

Mixed (organic) bulk liquids are radioactive bulk liquids that contain a hazardous component and meet the characteristics of hazardous material. Bulk liquids are considered mixed if they consist of hazardous chemicals such as toluene, xylene, or other flammable, toxic, or reactive fluids. NOTE: Regulations mandate that the generator (sub-licensee) be able to verify the contents of all wastes and their associated hazard classification.

H14.b.2.c

Liquid scintillation vials are glass or plastic vials with a capacity of less than 50 ml each which contain, or have contained, liquid scintillation fluid. Biodegradable scintillation cocktails such as Opti-flour, Aqua-sol, Ready-Safe, etc. should be used unless there is absolutely no way to avoid using the nonaqueous scintillation cocktails. NO blood or aqueous non-scintillation vials are to be placed in the LSV containers. Stock solution vials (NEN, ICN, etc.), liquid scintillation counter standards, or vials with non-scintillation fluids are not acceptable in LSV containers. NEVER mix dry solid or biological wastes in LSV containers.

NOTE: If any non-scintillation material is found in a LSV container, the container will be returned, or if found during an inspection the generator will be responsible for correction of the situation. If the hazard is considered not in the best interest of ALARA the generator may be held responsible for additional broker or disposal sites. Flagrant or repeated violations will be reported to the RSC.

H14.b.3

Animal carcasses

This would consist of any animal used and/or sacrificed (during research) that contains radioactive material. This would include all parts of these animals (e.g. body, internal organs, etc.).

H14.c

Responsibilities of the Generator (sub-licensee):

H14.c.1

Proper collection and storage of all radioactive waste.

H14.c.2

Compliance with state and local regulations and control of the wastes until removal by the RSO.

H14.c.3

Insurance that all radioactive waste materials are separated according to (liquid, scintillation vials, or dry solid) and (less than 300 days and greater than 300 days).

H14.c.4

Completion of all necessary paperwork prior to removal of wastes by the RSO. NOTE: The RSO will not pickup wastes without completed paperwork (Form RS-14A).

H14.c.5

The generator shall not at any time permit the disposal of radioactive material or radioactive waste into general waste pathways, other than trace amounts into the sanitary sewer system.

H14.c.6

If one wishes to retain and re-use glassware containing radioactive material the following procedure shall be followed:

- Pour off radionuclide(s) into an approved storage bottle.
- Rinse and pour this into the waste storage bottle.
- Repeat Step 2.
- Further rinses may be placed in the sewer followed by an adequate dilution of tap water in a designated and labeled sink only.

H14.c.7

Regardless of the frequency of disposal and the individual concentrations, the total activity disposed into the sewer by each individual sub-licensee SHALL NOT EXCEED ONE uCi PER DAY.

H14.d

Laboratory Waste Handling and Storage

H14.d.1

The RSO will provide small sturdy cardboard boxes (i.e., 10"x10"x15") and 4 mil plastic bags for dry solid wastes and animals and polyethylene carboys (2.5 to 5 gallons) for liquid waste. These containers shall be labeled with "radioactive material" labels.

H14.d.2

Wastes will be separated by the generator and stored according to physical form (dry solid, animal, liquid, scintillation vials) and half-life (less than 300 days and greater than 300 days). Chemically hazardous wastes should be held to a minimum.

H14.d.3

Wastes must only be stored in restricted areas where they can be secured against unauthorized removal.

H14.d.4

Liquid wastes shall be stored in unbreakable polyethylene carboys and provided double containment.

H14.d.5

Aqueous liquid wastes shall be neutralized prior to deposition in a waste container to prevent any violent or hazardous chemical reactions.

H14.d.6

Each laboratory having radioactive waste containers shall display a "radioactive waste" sign in the area designated for radioactive waste.

H14.d.7

Any material that could cause puncture of the skin (i.e. syringe needles, broken glass, razor blades, etc.) shall be placed in puncture-resistant containers and labeled as such before placement into dry solid containers.

H14.d.8

ALL radiation labels, signs, tape, symbols, etc. indicating there is or was radioactivity in the waste shall be removed or defaced BEFORE placing waste in dry solid container [reference TAC §289.202(cc)(2)].

H14.d.9

All animal carcasses and parts thereof containing radioactive material or contaminated with radioactive material shall be stored frozen.

H14.d.10

Waste Records are required to assure that the radionuclides and activities determined for the disposal purposes of each container are accurate. An inventory log sheet (developed by each sub-licensee) or the radioisotope use form on or near waste receptacles is a practicable way to account for the contents.

NOTE: It is the responsibility of the generator to keep an accurate isotope and activity log for each waste container. Routine pickups, inspections and record keeping audits by the RSO are used to evaluate a generator's (sub-licensee) waste management controls.

H14.e

Animal Carcasses and Animal Waste

Animals sacrificed containing radioactive material shall be prepared and stored frozen. The sub-licensee is responsible for the storage (frozen) of the animals until such time that the RSO can arrange for animal disposal through a contracted radioactive waste broker or landfill disposal according to procedures accepted by TAC requirements.

H14.f

Waste Pickup

H14.f.1

Request for removal of radioactive waste from the lab by radiation safety may be made by telephone to the RSO.

H14.f.2

The generator (sub-licensee) will be responsible for accurately filling out the "Request for Radioactive Waste Disposal" form (Form RS-14A). This form is available from the RSO. The form details information needed for accurate disposal of the waste. Each type of waste (physical form) will require a separate form.

NOTE: Wastes will not be picked-up without this form filled out completely and signed by the generator. It is the responsibility of the generator to indicate any known or suspected hazardous characteristics. This would include ignitability, corrosiveness, reactivity, toxicity, or other hazardous characteristics.

H14.f.3

NO radioactive waste having biohazardous characteristics shall be released from a laboratory for pick-up prior to autoclaving or otherwise suitable deactivation of any infectious agent(s).

H14.g

Sanitary Landfill Disposal

Certain radionuclides may be disposed of in a Type I municipal solid waste site such as the City of Lubbock Landfill (permit #69) by the TTU Radiation Safety Office as authorized by the Bureau of Radiation Control.

The radionuclides authorized for disposal are the less than 300 day half-life isotopes listed in the appendix of TAC §289.202, and can be disposed of in a Type I municipal solid waste site provided that the waste is dry and non-hazardous and the concentration and activity limits specified in TAC §289.202 are not exceeded.

Non-hazardous dry waste from in vitro clinical or in vitro laboratory testing containing 0.05 microcuries or less of Hydrogen-3 (tritium), Carbon-14, or Iodine-125 can be discarded without regard to its radioactivity; this waste should be physically delivered to the landfill.

Animal carcasses containing 0.05 microcuries or less of Hydrogen-3, Carbon-14, or Iodine-125, per gram of animal tissue per animal can be disposed of without regard to its radioactivity.

H14.g.1

The disposal is approved by the Bureau of Radiation Control and the Texas Natural Resource Conservation Commission and is in compliance with all requirements of TAC §289.202 and other applicable regulations.

H14.g.2

The burial is made a matter of record by listing the activity, radionuclides, biological materials, date, and name of the individual supervising the burial.

H14.g.3

Tissue in animal carcasses are frozen.

H14.g.4

The burial is coordinated with landfill personnel at least 24 hours in advance.

H14.g.5

The waste material is transported to the burial site by an individual familiar with the concepts of radiation safety and is authorized by the RSO.

H14.g.6

The authorized individual will not leave the burial site until they are assured that all animal waste materials are covered by a minimum of four feet of fill.

H14.h

Disposal Through Natural Decay

The Radiation Safety Office is the only entity at TTU authorized to supervise long term retention of radioactive material for the purpose of decay. After retention for a suitable time interval (several half-lives), the RSO shall evaluate the remaining activity and properly document the evaluation.

If the evaluation demonstrates that the activity(s) are below the "exempt quantities of concentrations" [reference TAC §289.202(ggg)(3) – Table III], the RSO may authorize the disposal of the material as conventional waste, provided all radioactive material labels, symbols, etc. are removed and the waste contains no hazardous characteristics.

H14.i

Sanitary Sewerage Disposal

H14.i.1

The Radiation Safety Office is the only entity at TTU authorized to dispose of radioactive materials through the sanitary sewer.

H14.i.2

All sanitary sewer disposals shall be in accordance with TAC §289.202(gg). Furthermore, these disposals shall be made a part of the RSO's disposal records.

H14.i.3

Any liquids containing radioactive material with hazardous characteristics will not be disposed of by this manner. These will be disposed of as mixed waste or hazardous waste.

H14.j

Other Disposal Information

H14.j.1

The generator (sub-licensee) is responsible, upon receipt of the isotope, for recording the use and recording the disposal of radioactive material on the Radioactive Material Use Form (Form RS-14).

H14.j.2

The generator (sub-licensee) shall maintain copies of all disposal forms with other required record keeping.

H14.j.3

Tritium (^3H) stored in a closed plastic bag will produce HTO and be released through the plastic. Tritium contaminated objects should be temporarily stored in an open tray pending placement in a waste disposal barrel.

H14.j.4

Lids shall remain on all waste containers at all times.

H14.j.5

Plans for proper disposal of infectious agents or highly toxic or hazardous substances shall be made early in the design stage of the experiment. Proposed procedures involving unusual waste disposal problems will be considered individually by the RSC and/or the RSO.

H14.j.6

The RSO shall maintain proper disposal records for all TTU campus-wide radioactive waste disposals in accordance with the TAC §289.202.

H14.j.7

Bulk liquid waste that contains greater than or equal to 75% water, less than or equal to 15% methanol, less than or equal to 10% acetic acid, and a less than 300 day half-life radioisotopes (i.e., S-35 and P-32) may be stored and decayed. After the radioisotope component has decayed, the liquid may be tested for its hazardous characteristic and then disposed of accordingly.

H15

Additional Policies and Procedures

H15.a

Radioactive Materials Use

H15.a.1

Proper marking of laboratories, areas, and equipment.

- a) A "CAUTION RADIOACTIVE MATERIALS" sign must be conspicuously posted on the doors to laboratory areas where radioactive materials are being used or stored in accordance with TAC §289.202(z) and §289.202(aa). The signs must not be removed from any room except by the RSO following a deactivation or termination inspection or survey.
- b) Storage areas shall be conspicuously marked with a "CAUTION RADIOACTIVE MATERIALS" label. This label shall also state the isotope activity and date.
- c) A "CAUTION RADIATION AREA" sign(s) shall be posted for any area where radiation levels could result in an individual(s) to receive a dose equivalent in excess of 5 millirem in any one hour at 30 cm from a radiation source or surface from which radiation penetrates.
- d) A "CAUTION HIGH RADIATION AREA" sign(s) shall be posted for any area where radiation levels could result in an individual(s) to receive a dose equivalent in excess of

100 millirems in any one hour at 30 cm from any source of radiation or from any surface from which radiation penetrates.

- e) All equipment contaminated with radioactive material shall be marked with signs, decals, or other conspicuous means. Equipment labeled as contaminated SHALL NOT be removed for unrestricted use, disposal, or transfer as uncontaminated. Labeling will not be required of equipment used transiently in laboratory procedures during the presence of the user.
- f) All radioactive refrigerators and freezers shall be posted with "Caution Radioactive Material" labels and "Food Must Not Be Stored In This Refrigerator" labels.
- g) All signs needed for proper labeling of the laboratory are available from the Radiation Safety Office. All sub-licensees are responsible for equipment, source, and area labeling tape, as well as work area absorbent paper, and any other specialized signage needed.

H15.a.2

Shielding of Sources

- a) Radioactive sources or stock solutions in the laboratory shall be shielded in such a manner to keep exposures ALARA, never to exceed 100 mrem in any five consecutive days.
- b) A beta shield will be required for procedures involving greater than 1 mCi of P-32.
- c) Proper shielding materials shall be obtained by each sub-licensee for his/her particular use so as to comply with Item a. (above). Various shielding materials (limited supply) are available on temporary loan from the Radiation Safety Office.

H15.a.3

Aerosols, Dusts, and Gaseous Products

- a) Procedures involving aerosols, dusts, or gaseous products, or procedures which might produce airborne contamination shall be conducted in an approved hood, dry box, or other approved closed system.
- b) All releases from such systems into the work place shall not exceed 10% of the applicable annual limit on intake (ALI) listed in Columns 1 and 2 of Table I of TAC §289.202(ggg)(2). However, when practical, traps should be incorporated to ensure that environmental releases are ALARA.
- c) Radioactive gases or materials with radioactive gaseous daughters must be stored in gas tight containers and must be kept in areas having approved ventilation.
- d) Microcentrifuge tubes placed in heat blocks must be done within a hood if the activity of the isotope in the microcentrifuge tube is >20 uCi. I.E., if there are 10 tubes per heat block, then the total activity must be ≤ 20 uCi for this procedure to be performed in the open.

H15.b

Gas Chromatographs

H15.b.1

Radioactive material in gas chromatography units (GC) shall be regulated the same as any other radioactive material at TTU.

H15.b.2

In addition, each gas chromatograph containing a radioactive foil must have a label showing the radiation caution symbol with the words "Caution Radioactive Material" and the type and activity of the radioactive material.

H15.b.3

The radioactive foil shall not be removed or transferred from its identifying cell or laboratory without prior RSO approval.

H15.b.4

The sub-licensee shall post the following notice on the outside of each gas chromatograph unit: "This equipment contains a radioactive source registered with the Department of Environmental Health and Safety. Notify the Radiation Safety Office before removing the source from this equipment or area, or upon change in are responsibility."

H15.b.5

Individuals using radioactive material components in gas chromatography equipment must vent the cell exhaust through plastic tubing into a hood, or radiation safety approved trap to avoid contamination of work areas from the release of radioactive tagged samples introduced into the system.

H15.b.6

The RSO will perform leak tests at the minimum of every 6 months, store radioactive foils, and maintain necessary records.

H15.c

Sealed Sources

Sealed sources of radioactive material, unless otherwise noted in this manual shall be tested for leakage of radiation on a semi-annual basis [reference TAC §289.201].

H15.d

Use of Hoods

H15.d.1

Hoods used for radioactive work should be tested by the Department of Environmental Health and Safety to insure the fume hood meets the minimum requirements for air velocity at the face of the hood.

H15.d.2

Hoods should be checked at least annually for radioactive material contamination by performing a smear survey of the interior and if P-32 or I-25 are used in the hood, a scan with a survey meter should be performed.

H15.d.3

No more than 10 mCi of any volatile isotope should be used in a hood without first contacting the RSO.

I POLICIES AND PROCEDURES FOR RADIOACTIVE MATERIAL USE UNDER SUB-LICENSES

I1

Each individual user shall work under an Authorized Sub-license and SHALL use the following procedures to assure safety in the work environment and compliance with TTU's radiation safety policies and practices:

I1.a

ALL users of radiation sources SHALL fulfill TTU's radiation safety training requirements PRIOR to using radiation sources.

I1.b

Radiation exposure of all individuals shall be maintained ALARA.

I1.c

The prescribed personnel monitoring devices (such as film badges and pocket dosimeters) SHALL BE WORN in radiation areas and while using radiation sources.

I1.d

Personnel monitoring devices shall be protected from inadvertent exposure and damage and shall be returned to the Radiation Safety Office as scheduled.

I1.e

When working with unsealed radioactive material, the user's hands, shoes, clothing and body SHALL be surveyed for radioactive contamination. at the conclusion of the work (Note: periodic surveys should be performed during operations using radioactive materials).

I1.f

If radioactive contamination is detected on an individual's hands, shoes, clothing or body, the contamination will be removed before the individual is permitted to leave the restricted or laboratory area.

I1.g

The following protective equipment shall be worn, and protective procedures followed, at all times when working with radiation sources:

I1.g.1

wear protective clothing, gloves, and (in some cases) shoe covers when working with unsealed radioactive materials;

I1.g.2

using protective barriers and shields whenever possible -- also protective eyewear if laser hazards exist;

I1.g.3.

use mechanical devices (tongs, remote handling tools, etc.) to assist in reducing exposure;

I1.g.4

perform all work with radioactive materials within the confines of an approved fume hood or glove box – except where a safety review has determined it is safer to work in an open area;

I1.g.5

PIPETTING BY MOUTH IS STRICTLY PROHIBITED when working with radioactive materials AND/OR with chemically and biologically hazardous substances; and

I1.g.6

respiratory protection may NOT be used as a safety function. [Note: Procedures involving radioactive materials that rely on respiratory protection devices require specific approval from the Bureau of Radiation Control, Texas Department of Health. Approval will require participating individuals to receive training in use of respiratory protective devices, passing a respiratory physical, and fit testing by the Environmental Health and Safety Office].

I1.g.7

Eating, drinking, smoking, applying makeup, etc. in radiation laboratories and areas where unsealed radioactive materials are stored or used is strictly PROHIBITED.

I1.g.8

Radiation use and storage areas SHALL NOT be used jointly for storage of radioactive material and material for human consumption.

I1.h

Each user shall maintain good personnel hygiene and occupational safety habits (such as not working with radioactive material if there is a break, cut, scratch, etc. in the skin below the wrist and always washing hands and arms thoroughly before handling any object near the face.

I1.i

Areas where radioactive material, radiation producing equipment, and/or lasers are used, shall be periodically surveyed and checked for contamination, excessive radiation levels (ionizing, non-ionizing), and proper operation of all warning devices and interlocks according to the procedures required in this manual. Records of these surveys and checks shall be maintained for review and inspection by the Radiation Safety Office and the regulatory agency.

I1.j

Radiation use/storage areas, devices, and containers shall be periodically inspected for proper display of required warning signs and labels.

11.k

Each radiation-use laboratory and work area:

- 1) shall be maintained neat and clean;
- 2) shall be free from unnecessary equipment and material:
- 3) shall store and transfer/transport radioactive materials in a manner that prevents breakage or spillage (use double containers, for example);
- 4) shall provide for adequate shielding;
- 5) shall have work areas covered with absorbent material and/or stainless-steel trays or pans to limit and collect spillage in case of accident; and
- 6) all laboratory equipment (such as glassware), stock radioactive material, and radioactive waste, shall be labeled and isolated appropriate storage facilities. Equipment that has been used in work with unsealed radioactive materials shall not be used for other work and shall not be sent from the area to central cleaning facilities, repair shops, or to surplus, until it has been demonstrated and certified by the Radiation Safety Office to be free of radioactive contamination.

11.l

Emergency repair of contaminated equipment by shop personnel or by commercial service contractors will not be performed except under the direct supervision of the RSO or his/her designee. Timely requests for such supervision shall be made to the RSO to allow for scheduling.

11.m

A member of the laboratory staff shall be present to provide specific information when service personnel are permitted to work on equipment in radiation areas.

11.n

Each user/individual SHALL:

- 1) IMMEDIATELY REPORT accidental exposure, inhalation, ingestion, or injury involving radioactive materials, X-ray radiation, or laser radiation to his/her supervisor AND to the RSO;
- 2) IMMEDIATELY conduct the required/recommended corrective measures and procedures – unless otherwise directed by the RSO;
- 3) Individual(s) shall cooperate in any and all attempts to evaluate his/her exposure;
- 4) Perform emergency decontamination procedures, when required or necessary, and take the necessary precautions to prevent the spread of contamination to other areas and equipment;
- 5) Comply with requests from the RSO for bioassays, body burden measurements and/or the submission of urine samples for internal radioassay; and

- 6) Comply with the required procedures for handling radiation incidents. according to Section V - Emergency Procedures and TTU Operating Procedure 78.05 Vol.II.

J GENERAL LABORATORY RADIATION SAFETY RULES

The following rules are to be used with the ALARA concept in mind. The TTU Radiation Safety Manual, in addition to the state and federal regulations and guidelines, are minimal requirements that are designed to enable ALARA controls and keep exposures well under the maximum limits. This list should be posted conspicuously in each laboratory area:

J1

NO PIPETTING BY MOUTH

J2

No open toed shoes (i.e. sandals, flip-flops, etc.) in radioactive material laboratories.

J3

All radioactive material containers must be labeled as to isotope, activity, and date.

J4

NO eating, drinking, smoking, food storage, application of cosmetics, or food preparation in radiation labs.

J5

Place rad-waste in appropriately labeled waste receptacles.

J6

NEVER mix different forms of rad-wastes.

J7

Remove protective clothing and gloves before leaving radiation lab.

J8

Monitor hands, shoes, and clothing before leaving radiation lab.

J9

Personnel exposures shall be kept ALARA by using time, distance, and shielding safely and effectively.

J10

Use the fume hood when needed.

J11

perform all required surveys and safety checks.

J12

All spills and accidents must be reported immediately to the RSO. If you are unsure as to the proper course of action to take in any given situation, always consult your supervisor or call the Radiation Safety Office (742-3876).

END OF SECTION II

SECTION III – RADIATION PRODUCING MACHINE SAFETY PROGRAM

Introduction

This section will outline Policies and Procedures for radiation producing equipment. The equipment referred to will be analytical X-ray equipment, research accelerators, and other ionizing radiation producing equipment. These Policies and Procedures, established with the utmost concern for ALARA, are in addition to Texas Regulations for Control of Radiation Parts 34, 35, and other applicable regulations.

A RADIATION PRODUCING MACHINES (X-RAY)

A1

Registration

The Texas Regulations for Control of Radiation require that radiation producing machines be registered with the Bureau of Radiation Control, Texas Department of Health.

A2

Proposed devices

Registration of proposed devices must be conducted through the RSO.

A3

Personnel Protection

A3.a

Personnel Monitoring

All operating personnel and personnel in the immediate area shall wear a film badge or other personnel monitoring device, as supplied by the RSO.

A3.b

Personnel Safety

Personnel specifically responsible for such equipment used or to be used shall:

A3.b.1

Ensure that all rules and regulations (TTU, state and local) have been implemented and are followed; and

A3.b.2

Ensure that all users have attended the TTU Radiation Safety Shortcourse, given by the RSO, for radiation producing equipment prior to using the radiation producing equipment.

A4

Facilities

A4.a

Posting and Labeling

A4.a.1

Areas in which radiation producing equipment are located or are being used shall be posted with a standard "CAUTION – X-RAY RADIATION" sign.

A4.a.2

The controls of each radiation producing device shall bear a label or decal with the statement: "CAUTION RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED." Signs, labels and decals are available from the Radiation Safety Office.

A4.b

Record of Operation

A log book and a copy of the operating procedures for that particular instrument or area shall be attached to each instrument or near the control panel.

A5

Radiation Surveys and Record Keeping Requirements

A5.a

Sub-licensee Requirements

A5.a.1

Radiation surveys

A5.a.1.a

Radiation surveys will be conducted after every change that might increase radiation exposure hazard.

A5.a.1.b

Radiation surveys shall be conducted at least once a month.

A5.a.1.c

The results of each radiation survey shall be recorded in the log book.

A5.a.1.d

Radiation surveys shall be performed using only the appropriate instrument.

A5.a.1.d.1

Interlocks, visual and audible warning devices, and shutter mechanism checks shall be conducted at the same time as the radiation surveys and the results shall be recorded in the log book.

A5.a.2

Log book

Each log book (record) shall contain the following information:

A5.a.2.a

Users log (user, date, start, finish, power settings);

A5.a.2.b

Survey Records (date, surveyor, instrument used, drawing or photograph of instrument/area, particular area surveyed, and results of the survey recorded in proper units); and

A5.a.2.c

Safety device records (date, surveyor, drawing or detailed photograph of the instrument - indicating the location of the safety devices, results of the checks as to whether the devices were Operative (O) or Inoperative (IO)).

A5.a.3

Written Safety Procedures

Safety and Operating Procedures shall be written and updated as changes in that particular instrument or area warrant the need for revision.

A5.a.3.a

The written safety and operating procedures shall be available to all users.

A5.b

Radiation Safety Office Requirements

A5.b.1

A radiation survey of all radiation producing devices shall be conducted on a 6 month interval by the Radiation Safety Office.

A5.b.2

All interlocks, visual and audible warning devices, and shutter mechanisms shall be inspected for proper operation on a 6-month interval by the Radiation Safety Office.

A5.c

Additional Rules and Requirements

A5.c.1

The RSC, upon recommendation of the RSO, may require additional safety devices or procedures (beyond the minimum TAC requirements) to ensure conformance with ALARA.

The following criteria will be used to determine the need for additional safety devices or procedures:

- (a) The number of persons involved with the use of the x-ray producing devices.
- (b) The need to reduce the chance of any unneeded exposures.
- (c) The amount of personnel traffic in and out of the lab.
- (d) The age of the x-ray producing devices.

- (e) The current safety devices in use.
- (f) Number of x-ray producing devices located in a single area.
- (g) Previous compliance during local and state inspections.
- (h) Previous exposure reports.

A5.c.2

The structural shielding requirements of any new installation, or an existing one in which changes are contemplated, shall be reviewed with the RSO.

A5.c.3

No person shall be permitted to operate radiation producing equipment in any manner other than specified in the procedures unless such person has obtained written permission from the RSO and the RSC.

A5.c.4

No person shall bypass a safety device unless such person has obtained written permission from the RSO and the RSC.

A5.c.5

All log books and current Operating Procedures shall be readily available to each radiation producing device or near the control panel.

A5.c.6

Each sub-licensee must maintain portable radiation monitoring device(s) capable and calibrated for the measurement of X-ray radiation in beams of a small cross-section.

A5.c.7

The local components of any radiation producing equipment system shall be located and arranged and shall include sufficient shielding or access control such that no radiation levels exist in any area surrounding the local component group which could result in a dose to any individual present therein in excess of the dose limits given in this manual. These levels shall be met at any power rating.

A5.c.8

The RSO must be notified in advance of the procurement, transfer, or donation (received or given) of ALL radiation producing equipment, whether ionizing or non-ionizing: X-ray units, accelerators, or lasers.

A5.c.9

All radiation producing equipment shall be shipped to the following address:

ATTN: RSO
Central Receiving
Texas Tech University
Lubbock, Texas 79409

A5.c.10

Radiation producing equipment or lasers transferred within TTU must be coordinated with the RSO.

A5.c.11

The RSO shall be notified of any instrument taken out of use and placed into storage or to be disposed of.

B RADIOFREQUENCY AND MICROWAVE DEVICES

B1

Protection from Microwave Oven Radiation

B1.a

Non-public use (i.e. departmental, laboratory/research)

B1.a.1

Registration

Person(s) responsible for each microwave oven at TTU should notify the Radiation Safety Office of its presence.

B1.a.2

Surveys

The Radiation Safety Office will perform surveys of microwave ovens at TTU that are used for non-public use on a request only basis. In the event that the microwave oven is found to be leaking microwave radiation in excess of the limits specified in TRCR Part 90.9 (a)(1), the RSO (RSO) shall notify responsible person(s). Person(s) responsible for the defective oven should discontinue use until the oven is repaired and surveyed.

B1.a.3

Repairs

All repairs to defective ovens shall be performed by qualified repair technicians that can certify compliance with emission levels listed in TRCR 90.9 (a)(1). A completed Repair Certification label shall appear on all microwave ovens. This label shall include the name of the person certifying the compliance with emission limits, and signature of authorized agent and date.

B1.b

Public-Use Microwave Ovens (i.e. Commercial food vending service)

Public use microwave ovens include any microwave oven or equipment offered for public use, or where public access to the use of the microwave oven or equipment is made available.

B1.b.1

Registration

The persons and/or companies responsible for each microwave oven at TTU should notify the Radiation Safety Office of its presence, and should have available survey records performed in accordance with TRCR 90.5 for the previous three years.

B1.b.2

Surveys

The persons and/or companies responsible for each microwave oven at TTU shall ensure that each microwave oven meets the microwave oven standards established in TRCR Part 90.9 (a) & (b).

B1.b.2.a

Compliance surveys of the microwave oven(s) as described in TRCR Part 90 will be performed by the Radiation Safety Office shall be performed semi-annually.

B1.b.2.b

The microwave oven(s) shall be labeled after every survey and the label shall include: the signature of the person performing the survey, and date of the compliance survey.

B1.b.2.c

The Radiation Safety Office, upon notification or discovery of a microwave oven not in compliance or without proper survey labeling or records, shall immediately shut down and discontinue the use of the microwave oven until the unit is determined to be in compliance.

B1.b.3

Repairs

All repairs to defective ovens shall be performed by qualified repair technicians that can certify compliance with emission levels listed in TRCR 90.9 (a)(1).

B1.b.3a

A completed Repair Certification label shall appear on all microwave ovens. This label shall include the name of the person certifying the compliance with emission limits, and signature of authorized agent and date.

B1.b.4

Other Requirements

As specified in TRCR 90.0(b) all commercial food service microwave ovens (i.e. public use) shall meet the National Sanitation Foundation Standards or be approved by the U.S. Food and Drug Administration or the Texas Department of Health.

B1.b.4.a

Microwave ovens or equipment brought on TTU property by outside vendors, food brokers, etc. shall meet all requirements of the TRCR Parts 80 and 90.

B1.b.4.b

The outside vendor, food brokers, etc. shall be responsible for repair, cleaning, and notification to the TTU Radiation Safety Office of relocation or new locations of microwave ovens for public use.

B1.b.4.c

The food contact and RF radiation sealing surfaces of the cavities of microwave ovens shall be cleaned at least once a day and shall be kept free of encrusted grease deposits and other accumulated soil (TRCR 90.9 (b)(2)).

B1.b.4.d

Where microwave equipment and utensils are used for food preparation of potentially hazardous foods on a continuous or production-line basis, utensils and sealing surfaces of equipment, shall be cleaned and SANITIZED at intervals throughout the day on a schedule approved by the regulating health authority. This schedule shall be based on food temperature, type of food, and amount of food particle accumulation (TRCR 90.9 (b)(3)). For information concerning TTU cleaning and sanitization policies contact the TTU Department of Environmental Health and Safety at 742-3876.

B1.b.5

Contact

Any questions concerning standards for RF or microwave radiation not being produced in microwave ovens or exempt equipment should be addressed to the TTU Radiation Safety Office.

B2

Safety Tips for Microwave Oven Users

(published by the U.S. Govt. Bureau of Radiological Health)

B2.a

Follow the manufacturer's instruction manual for recommended operating procedures.

B2.b

Examine the oven for evidence of shipping damage.

B2.c

Never insert objects (for example, a wire) through the door grill or around the door seal.

B2.d

Never tamper with or inactivate the oven safety interlocks.

B2.e

Never operate an EMPTY oven.

B2.f

Clean oven cavity, door, and seals frequently with water and mild detergent. DO NOT use scouring pads, steel wool, or other abrasives.

B2.g

Have oven serviced regularly by a qualified serviceperson and inspected for signs of wear, damage, or tampering.

B2.h

Additionally, users of microwave ovens manufactured prior to the new standards (prior to October 10, 1971) should follow these precautions:

B2.i

Switch the oven off before opening the door.

B2.j

Stay at least an arm's length away from the front of an oven while it is on.

END OF SECTION III

SECTION IV - EMERGENCY PROCEDURES

Introduction

This section outlines basic emergency procedures. An emergency situation or accident can arise from the use, storage, or transfer of radioactive material or from the misuse or abuse of equipment that produces X-ray radiation or other forms of ionizing or non-ionizing (i.e. laser) radiation. This section is intended to enhance each sub-licensee's and worker's ability to react properly to radiation accidents.

Due to the broad scope of possible accidents at TTU, listing every step that must be followed for each type of accident would be impracticable. Instead, one must use the following basic procedures and apply them to his/her individual situation. The best advice for protection against radiation accidents is to prepare for them.

A GENERAL INFORMATION

A radiation incident at TTU should be defined as any unintentional accident or any single exposure or suspected exposure in excess of 45% of the maximum allowable exposure as set forth in TAC §289.202, the ingestion of radioactive material in the form of liquid, gas, or dust in excess of limits set forth in TAC §289.202(ggg)(2), any radioactive material spill regardless of activity and size, or accidents involving laser radiation exposure to the eyes or skin.

If persons involved in a radiation incident are unsure as to the extent of exposure, ingestion, or magnitude of the spill, those persons shall proceed with the assumption that an overexposure (internally or externally) or major spill has occurred, unless otherwise noted. Users will report all radiation incidents.

A1

Organization and Authority

A1.a

The responsibility of incident investigation shall be that of the RSO.

A1.b

The RSO will promptly report all investigation findings to the RSC and to the Agency [reference TAC §289.202(xx)] for direction and action.

A1.c

If preliminary findings of an incident presented to the RSC indicate there is probable cause of neglect or violation of state, federal, or local regulations or policies, the sub-licensee involved will be asked to attend the next RSC meeting to answer questions and present his/her account of the incident.

A1.d

In the event of a major emergency situation the RSO shall have the authority to bring the situation under control. It should be noted that this may not follow the TTU Administration Organization Chart. However, if this will only be used in extreme emergencies where this is immediate radiological danger to individual(s) or possible major building contamination.

A1.e

It is the responsibility of each sub-licensee to see that personnel working under their supervision have practical and well understood plans for an emergency, and control of an emergency in their respective laboratory. (reference TTU - Operating Procedure 78.01 Vol.III)

A1.f

The RSO has the responsibility to see that each radiation sub-licensee/worker knows how to:

- Recognize a radiation or laser emergency.
- Prevent or confine the accident.
- Exclude all personnel from possible risk of exposure.
- Immediately contact his/her supervisor, the RSO, and/or other emergency personnel for assistance.

A1.g

Each sub-licensee will be responsible for assisting the RSO in controlling and/or investigating the accident. Furthermore, the sub-licensee is responsible for assisting the victim(s) in getting medical attention, if necessary, as soon as practicable.

B FIRES, EXPLOSIONS AND MAJOR EMERGENCIES

1. Notify all persons in the area to leave at once.
2. Notify the TTU Fire Marshall, Lubbock Fire Department, the RSO as well as other supervisory personnel. Give them the address and the location of the fire.
3. If firemen arrive before the RSO, caution them that radioactive material is present in the area. Be ready to advise them on location, isotope(s), activity(s), type of storage, and any other information that may be needed to avoid radioactive contamination of personnel, building, or equipment.
4. The sub-licensee and/or workers will need to be available to evaluate or help evaluate the extent of damage to radioactive material and/or survey emergency personnel and equipment for radioactive material contamination.
5. All sub-licensees and workers will be required to file an incident report with the RSO.
6. MINOR FIRES - If the fire is minor (individual decision) and there are no radiation or chemical hazards involved, a sub-licensee or worker may attempt to put out the fire with approved firefighting equipment.

C ACCIDENTS INVOLVING POSSIBLE RADIATION OVEREXPOSURE

If a radiation overexposure has occurred, or is suspected to have occurred, proceed as follows:

1. Immediately remove affected person(s) from the area and notify the RSO.
2. Secure the area.
3. Take the affected persons(s) to the nearest emergency center immediately for clinical observation. Be sure to inform the attending medical personnel that it is a radiation accident. Be prepared to answer any questions that may arise concerning the accident or type of radiation involved.
4. Assist the RSO in obtaining all details of the incident.

5. The RSO will obtain the dosimetry of all involved person(s). The RSO will then forward the dosimetry for emergency processing.
6. Persons involved in the incident will not be permitted to work with radiation until exposure results have been received and the RSO has determined that exposure limits have not been exceeded.
7. The RSO will provide reports to the RSC and regulatory agencies.

D ACCIDENTS INVOLVING SIGNIFICANT RELEASES OF RADIOACTIVE MATERIALS

1. Notify all other persons in the area of the accident.
2. If possible, hold breath and close all air vents.
3. Vacate the room and seal off the area, if possible.
4. Notify the RSO immediately.
5. Secure access to the area.
6. Monitor all involved persons for contamination.
7. Assist and/or submit to any bioassay deemed necessary by the RSO, RSC, or the BRC.
8. Assist the RSO in hazard evaluations and decontamination procedure.

E PERSONNEL INJURIES

Persons should not work with uncontained radioactive material when they have a break in the skin (cut, scrape, etc.) below the wrist. If a person is cut by an article contaminated with radioactive material the following should be used as a guide:

1. Cleanse the wound immediately by placing it under running water. If possible, retain any cotton balls, paper towels, fluids, etc. for radiological analysis. Contact the RSO as soon as practicable.
2. If necessary take the person(s) for emergency treatment. Be sure to tell the attending medical personnel that radioactive material was involved in the accident.
3. Follow the necessary steps in Item D of this section, under the direction of the RSO and/or RSC.
4. Contact the RSO before proceeding with more severe methods of decontamination.

F POLICIES FOR RADIOACTIVE SPILLS

The following procedures are a generalized summary of procedures listed in NCRP REPORT 48 and ICRP Report 28:

1. Minor Spills (i.e. at the microcurie level)
 - a. Notify other persons in the laboratory and minimize radioactive material ingestion, inhalation, etc.
 - b. Prevent the spread of contamination of the accident.
 - c. Contact the RSO.
 - d. Survey all persons involved, decontaminate if necessary, and release unneeded persons.
 - e. Begin decontamination procedures.
 - f. Submit incident report to the RSO.

2. Major Spills

- a. Notify all persons in the laboratory and minimize radioactive material ingestion, inhalation, etc.
- b. Prevent the spread of contamination of the accident.
- c. Contact the RSO.
- d. If possible, block all air vents to avoid creation of airborne contamination.
- e. Vacate the laboratory, avoid spreading the contamination.
- f. Survey all persons involved, and decontaminate if necessary. Do not release persons directly involved, except for emergency medical treatment. Wait for the RSO and/or the RSC to authorize release.
- g. If deemed necessary by the RSO and/or RSC specific steps in Items D. E., or F. of this section may need to be initiated.

G LOSS OR THEFT OF RADIATION EQUIPMENT

1. Any loss or theft of radioactive material, a device containing radioactive material, or a radiation producing device, shall be immediately reported to the RSO.
2. The RSO will provide required notification to the Bureau of Radiation Control.
3. The RSO will determine the extent of damage and analyze the recovery plan.

NOTE: Repair of any encapsulated radioactive material source IS PROHIBITED. Radiation sources involved in an accident, fire, flood, etc. MAY NOT BE USED until tested by the RSO and found to be in proper and safe operating condition.

H MALFUNCTION OF RADIATION PRODUCING EQUIPMENT

1. Any radiation device (X-ray, PMDG, Laser, etc.) believed to be defective shall be locked into a safe position and made inoperative immediately. In emergency situations the individual user, authorized user, and/or the RSO can take such action as to shield the source, deactivate the equipment, or retrieve the source.
2. The responsible user must restrict access to the area until the RSO arrives.
3. The RSO will evaluate the incident thoroughly, notify the RSC in writing within 10 days and if necessary report the incident to the BRC within 30 days.

I VEHICLE ACCIDENT DURING PMDG OR RAM TRANSPORTATION

If a vehicle accident occurs during the transportation of a PMDG or radioactive material and there are no fires or injuries the following procedure should be used:

1. If a minor accident and it can be visually determined that the source is safely stored in its DOT container then no restricted area is required, otherwise establish a safe perimeter around the source assuming the source is in an exposed position.
2. If a survey meter is available, and no radiation hazard exists, and the vehicle is movable proceed to destination.
3. If the source cannot be found, does not appear to be safe, vehicle is not moveable, etc. have a responsible person notify the RSO and/or the BRC. Then proceed to isolate the vehicle and area.

4. Other areas of the Emergency Procedures may need to be instituted before the RSO or emergency personnel arrive.

J REPORTING OF RADIATION INCIDENTS

J1

IT IS THE RESPONSIBILITY OF THE SUB-LICENSEE to report all accidents incidents involving radioactive materials or radiation producing equipment in his/her approved facilities to the RSO, by telephone, as soon as practicable. In addition, he/she must also report all incidents involving his/her radioactive materials or radiation producing equipment that may occur outside his/her approved facilities.

J2

The sub-licensee initiates this report (in writing) by completing the standard report form ("Report of Accidents Involving ionizing Radiation" Form RS-29) and filing it with the RSO as soon as possible. IN NO CASE should the delay exceed one work day. If any required signatories are absent, their designees should sign in their absence. Any questions on the proper completion of this form should be directed to the RSO.

K DECONTAMINATION PROCEDURES

There are many different methods of decontamination depending on the isotope, activity involved, items or material contaminated, and other influencing circumstances. One must also consider the amount of waste to be generated in decontamination and whether the decontamination is cost effective.

K1

Preoperational Decontamination Procedure

- a. Contact the RSO.
- b. Plan the decontamination operation thoroughly and obtain adequate supplies.
- c. Provide adequate protection for all personnel involved in the decontamination process. If necessary be prepared to allow for replacement personnel.
- d. Provide for storage of all radioactive wastes and decontamination supplies.

K2

Operational Decontamination Procedure

- a. Always work toward center of contaminated area.
- b. Monitor frequently.
- c. Cover clean areas to avoid recontaminating the area.
- d. Monitor all personnel involved before allowing them to proceed to clean areas or leave the laboratory.

K3

Post-Operational Decontamination Procedure

- a. Monitor all cleaning supplies and equipment before release.
- b. Use proper disposal procedures for all radioactive wastes.

K4

General Procedures for Handling Minor Spills

- a. Put on extra gloves and protective clothing to prevent unneeded personnel contamination.
- b. Monitor all persons first to ensure he/she is not contaminated as a result of the accident.
- c. Drop absorbent paper, cloth or other suitable containment material on or around spill to limit the spread of contamination.
- d. Monitor and mark off the contaminated area. DO NOT let any person out of the laboratory without being monitored. It is a good idea to assign monitoring responsibilities to one person.
- e. Using normal cleaning agents, proceed from the outermost edges of the contained area inwards, systematically reducing the contaminated area.
- f. Keep cleaning supplies to a minimum needed to do the job and place into sealed bags after use.
- g. Put all contaminated objects and material into proper waste containers. If the above method does not work after 3 or 4 tries, contact the RSO before proceeding to more extreme methods of decontamination.

K5

Personnel contamination

K5.a

Identify areas(s) with a survey meter (swipe test of area may be needed if very low energy beta emitters are involved). DO NOT use decontamination methods, which will spread localized material or increase penetration of the radioactive material into the body (e.g. by abrasion of the skin).

K5.b

Decontamination of an open wound shall only be accomplished by a physician.

CAUTION - AVOID THE USE OF HIGHLY ALKALINE SOAPS (may result in the fixation of radioactive material) or ORGANIC SOLVENTS (may increase skin penetration of radioactive material).

K5.c

The following procedure should be used on intact skin:

- (1) Wet hands and apply detergent.
- (2) Work up good lather, keep lather wet.
- (3) Work lather into the contaminated area by rubbing gently for at least 3 minutes. Apply fresh water frequently.
- (4) Rinse thoroughly using lukewarm water, limiting water to contaminated area.
- (5) Repeat above procedures several times, if necessary gently scrub residually contaminated areas with a VERY SOFT bristle brush.
- (6) Additional decontamination methods can be obtained from the RSO, however DO NOT proceed with more severe methods until consultation with the RSO.

NOTE: If contamination is at a wound site, medical personnel should monitor or perform the cleansing of the wound area. REMEMBER - If your initial efforts at decontamination DO NOT produce encouraging results; cover the contaminated area and seek the proper assistance.

L EMERGENCY PHONE NUMBERS

TTU RADIATION SAFETY OFFICE..... 742-3876
RSO (Cell) 773-1645
TTU POLICE SERVICES 742-3931
CAMPUS EMERGENCY DIAL 9911
TEXAS BUREAU OF RADIATION CONTROL (BRC)(512) 835-7000

*IF TTU RADIATION EMERGENCY PERSONNEL CANNOT BE CONTACTED CALL:
BRC 24 HOUR EMERGENCY PHONE NUMBER(512) 458-7460*

END OF SECTION IV

SECTION V – RADIATION SURVEYS

A GUIDELINES FOR SURVEYS OF RADIATION LEVELS

A1

Radiation Detection Equipment

There are several types of radiation detection equipment for monitoring areas that are subjected to radioactive contamination, monitoring radiation producing equipment, and sealed sources of radioactive material. Each type is best suited for a particular application and should be used in conjunction with one another.

The most common type is the G-M survey-rate meter, which is used for monitoring low-level radiation areas (most common in radioactive material labs). The G-M tube type meter may saturate and read zero when exposed to high radiation levels; thus, personnel could be subjected to dangerously high radiation levels in belief that no radiation hazard existed.

For high-level areas, accelerators, analytical x-ray instruments, etc. an ion-chamber type (i.e. Cutie Pie) is recommended over the G-M survey rate meter type. It has two basic, yet important advantages: higher radiation levels can be measured (up to 5,000 mR/hr or more) and it will not saturate in high radiation fields.

A1.a

Survey rate-meters are required in all installations using radioactive material or Radiation Producing Equipment.

A2

Survey Information

Because a direct radiation survey is time consuming if properly done; a preliminary evaluation should be performed. A properly calibrated survey meter (G-M or scintillator as appropriate) with audible signal should be used. Be sure the survey meter has a range capable reading the radiation fields that are most commonly encountered in that particular area. In other words, make sure the meter will not zero out as described above in A1.

A3

Performing a Survey

A3.a

First find a radiation free area or make sure that all radiation producing equipment is turned off or not generating x-rays; then with the meter on its lowest scale take a general or average background reading (usually 0.01 - 0.05 mR/hr or 0 - 150 cpm in clean areas); this reading should be recorded on the survey map or in the log book.

A3.b

While listening for changes in the audible output signal, the individual conducting the survey will perform a thorough scan of all areas within the area covered by the survey map and/or equipment involved. Any area indicating an average reading of more than 3 times the recorded average background reading will be marked on the survey map. If there are no areas where

direct radiation levels exceed 3 times background, direct radiation levels may be recorded as "0.1 mR/hr" unless this level (0.1) exceeds recorded background. Then the actual levels should be recorded.

A3.c

The surveyor will immediately re-measure areas where readings were greater than 3 times recorded background to identify excessive radiation levels. This survey should be conducted with an ion-chamber type instrument; the reading properly recorded on the map or in the log book (i.e. mR/hr, cpm, etc.).

A3.c.1

Survey meters are required to be calibrated annually. Contact the RSO if your meter has not been calibrated within the past year. There should be a calibration sticker attached to the meter indicating the last calibration and the due date for the next one.

A4

Results/Reporting

A4.1

Record all results in the proper units (mR/hr and/or cpm) in your log book or on the survey map.

A4.2

Contact the RSO if:

- (a) surveys show areas that are greater than 2 mR/hr for radioactive material laboratories, and/or
- (b) surveys show more than 3 times the normal recorded reading for radiation producing equipment.

NOTE - In general it is very hard to put exact numbers on excessive levels (readings) since much of the older analytical x-ray equipment will have radiation levels that are relatively high compared to most radioactive material use areas or the newer closed beam analytical x-ray equipment. However, if there is ever a question concerning the radiation levels around a particular instrument or area call the RSO immediately.

B SURFACE CONTAMINATION SURVEYS (i.e. SMEAR/SWIPE SURVEY)

B1

General Information

The routine monitoring for radioactive contamination in radioactive material laboratories is a necessary and required part of the radiation safety program at TTU. Failure to control surface contamination may cause unnecessary internal or external radiation exposure to individuals, costly decontamination of equipment, laboratories or buildings and/or the loss of equipment, laboratories or building, if gross contamination were found and could not be decontaminated to acceptable levels.

Generally, the primary concern is to avoid internal exposure resulting from the intake of loose radioactive material via inhalation, ingestion, or skin absorption. However, external radiation

levels from radioactive contamination may at times be hazardous. Another major concern is limiting contamination to areas of equipment where it can be controlled or properly disposed and/or maintaining levels of contamination at/or below acceptable levels listed in TAC §289.202(ggg)(6).

B1.a

Removable Contamination

Removable contamination is that fraction of contamination present on a surface that can be transferred to a smear test paper by rubbing with moderate pressure.

B1.b

Fixed Contamination

Fixed contamination is generally defined as radioactivity remaining on a surface after repeated decontamination efforts have failed to significantly reduce the contamination level.

B1.c

Equipment

Instrument(s) used in surface contamination surveys should be sufficiently sensitive to detect the nuclides being monitored. Uniform methods of collecting and analyzing these smears should be used over extended periods of time in order to evaluate trends.

B1.c.1

The equipment used to count (analyze) the smear samples shall be properly calibrated, maintained, and shall be capable of detecting the radiation from the smears.

EXAMPLE - Smears of ^3H , ^{14}C , ^{35}S , or other beta emitters should be analyzed with a liquid scintillation counter or internal proportional counters.

B1.d

Method

The methodology in conducting smear tests varies greatly from institution to institution, from researcher to researcher, and from individual to individual. Keeping this in mind the following is a general guideline for smear testing.

B1.d.1

The purpose is to find ANY contamination that might be present. Continual, aggressive monitoring will almost always give the surveyor confidence in certifying his/her area is CLEAN.

B1.d.2

Prepare for the survey by; looking over previous survey records; find out what radiation sources are in the lab; identify problem areas (fume hoods, radiological sinks) ; identify previous problem areas.

B1.d.3

The next step in the smear process is to obtain a map (diagram) of the area or sketch it out on a piece of paper.

NOTE -This should only have to be done on a first survey only: after that a good diagram should be kept on file, unless the physical layout of the area significantly changes. Current copies of most laboratory diagrams are available from the RSO.

B1.d.4

When needed the diagram may be replaced or written on to include a detailed list of specialized items or equipment surveyed. In addition to this the surveyor might find it beneficial to specify key areas on the diagram that are smear tested at each survey.

B1.d.5

Before beginning the surveyor should prepare him/herself with the proper equipment to conduct a routine survey: smear paper (Whatman 4.25 cm #1 or equivalent), rubber gloves, diagram, writing instruments, vials or some other apparatus to prevent cross-contamination of the smears.

B1.d.6

CAUTION - The surveyor should mentally and physically go about his/her survey in a method that would prevent the unnecessary spread of contamination. What this means is to start in the "coldest" area (least area of probable contamination) and progressively proceed to areas of greater probable contamination.

B1.d.7

If the surveyor is conducting a survey in his/her own area or in another the following questions might be asked of him/herself or the lab workers to get a better idea of where to smear and how many smears should be taken:

- What isotopes have been used since the last survey?
- Where are/were they used?
- Where are they stored?
- Where is the waste stored?
- Have there been any contamination problems in surveys conducted by the lab personnel?

B1.d.8

The surveyor then decides on a representative sampling of the area (i.e. where and how many) usually based on three areas of input: individual idiosyncrasies, materials and processing, and traffic patterns.

B1.d.8.a

Idiosyncrasies: Look for information regarding habits and misplaced items around the lab; feet on the desks, misplaced books and equipment, etc.

B1.d.8.b

Materials: Look for changes in work areas, changes in previously recorded storage location, or waste storage areas, non-radioactive use of storage containers, etc.

B1.d.8.c

Traffic: Look for high traffic areas. Particularly worn areas on the floor, high use equipment, floors near a desk, phone, sink, hood, etc, etc.

B1.d.9

Where to Smear; Where Not to Smear

Probably the biggest problem associated with smear surveys is "what is proper to smear and what is not". Many manuals and institutions are very vague about this, but few good points to remember are:

(a) Areas of known contamination need not be smeared. This does not mean anything can be treated as contaminated. It is for certain hood trays, absorbent paper, or other equipment which is frequently used for radioactive material work and which is CLEARLY marked with standard caution signs, and stickers.

NOTE - These items SHALL be decontaminated or disposed of after the experiment or use and BEFORE deactivation or termination of the sub-license.

(b) Some DO'S and DON'TS

- DON'T smear the inside of a working or holding tray.
- DO smear: the counter around the tray, the floor around and/or below the tray, and the walls around the tray.
- DON'T smear used vials or labware containing radioactive material.
- DO smear: surfaces where the vials were placed, rings on surfaces where the containers may have been located.
- DON'T smear the inside of rad-waste containers.
- DO smear: the exterior of the container and any suspicious looking streaks of areas, the floor or countertop around the container, and walls or vertical areas near the container.

(c) Other Items and Special Areas to Pay Attention to:

- Telephone
- Door knobs
- Refrigerators/freezers (inside; shelves, bottom, shelf guards. outside; flat tops, suspicious streaks, handles, locks).
- Base cabinet doors (inside and outside)
- Drawers - inside (where contaminated equipment may have been placed).
- Instruments - knobs, on-off switches, keyboards, etc.
- Floors - entrances, near hoods, refrigerators/freezers, sinks, work stations, worn areas.
- Any area where equipment has been moved from -walls, floors, etc.

B1.d.10

Taking the Smear

- (1) Here is the second problem associated with the smear surveys: What constitutes a smear or swipe? Fundamentally, the surveyor applies (using rubber gloves) moderate pressure to the back of the smear and rubs it over the surface to be surveyed (some surveyors like to use a No. 8 or No. 10 rubber stopper) usually no more than 100 cm² or 16 square inches.
- (2) Most institutions allow and "S" motion of about 12-16 inches on a large, open surfaces (eg, walls, floors, countertops, etc). The smear is then placed either in separate vials or something to prevent cross-contamination. It is a good idea to change gloves periodically to prevent cross-contamination from the gloves.
- (3) The smears are then transported to a counter capable of monitoring the radiation surveyed.

B2

Frequency of Surveys

B2.a

General Information

The frequency of surveys depends on the nature, quantity, and use of radioactive material as well as equipment and procedures that are designed to protect the workers from unnecessary exposure.

Routine surveys are necessary to control the containment of radioactive material within specified areas and to ensure the reliability of protective equipment, containers and procedures. For any process involving any type of "loose" radioactive material (i.e. gas, liquid, finely divided form) the surveys shall be designed to monitor the containment and control of radioactive material involved.

B2.a.1

Frequency

Surveys should be performed in direct proportion to isotope use.

EXAMPLE - If a person uses radioactive material once or twice a month then 1 or 2 surveys a month should be conducted.

B2.a.2

If there is no use of radioactive material, a survey is still required at least ONCE a month, to ensure containment control. Surveys shall be continual as long as there is radioactive material or rad-waste in the laboratory.

B3

Records of Surveys

B3.a

Records shall be maintained in logbooks or on special forms as long as they are clear, legible, understandable, and reviewed by authorized individuals.

B3.b

Maintain the following information in the logbook or on a special form:

1. date of survey
2. counts per minute
3. diagram of laboratory
4. smear location
5. machine copy of results
6. dpm or standard reference source count

B3.c

Each batch of survey samples should include a standard reference source and a background sample count.

B3.d

Refer to TAC §289.202(ggg)(6) for contamination action levels and release limits.

END OF SECTION V

SECTION VI – FORMS AND RECORDS

- A. Radioactive Material Use Forms
- B. Radiation Producing Equipment Forms
- C. Additional Forms

Contact the Radiation Safety Office for forms.

END OF SECTION VI

SECTION VII – APPENDICES

RADIATION SAFETY INFORMATION AND RESOURCES

APPENDIX A – REFERENCE INFORMATION

A GLOSSARY OF TERMS

Introduction

This section lists information pertinent to radiation safety and is considered to be a part of this manual. The definitions in this glossary will not cover every term associated with radiation but does cover a majority of the terms. If a term should be encountered in your work with radiation and is not in this glossary, consult your supervisor or call the TTU Department of Environmental Health and Safety.

Radiation Terms

Absorbed Dose - The amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material.

Absorption - The phenomenon by which radiation imparts some or all of its energy to any material through which it passes.

Activity - The number of nuclear disintegrations occurring in a given quantity of material per unit time.

Administrative Penalties - A monetary penalty assessed by the Bureau of Radiation Control for violations of the **TRCR (TAC)** and/or local policies and procedures, to deter future violations and to assure continued compliance.

Airborne Radioactive Material - Any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases.

Alpha Particle - A strongly ionizing particle emitted from the nucleus during radioactive decay having a mass and charge equal in magnitude to a helium nucleus.

Alpha Ray - A stream of fast-moving helium nuclei (alpha particles), a strongly ionizing and weakly penetrating radiation.

Analytical X-Ray Equipment - X-ray equipment used for x-ray diffraction, fluorescence, or spectroscopy.

Analytical X-Ray System - A group of local and remote components utilizing x-rays to determine the elemental composition or to examine the microstructure of materials. Local components include those that are struck by x-rays such as radiation source housing, port and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors, and shielding. Remote components include power supplies, transformers, amplifiers, readout devices, and control panels.

Annihilation - An interaction between a positive and negative electron; their energy, including rest energy, being converted into electromagnetic radiation (annihilation radiation).

Annual Limit on Intake (ALI) - Derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year.

Atom - Smallest particle of an element which is capable of entering into a chemical reaction.

Autoradiograph - Record of radiation from radioactive material in an object made by placing the object in close proximity to a photographic emulsion.

Background Radiation - Ionizing radiation arising from radioactive material other than the source directly under consideration.

Beta Particle - Charged particle emitted from the nucleus of an atom, having a mass and charge equal in magnitude to an electron.

Beta Ray - A stream of high-speed electrons or positrons of nuclear origin. Higher penetration but less ionization than alpha rays.

BRC - Bureau of Radiation Control a division of the Texas Department of Health.

Bremsstrahlung - Electromagnetic (x-ray) radiation associated with deceleration of charged particles passing through matter.

Committed Dose Equivalent (HT,50) - Dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent - Sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues (HE, 50 = SwTHT,50).

Contamination, Radioactive - The deposit of radioactive material in any place where it is not desired, and particularly where its presence can cause harm.

Carrier Free - An adjective applied to one or more radionuclides in minute quantity, essentially undiluted with a stable carrier.

CFR: Code of Federal Regulations.

Critical Organ - Organ or tissue in which the irradiation of will result in the greatest hazard to the health or the individual or his/her descendants.

Decay, Radioactive - Disintegrations of the nucleus of an unstable isotope by the spontaneous emission of charged particles and/or photons.

Deep Dose Equivalent (Hd) - Applies to external whole-body exposure, is the dose equivalent at a tissue dept of 1 cm (1000 mg/cm².) but internal organ(s) still considered to be irradiated.

Derived Air Concentration (DAC) - Concentration of a given radionuclide in air which, if breathed by the reference man for working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

Dose - A general term denoting the quantity of radiation or energy absorbed in a specified mass. For special purposes it must be appropriately qualified, e.g. absorbed dose.

Dose Equivalent - A quantity used in radiation protection expressing all radiation on a common scale for calculating the effective absorbed dose. The unit for the dose equivalent is the rem, which is numerically equal to the absorbed does in rads multiplied by a quality factor.

Electron - Negatively charged elementary particle which is a constituent of every neutral atom.

Electron Volt - A unit of energy equivalent to the amount of energy gained by an electron in passing through a potential of 1 volt.

Exposure - A measure of the ionizing that is produced in air by x or gamma rays. It is the sum of the electrical charges on all the ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in air, divided by the mass of air in the volume element. Note: The unit for exposure is the roentgen.

Fail-Safe Characteristics - A design feature which causes beam port shutters to close, or otherwise prevents emergence of the primary beam, upon failure of a safety or warning device.

Gamma Ray - Very penetrating electromagnetic radiation of nuclear origin. Except for origin, identical to x-rays.

Geiger-Mueller (G-M) Counter - Highly sensitive gas-filled detector and associated circuitry used for radiation detection and measurement.

Genetic Effect of Radiation - Inheritable changes, chiefly mutations, produced by the absorption of ionizing radiation. On the basis of present knowledge these effects are purely additive, and there is no recovery.

Half-life, Biological - The time required for the body to eliminate one-half of an administered dose of any substance by the regular processes of elimination. This time is approximately the same for the stable and radionuclides of a particular element.

Half-life, Effective - Time required for a radionuclide in a system to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

Half-life, Radioactive - Time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has its own unique half-life.

Half-value Layer (half-thickness) - The thickness of any specified material necessary to reduce the intensity of an x-ray or gamma ray beam to one-half its original value.

Inspection - Means of examination and/or observation including but not limited to records, tests, surveys, safety check, and monitoring to determine compliance with state and local rules, regulations and requirements.

Inverse Square Law - The intensity of radiation at any distance from a point source varies inversely as the square of the distance.

Ion - Atomic particle, atom, or chemical radical bearing an electrical charge, either negative or positive.

Ionization - The process by which a neutral atom or molecule acquires either a positive or negative charge.

Ionization Chamber - An instrument designed to measure the quantity of ionizing radiation in terms of the charge of electricity associated with ions produced within a defined volume.

Ionization, Specific - The number of ion pairs per unit length of path of ionizing radiation in a medium.

Ionizing Radiation - Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly in its passage through matter.

Isotope - Nuclide that has the same number of protons in their nucleus, and hence having the same atomic number but differing in the number of neutrons, and therefore in the mass number.

Labeled Compound - A compound consisting, in part, of labeled molecules.

Maximum Permissible Dose - Maximum dose of radiation which may be received by persons working with ionizing radiation, which will produce no detectable damage over the normal life span.

Millirotogen (mR) - A submultiple of the roentgen equal of one-thousandth of a roentgen.

Neutron - Elementary particle with a mass approximately the same as that of a hydrogen atom and electrically neutral. It has a half-life in minutes and decays in free state into a proton and an electron.

Normal Operating Procedure - Operating procedure for conditions suitable for analytical purposes with shielding and barriers in place. These do not include maintenance but do include routine alignment procedures. Routine and emergency radiation safety considerations are part of these procedures (reference **TRCR 32.2(d)**).

Nuclide - A species of atom characterized by its mass number, atomic number, and energy state of its nucleus, provided that the atom is capable for a measurable time.

Open Beam Configuration - An analytical X-ray system in which an individual could accidentally place some part of his body into the primary beam path during normal operation.

Primary Beam - Ionizing radiation which passes through an aperture of the source housing by a direct path from the x-ray tube located in the radiation source housing.

Radiation - 1) The emission and propagation of energy through space or through a material medium in the form of waves. 2) The energy propagated through a material medium as waves; for example, energy in the form of elastic waves. Such as Hertzian, infrared, visible (light), etc. 3) By extension, corpuscular emissions, such as alpha and beta radiation, or ray of mixed or unknown type, as cosmic radiation.

Radiological Survey - Evaluation of the radiation hazards incident to the production, use or existence of radioactive materials or other sources of radiation under a specific set of conditions. Such evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes using or affecting these materials to predict hazards resulting from expected or possible change in materials or equipment.

Radionuclide - A nuclide with an unstable ratio of neutrons to protons placing the nucleus in a state of stress. In any attempt to reorganize to a more stable state, it may undergo various types of rearrangement that involve the release of radiation.

Radiotoxicity - Term referring to the potential of an isotope to cause damage to living tissue by absorption of energy from the disintegration of the radioactive material introduced into the body.

RAM - Radioactive material.

Relative Biological Effectiveness - For a particular living organism, the ratio of absorbed dose of a reference radiation that produces a specified biological effect to the absorbed dose of the radiation of interest that produces the same biological effect.

REM - The special unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, distribution factor, and any other necessary modifying factors.

RSC - Radiation Safety Committee; interchangeable with ILSC.

Roentgen - The quantity of x or gamma radiation such that the associated corpuscular emission per 0.001293 grams of dry air produces, in air, ions carrying one electrostatic unit of quantity of electricity of either sign. The roentgen is the special unit of exposure.

RSO - Radiation Safety Officer of TTU.

Shielding Material - Any material which is used to absorb radiation and thus effectively reduce the intensity of radiation, and in some cases eliminate it.

Smear (smear or swipe test) - A procedure in which a swab (e.g., a circle of filter paper) is rubbed on a surface and the radioactivity measured to determine if the surface is contaminated with loose radioactive material.

Specific Activity - Total radioactivity of a given nuclide per gram of compound, element or radioactive nuclide.

Total Effective Dose Equivalent (TEDE) - Sum of the deep dose equivalent (for external exposures) and CEDE (for internal exposures).

Tracer, Isotopic - The isotope or non-natural mixture of isotopes of an element which may be incorporated into a sample to make possible observation to the course of that element, alone or in combination, through a chemical, biological, or physical process. The observations may be made by measurement of radioactivity or of isotopic abundance.

Thermoluminescent Dosimeter (TLD) - A dosimeter made of certain crystalline material which is capable of both storing a fraction of absorbed ionizing radiation and releasing this energy in the form of visible photons when heated. The amount of light released can be used as a measure of radiation exposure to these crystals.

X-Rays - Penetrating electromagnetic radiation having wavelength shorter than those of visible light they are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extranuclear part of the atom as x-rays.

B INDEX OF ABBREVIATIONS AND ACRONYMS

ALARA

As
Low As Reasonably Achievable

BRC Bureau of Radiation Control

CFR Code of Federal Regulations

DOH Department of Health

DOT US Department of Transportation

FDA Federal Drug Administration

FRC Federal Radiation Council

GC Gas Chromatograph

ICRP International Commission on Radiation Protection

MPD Maximum Permissible Dose

NCRP National Council on Radiation Protection and Measurements

NRC Nuclear Regulatory Commission

OP Operating Procedure

PO Purchase Order

RAM Radioactive Material

RIA Radioimmunoassay

RPG Radiation Protection Guide

RSC Radiation Safety Committee

RSO Radiation Safety Officer

TDH Texas Department of Health

TLD Thermoluminescent Dosimetry

TRCR Texas Regulations for Control of Radiation

TTU Texas Tech University

C List Of Symbols for Radiation Units and Terms

Measurements /Units

Ci	Curie
m	milli (onethousandth)
u	micron (onemillionth)
k	kilo (thousand)
R	roentgen
rem	radiation equivalent man
dpm	disintegrations per minute
dps	disintegrations per second
cpm	counts per minute
MeV	Million electron volt
LET	Linear Energy Transfer
QF	Quality Factor

Appendix B - Texas Regulations for Control of Radiation References

Introduction

The following section will briefly describe specific parts of the **Texas Regulations for Control of Radiation (TRCR) and the Texas Regulations for Control of Laser Radiation Hazards (TRCLRH)**. TTU is subject to the rules of the **TRCR, TRCLRH**, and other state, federal, and local regulations when using radiation. These specific parts have been extracted because of overall benefit to all radiation users at TTU. More specific information can be obtained from the Radiation Safety Office

1. **25 TAC §289.201 (TRCR Part 11) - General Provisions**, Texas Regulations for Control of Radiation: contains general information concerning recordkeeping, testing of sealed sources, violation information, and transport grouping of radionuclides.
2. **TRCR Part 13** contains rules and regulations pertaining to amending licenses, annulment of licenses, administrative penalties (i.e., fines), impoundment of sources of radiation, etc.
3. **25 TAC §289.202 (TRCR Part 21), Standards for Protection Against Radiation** - establishes standards for protection against ionizing radiation hazards. It is the purpose of the rules in this part to control the possession, use, and transfer of sources of radiation by any licensee so as to ensure that the dose to any individual does not exceed the standards established in this part. Areas covered include exposure limits, concentration of radioactive material in effluents, personnel monitoring, storage, disposal, records, limits of concentrations, etc.. This part is the basis for **ALARA**, "As Low As Reasonably Achievable", which means that each user should make every effort to keep exposures and releases as low as reasonably achievable.
4. **25 TAC §289.203 (TRCR Part 22), Notices, Instructions, and Reports to Workers; Inspections** - establishes requirements for notices, instructions, and reports by licensees or registrants to individual engaged in work under a license or registration, and options available to such individuals in connection with the State Bureau of Radiation Control (BRC) inspections regarding radiological conditions. Areas of particular interest are requirements for Posting of Notices, Instructions to Workers, Requests by Workers for Inspections, etc.
5. **TRCR Part 34, Radiation Safety Requirements for Analytical X-Ray Equipment** - This part provides special requirements for analytical X-ray equipment. Areas covered are equipment requirements, area requirements, operating requirements, and personnel requirements.
6. **PARTS 50, 60, & 70 - TEXAS REGULATIONS FOR THE CONTROL OF LASER RADIATION HAZARDS** - The objective of these regulations is to provide guidance for safe use of laser products and laser installations. Areas of particular interest include supervision, controls, safety requirements, regulations, and requirements for safe operation, signs, surveys, records, and registrations.

Appendix C - Instrument Calibration Procedures

(12/01/99)

Note:

Only persons specifically authorized by the RSO may participate in the procedures set out in Appendix C.

APPENDIX C - INSTRUMENT CALIBRATION PROCEDURES

A General Procedure for Calibration of Radiation Detection and Measurement Instruments

- 1. Alpha Measuring Instruments:** will be calibrated annually by using a standard alpha source.
- 2. Beta Measuring Instruments:** will be calibrated annually by using a standard beta source.
- 3. Ionization Chamber Instruments:** will be calibrated annually by an authorized instrument service company or by the procedure in Part B.
- 4. Well Counters:** will be calibrated annually by an authorized instrument service company.
- 5. MCA's:** will be calibrated, using standard sources, each time they are turned on for operation and as necessary during analytical procedures.
- 6. GM Radiation Survey Instruments:** will be calibrated annually using the procedure in Part B of this procedure or by an authorized instrument service company

Periodic Calibration of Instruments

1. Purpose

This procedure will be used by TTU to perform its own annual radiation survey instrument calibrations for GM and, in some cases, ionization chamber instruments. *In the event that TTU cannot perform the calibration of a needed instrument, an authorized service company will be used.*

2. Scope

Each instrument will be calibrated to verify that it correctly measures the intensity of a radiation field (mR/hr). The procedure involves using a Ludlum Pulser to adjust the electronics of the instrument and then placing the instrument in a radiation field of known intensity and making necessary adjustments or calculations to verify the accuracy or determine correction factors.

3. Objective

To verify that each instrument is capable of measuring radiation levels over its multiple ranges to within plus or minus 20 percent of the true radiation level for the appropriate energies of the radiation.

4. Method

A known radiation field for the calibration procedure is provided through the use of a known source in a calibrator/shield. The beam calibrator is a manually operated device which incorporates a Cesium-137 source with an initial activity of 100 millicuries. The shield of the calibrator provides for full shielding in all directions at all times except when the unit is in the "ON" position. In the "ON" position, a radiation beam is emitted out of the port.

5. Applicability

This procedure applies only to GM and ionization chamber type instruments

6. Precautions and Safety

- a. **Personnel Monitoring:** The person(s) performing the calibration procedures MUST wear his/her assigned personnel monitoring device and pocket dosimeter.
- b. **Area Access:** ONLY persons properly trained in instrument calibration procedures AND authorized by the RSO may conduct instrument calibrations.
- c. **Area Control:** The area(s) where the calibrations are to be performed will be cleared of unauthorized/non-essential persons prior to initiating calibration procedures. "Caution - Radiation Area" signs will be posted at the entrance(s) to the area. Should any unauthorized/unmonitored person enter the area, the calibrator will immediately be turned to the OFF position.
- d. **Emergencies and Malfunctions:**
 - (1) **Calibrator Malfunction:** if the ON/OFF shutter mechanism fails such that the beam cannot be shut off, immediately clear and secure the area and notify the RSO. DO NOT leave the area unattended!
 - (2) **Improper Calibrator Operation:** should the operation of the source rod become difficult, the calibrator shall be removed from service and returned to the manufacturer for repair.

7. Instrument Inspection

A thorough inspection of the instrument must be performed prior to the calibration procedure, as follows:

- a. **Visual Inspection:** Visually check the outer meter face, adjustment knob, handle and meter case. Certain components, when damaged (such as the meter face, needle and adjustment knob), may affect the ability to calibrate.
- b. **Battery Condition Check:** Inspect the batteries for damage and test for charge. Replace if necessary. Weak batteries can cause erratic behavior.
- c. **Electrical Inspection:** Remove the case and visually inspect the electrical/electronic components. Inspect the internal probe, if present. If any component appears to be burned, broken, or loose, or there appears to be internal corrosion or moisture, do not proceed with calibration. Minor problems may be correctable, such as re-soldering a wire or removing corrosion or moisture. If repairs are satisfactorily performed, replace the cover and proceed with calibration. Otherwise, the instrument must be sent to an instrument repair service.
- d. **Electronics Test:** Perform the electronics test using the Pulser as stated in the applicable Ludlum Instruction Manual.
- e. **Mechanical Inspection:** Inspect and/or test all mechanical hardware, such as nuts, screws, etc., to ensure that they are secure. Check the retaining screw that holds the selector knob on, the retaining screw for the handle, screws that hold the circuit board to the meter body, screws on the meter movement, etc. If necessary, all loose hardware must be tightened. Check the proper operation of switches to assure that they "lock in" on the selected positions.
- f. **Probe and Connecting Cable Inspection:** Inspect the cable and connectors for signs of damage or wear. Kinks in the cable may cause erratic behavior. The connectors must

be of tight fit and the pins intact and firm. The connectors should attach to the instrument and probe connections firmly. Repair or replace the cable before proceeding with calibration.

8. Instrument Calibration (GM and ionization chamber instruments):

Only persons authorized by the RSO shall be allowed to calibrate radiation survey instruments.

- a. **Prepare Calibration Record/Certificate:** Prepare a calibration record/certificate for each instrument to be calibrated.
- b. **Determine Calibration Points:**
 - (1) Calculate and record the current source strength.
 - (2) Determine the points (distances from calibrator) at which the instrument (probe) must be placed to produce the necessary radiation levels which allow calibration at two points on each range. Enter the field intensities on the calibration record(s) for each instrument.
- c. **Establish Calibration Range:** Mark the calibration range for the determined points (distances).
- d. **Calibrate at Each Point:**
 - (1) Place the instrument at the desired point to checked
 - (2) Unlock the device and expose the source.
 - (3) Observe the reading on the instrument face at each predetermined point.
 - (4) If the instrument reading does not agree with the field intensity (within plus or minus 20%), the calibration potentiometer for that range must be adjusted until the instrument indicates the correct response. Caution: a small amount of adjustment produces a relatively large change in the instrument reading.

<p>Note: <i>For instruments that have only one calibration potentiometer, all ranges must be checked before adjusting the potentiometer. The potentiometer affects all ranges.</i></p>

- (5) Once the adjustments have been made, place the instrument back at the same location and verify the reading.
- (6) Repeat steps 6.d.1 through 6.d.5 for each point to be calibrated. It may be necessary to use attenuation blocks to obtain the lower range readings.

- e. **Turn Calibrator Off:** Return the source to the "OFF" position. Lock the calibrator.

9. Calibration Records

- a. **Calibration Record and Certificate:** For each instrument calibrated, complete the following sections of the instrument calibration record (Attachment E.2 – Certificate of Calibration, Form RS-32):
 - Sublicensee name and identifying information

- Instrument/detector manufacturer and information
- Calibration results
- Calibration method information

b. Certification: The person performing the calibration must sign the “Calibrated by” space and enter the date of calibration. Indicate the next due date based on the calibration interval for the type of use of the instrument.

c. Calibration Sticker: A “calibration sticker”, should be placed on the instrument (obscure or remove previous ones) to indicate who calibrated the instrument; authorization (license number); date of calibration; next due date; instrument make, model and serial number; and the identity of the person performing the calibration.

10. Serviceability of Instruments:

a. Successful Calibration: If the instrument was successfully calibrated, submit the completed “Survey Instrument Calibration Certificate” to the RSO for review and filing. Return the instrument to its proper storage location.

b. Unsuccessful Calibration: If unable to calibrate an instrument, or the instrument requires repair, tag it as unusable and needing repair. Submit the instrument with notes of problem(s) to the RSO.

Sample: “SURVEY METER CALIBRATION LABELS” (stickers)

<u>TEXAS TECH UNIVERSITY</u>		
_____	_____	_____
MFG	Model	Ser.#
_____	_____	_____
Cal.Date		Due
Date		
_____	_____	_____
Cal.Source		High Voltage
Tube ID	_____	Cal. By

Texas Tech University

Laser Safety Manual

(POLICIES AND PROCEDURES)

Reviewed/Updated: January 2021

Implementation: February 2003

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[Biosafety](#)

[Radiation Safety](#)

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SECTION I: MANAGEMENT OF LASER LICENSE

D1 LASER SAFETY PROGRAM

Introduction

The purpose of this manual is to inform users and non-users of laser equipment about the policies and procedures concerning laser use at Texas Tech University and state regulations, 25 Texas Administrative Code (TAC) §289.301 are covered. Policies and procedures set forth in this guide have a primary goal to protect Texas Tech University faculty, staff, students, and visitors against unnecessary and potentially harmful laser radiation exposure. This manual includes the procedure for permitting lasers at TTU and the requirements to obtain a sublicense permit for laser usage from the Radiation and Laser Safety Committee.

D1.1

Objective

This program is designed to protect the faculty, staff, employees, and students of Texas Tech University (TTU); to protect members of the general public; and to comply with **25 TAC §289.301** [Texas Regulations for Control of Laser Radiation Hazards (TRCLRH)].

D1.2

Method

Texas Tech University (TTU) has established this Laser Safety Manual (LrSM) to provide safety guidance to its faculty, staff, and students when working with lasers. The Radiation Laser Safety Committee (RLSC) and Laser Safety Officer (LSO) are also, available for additional assistance.

D1.3

Date of Implementation

September 1, 2002, upon approval by the RLSC.

D1.4

Review

This program will be reviewed on an annual basis no later than the anniversary month of its inception.

D1.5

Program Elements

D1.5.1

Purchase, Transfer, Shipping, and Delivery Notification: Laser purchase, transfer, shipping, and delivery procedures are specified in D.13.1.

D1.5.2

Access Controls for Laser Areas: Access to the laser areas is controlled by D.13.4 of the LrSM. In addition, certain elements of administrative and engineering controls regarding

storage, use, and maintenance/service procedures contain steps which specifically address access controls.

D1.5.3

Posting of Areas and Rooms: D.13.3 of the LrSM provides for posting of the appropriate signage respective of the class(s) of the laser.

D1.5.4

Training: D.13.5 of the LrSM addresses the required training for laboratory personnel.

D1.5.5

Management of Required Records: Records management procedures are addressed in D.13.11 of the LrSM.

D1.5.6

Personal Protective Equipment: D.13.6 provides procedures for providing for the necessary protection respective of the class(s) of the laser.

D1.5.7

Reports of Incidents and Accidents: All TTU personnel are responsible for reporting incidents and accidents to the LSO - immediately. The specific procedures are found in Section IV of the LrSM.

D2 RADIATION LASER SAFETY COMMITTEE

D2.1

Purpose and Structure

The RLSC is composed of a group of administrators, faculty, and staff appointed by the Executive Vice President and Provost to establish policies and regulations governing the use of ionizing and non-ionizing radiation. The RLSC is primarily responsible for the administration, implementation, and enforcement of the laser radiation safety program at TTU.

D2.2

Duties (RLSC Authority)

The RLSC will:

D2.2.1

establish policies and procedures, as well as provide administrative advice regarding laser radiation safety;

D2.2.2

approve or disapprove all applications, amendments, and renewals relating to the use of laser equipment;

D2.2.3

receive and review reports from the LSO on monitoring, surveillance, and exposure;

D2.2.4

monitor procurement, use, and transfer procedures;

D2.2.5

take appropriate corrective action on laser incidents, including administrative guidance and license suspension or revocation;

D2.2.6

provide a representative to the University Safety Committee; and

D2.2.7

serve as an avenue of appeal in cases of dispute and exception to actions by the LSO.

D2.3

Membership

The members of the committee will be appointed by the Executive Vice President and Provost. Members of the committee, other than those specified by virtue of their position, will be nominated by the committee chairperson and the Associate Vice President for Operations. Each member will serve a term of three years except when lesser terms may be required to maintain balanced membership and continuity of committee operations. Re-appointments are permissible. The RLSC shall be composed of:

D2.3.1

three faculty members who regularly use radioactive materials;

D2.3.2

two faculty members who regularly use lasers;

D2.3.3

at least one faculty member who regularly uses radiation producing equipment;

D2.3.4

at least two faculty/staff members who are non-users of radioactive materials, lasers, or radiation producing equipment;

D2.3.5

RSO (Ex-Officio);

D2.3.6

LSO (Ex-Officio);

D2.3.7

Associate Vice President for Operations, (Ex-Officio)

D2.4

Operating Procedures

The RLSC shall observe the following:

D2.4.1

the RLSC shall schedule a regular meeting for each month of the year. Additional meetings may be called as necessary. The LSO will prepare and distribute a written agenda to committee members at least one day before each scheduled meeting;

D2.4.2

a quorum, at least one-half of the voting members, is required to conduct official business;

D2.4.3

sub or ad hoc committees may be appointed by the Chairperson as needed;

D2.4.4

if a committee member is unable to continue serving on the committee for any reason, the member shall notify the Chairperson so that a replacement may be appointed promptly; and

D2.4.5

if a committee member fails to attend three consecutive meetings or one-half of the called meetings in a twelve-month period, without just cause, the Chairperson will contact that member to determine if that person should be replaced. If so, the Chairperson will ask the Associate Vice President for Operations to arrange for a replacement under the appointment procedures of the committee.

D2.5

RLSC Responsibilities

The RLSC shall:

D2.5.1

establish policies regarding laser radiation and laser safety;

D2.5.2

provide administrative advice to the LSO on matters regarding laser radiation and laser safety;

D2.5.3

regulate type of training needed by laser users to meet applicable statutory and administrative requirements;

D2.5.4

receive, review, and act on all applications and any amendments for the use of laser equipment in any areas used by TTU personnel;

D2.5.5

receive and review periodic reports from the LSO on records, surveys, and inspections and require compliance with applicable record keeping standards;

D2.5.6

periodically review the overall use of laser equipment at TTU from the standpoint of operational hazards and potential secondary hazards;

D2.5.7

receive and review all reports from the LSO concerning laser radiation and laser incidents at TTU;

D2.5.8

conduct necessary investigations, hearings, and/or appropriate corrective action to be taken if a sublicensee or authorized laser personnel fail to operate the licensed laser equipment according to the criteria specified in this policies and procedures manual at TTU;

D2.5.9

meet regularly during the academic year;

D2.5.10

perform an annual audit of the Laser Safety Program; and

D2.5.11

upon committee action, issue sublicenses which will be duly signed and approved by the Chairperson of the RLSC.

D3 LASER SAFETY OFFICER

D3.1

Duties

D3.1.1

The LSO is a member of the Radiation Safety Office who is trained in the areas of laser operation and laser safety and registered with the Bureau of Radiation Control. The LSO is the University official primarily responsible for compliance with applicable safety policies and regulations. The LSO also provides various technical services necessary for achieving such compliance.

D3.2

Responsibilities

The LSO shall:

D3.2.1

suspend immediately or restrict operation of a laser system when, in the view of LSO, the sublicensee or authorized laser personnel working with laser system or other personnel in the vicinity of the laser are in danger;

D3.2.2

instruct laser users and others affected in proper procedures and policies concerning laser equipment use, including teaching laser safety training classes. The LSO shall also provide consulting services to TTU personnel for aspects concerning laser safety;

D3.2.3

assure that appropriate primary control measures are in effect and to recommend alternate control measures as back up if primary measures become infeasible or inappropriate;

D3.2.4

generate reports, receive and review records from sublicensees, and maintain all material concerning laser equipment, personnel working in laser areas, and any other information required by the Texas Regulations for the Control of Laser Radiation Hazards (TRCLRH). This shall include, but not be limited to: laser eye protection inspections, incident/accident reports, LSO laser lab inspections, registration, inventory forms, and medical surveillance records;

D3.2.5

periodically inspect laser sublicensees to ensure proper record keeping, verify inventories, inspect appropriate laser control measures, and ensure compliance with other laser safety aspects as detailed in this manual. The LSO shall also inspect all new and existing laser facilities and laser equipment prior to their installation or modification to ensure proper compliance. The results of these inspections shall be periodically presented to the RLSC;

D3.2.6

investigate all actual and suspected incidents resulting from operation of a laser system by personnel at TTU. The LSO shall prepare reports to applicable agencies and the RLSC shall approve such reports and initiate appropriate action concerning the incident;

D3.2.7

provide each sublicensee with a copy (and updates) of the TTU Policies and Procedures Manual for Laser Safety.

D4 INSPECTIONS

D4.1

The LSO performs routine monitoring and inspections of all laser sublicensees and the results are then presented to the RLSC for their evaluation. Through this process, the Laser Safety Program at TTU can keep abreast of past, present, and future concerns with laser safety.

D4.2

The entire laser safety program is periodically inspected by a Regional Inspector from the Bureau of Radiation Control for compliance with the Texas Regulations for the Control of Laser Radiation Hazards. The results of these inspections are presented to the Director of Environmental Health and Safety, the Laser Safety Officer, the Radiation Safety Manager, and the Radiation Laser Safety Committee.

D4.3

General Monitoring

D4.3.1

The LSO may visit laboratories to ensure laser operations are according to procedures set forth in this manual and sublicensee's SOPs.

D4.3.2

The LSO will immediately report any major violation to the sublicensee and RLSC.

D4.3.3

The LSO will report minor violations to the sublicensee and RLSC.

D4.4

Formal Inspections

D4.4.1

Laser inspections will be performed semiannually by the LSO.

D4.4.2

Inspection results will be presented to the RLSC.

D4.4.3

Violations found will be brought to the attention of the sublicensee.

D4.4.4

Inspections results and reports will be sent to the sublicensee.

D4.5

Violation Levels

D4.5.1

Violations by a sublicensee are classified as either major or minor. All violations will be presented to the RLSC at the next regularly scheduled meeting. A copy of the most current monitoring and inspection criteria and the type of violation may be obtained from the LSO

D4.5.2

Major Violations

Include but are not limited to:

D4.5.2.1

Unauthorized personnel in laser area when laser is in use (authorized personnel are listed on the laser sublicense);

D4.5.2.2

Operation of laser equipment in a manner which could cause injury to personnel outside the laser area;

D4.5.2.3

Operation of laser equipment in a manner other than that specified in the approved standard operating procedures;

D4.5.2.4

Personnel in a laser area not utilizing proper personal protective equipment when the laser is in use;

D4.5.2.5

Operation of laser equipment without prior authorization from the RLSC and LSO; or

D4.5.2.6

Any combination of D4.5.2.1 to D4.5.2.5.

D4.5.2.7

Any major violation may warrant the immediate deactivation of laser operation, and will remain so until safety concerns are addressed.

D4.5.3

Minor Violations

Include but are not limited to:

D4.5.3.1

Improper posting of a laser area;

D4.5.3.2

Improper labeling of laser equipment;

D4.5.3.3

Usage log books not filled out as required;

D4.5.3.4

Monthly surveys and interlock checks not performed;

D4.5.3.5

Standard operating procedures and laser equipment manuals not in vicinity of laser equipment;

D4.5.3.6

Expiration of a laser sublicense; or

D4.5.3.7

Information on laser sublicense out of date.

D4.5.3.8

Any minor violation will be reported to the Sublicensee for correction and results discussed in the RLSC meeting.

D4.6

Inspection Procedures

D4.6.1

The LSO shall inspect all laser usage facilities for compliance with all applicable regulations - state, federal, and local.

D4.6.2

The LSO shall make a record of each inspection and keep those on file in the Radiation Safety office.

D4.6.3

The LSO will forward a formal report of inspection (Form LS-1) to each sublicensee within two weeks of final evaluation of his/her inspection results, noting corrective action needed.

D4.6.4

Each sublicensee will revise or correct his/her individual program as noted in the report under "Corrective Actions". Questions or problems should be addressed to the LSO or the RLSC.

D4.6.5

The LSO will request a written response to some of the "Corrective Actions" from the sublicensee within 30 days.

D4.6.6

The LSO will report all major violations as well as any instance of non-compliance for a sublicensee to the RLSC.

D4.6.7

The LSO shall make follow-up inspections of all sublicensees having deficiencies deemed serious by the RLSC within 15 days of report.

D4.6.8

All inspection statistics should be evaluated by the RLSC.

D4.6.

Sublicensees having repeated violations (same violation during two consecutive inspections) will be reported to the RLSC and the RLSC for appropriate action.

D4.6.10

A Sublicensee who commits the same violation during three consecutive inspections will be reported to the RLSC. The RLSC will issue a written notice and require the sublicensee to meet with the committee during the next scheduled RLSC meeting to explain their violation.

D4.6.11

The RLSC may terminate a sublicense if major violations are continued.

SECTION II: SUBLICENSE PROGRAM

This section details the procedures and requirements for obtaining a sublicense for laser equipment. Also included, will be procedures for renewals and amendments.

D5 DEFINITIONS

D5.1

Laser License – the specific laser license issued to TTU by the Bureau of Radiation Control of the Texas Department of Health. This license authorizes all laser use programs to be conducted at the discretion of the RLSC.

D5.2

Sublicense – an authorization issued by the RLSC to use laser equipment.

D5.3

Sublicensees – authorized laser personnel, full-time faculty members, whose training and experience are such that they have been sublicensed by the RLSC to use lasers in their research and educational activities. The RLSC will determine the extent of required training respective of the laser classification involved.

D5.4

Authorized Laser Personnel – faculty, students and other professionals, usually research or laboratory assistants or workers which may be engaged in education, laboratory research, and research support activities. These personnel may work with lasers but only after completing the required safety training programs and the Sublicensee amending his/her Sublicense to include them on it.

D5.5

Non-Authorized Personnel – faculty, students, and other professionals and non-TTU personnel which have not had TTU Laser Safety Training nor listed on the researcher's Sublicense.

D5.6

Operation – the normal mode of the laser or laser system over the full range of its intended functions. It does not include *maintenance*.

D5.7

Maintenance – tasks specified in the maintenance instructions provided by the manufacturer which are to be performed by the user to ensure the intended performance of the product. It does not include *operation*.

D5.8

Service – procedures or adjustments described in the manufacturer's service instruction which are to be performed by a "licensed" manufacturer serviceman which is performed infrequently. It does not include *maintenance* or *operation*.

D6 SUBLICENSE APPLICATION PROCEDURES

D6.1

Qualifications for a Sublicense

D6.1.1

The applicant must have sufficient training and experience in the use of the laser(s) requested to ensure that proposed work is conducted and/or supervised in a safe manner.

D6.1.2

The applicant must be a TTU faculty member.

D6.1.3

The applicant must submit a completed application form for a laser usage sublicense, and a resume of use and experience within the area of interest shown by the application. This resume may include papers referencing the use of an instrument, and/or any formal training courses or continued education.

D6.1.4

The applicant must specify on the application all types and numbers of lasers to be licensed as well as the procedures involved.

D6.1.5

The RLSC will authorize issuance of the sublicense if it determines that all requirements have been met.

D6.1.6

The RLSC will require all applicants to attend the TTU Laser Safety Training and/or obtain experience by working under an active sublicensee for a specified period.

D6.1.7

The RLSC will require additional, "specific" training for individuals utilizing any class IIIB and IV laser users.

D6.2

Requirements for Individuals Working Under a Sublicense

D6.2.1

All workers must document, prior to approval, completion of computer-based Laser Safety Training.

D6.2.2

All workers will document, prior to approval, completion of required training for class IIIB and IV lasers.

D6.3

Procedures for Obtaining a Sublicense

D6.3.1

The LSO will first review all applications.

D6.3.2

If an licensing amendment is properly completed by an authorized laser Sublicensee and a qualifying inspection or a recent inspection of the laboratory by the TTU LSO shows that the laboratory is in compliance with state and local regulations, interim approval not to exceed 30 days may be granted by the LSO.

D6.3.3

A diagram of the proposed work area in the laboratory must accompany the application, indicating laser work areas, and non-laser work areas, and equipment location(s).

D6.3.4

Final approval is required of all applications by the TTU RLSC.

D6.3.5

To be considered for final approval all applications, amendments and renewals must be submitted at least two working days before a regularly scheduled RLSC meeting.

D6.3.6

All applications must be completed and signed by the applicant. Incomplete applications will be returned to the applicant for re-submission.

D6.4

Sublicense Renewal and Amendment

D6.4.1

Term

Texas Tech University sublicenses remain in effect for two years from date of issue.

D6.4.2

Renewal

Although the Radiation Safety Office will remind sublicensees of a pending expiration, it is the sole responsibility of the sublicensee to submit a timely renewal application to avoid expiration of a sublicense. If a sublicense expires, authorized use of laser equipment ends and may be continued again, only after a new application is processed and approved by the RLSC.

D6.4.3

Conditions

Any one of the following changes in the conditions of the sublicense requires an amendment to the sublicense:

D6.4.3.1

a change in personnel (additions and deletions);

D6.4.3.2

a change in the authorized locations of laser use (addition or deletion of rooms);

D6.4.3.3

a change in the laser inventory (new laser equipment, transfer or disposal of laser equipment, storage or reactivation of laser equipment);

D6.4.3.4

a change in the standard operation procedures;

D6.4.3.5

any change on the laser equipment.

D6.4.4

All modifications need to be reported to the LSO. Application forms for license renewal or amendment are available from the Radiation Safety Office or may be found in this manual.

D7 ABSENCE OF SUBLICENSEE FROM CAMPUS

D7.1

If a sublicensee expects to be absent from the campus for more than 30 days, the LSO shall be notified and the sublicensee shall:

D7.1.1

Deactivate all laser equipment on the sublicense during the absence (appropriate forms must be filled out to deactivate and subsequently reactivate laser equipment); or notify the LSO as to the responsible individual (another sublicensee) who will take over supervision of the use of the laser equipment to be used. This sublicensee must be competent in the use and regulations concerning the lasers to be used.

D7.1.2

Should arrangements as specified above in C.1 not be made, the RLSC Chairman and LSO, shall revoke and terminate the sublicense. The LSO will terminate all laser use in the affected laboratories.

D7.2

It is the sole responsibility of a sublicensee to notify the LSO during a period of his/her absence and to take appropriate action as outlined above.

D8 TERMINATION OF SUBLICENSE

The following procedure shall be used to terminate a laser equipment sublicense.

D8.1

A letter of intent to terminate the sublicense will be submitted to the **LSO**. This letter will include:

D8.1.1

The date of termination.

D8.1.2

The listing of the sublicensee's authorized laser inventory and laboratories, including storage areas. A diagram of all these areas should accompany this letter of intent.

D8.1.3

A statement that all lasers active and/or stored will be transferred either to the LSO for storage or disposal, or to another sublicensee authorized to possess the lasers under consideration.

D8.1.4

Upon receipt of the letter of intent, the LSO will conduct a visual inspection of the laboratory and laser equipment. All signs and labels indicating laser use will be removed.

D8.1.5

The LSO will label all laser equipment with a "Security Seal" to prevent use until the laser equipment is transferred or disposed. Laser equipment transferred to another TTU sublicensee will continue to bear the "Security Seal" until the recipient sublicensee has his sublicense adjusted accordingly and the laser equipment to be disposed will continue to bear the "Security Seal" until the laser is rendered incapable of emitting laser radiation.

D8.1.6

AT THIS POINT, FURTHER USE OF LASER EQUIPMENT BY THE SUBLICENSEE AND INDIVIDUAL WORKERS OF THAT SUBLICENSE IS STRICTLY PROHIBITED.

D8.1.7

Based on a review of the letter of intent, the results of the close-out survey, and the disposition of the laser equipment, the LSO will make recommendations to the RLSC regarding the request to terminate the sublicense.

D8.1.8

Until the RLSC and the LSO formally terminates the sublicense, the department chairperson will be responsible for all laser equipment until these termination procedures are complete until such time that the equipment is transferred to another sublicense.

D8.1.9

Once a sublicense has been terminated due to negligence, the sublicensee cannot apply for another laser sublicense for a period of one year from the date of his/her laser sublicense termination.

D9 DEACTIVATION/REACTIVATION OF SUBLICENSE

D9.1

Should a sublicensee foresee a period of time in which they do not plan to use laser equipment the affected laboratory may be deactivated, by meeting the following criteria:

D9.1.1

A letter of intent to deactivate the sublicense will be submitted to the LSO. This letter will include:

D9.1.1.1

The date of deactivation.

D9.1.1.2

The listing of the sublicensee's authorized laser inventory and laboratories, including storage areas. A diagram of all these areas should accompany this letter of intent.

D9.1.1.3

A statement that all lasers used and/or stored in the affected laboratory will be secured against any use.

D9.1.1.4

A statement that all associated laser hazards are secure and contained to ensure compliance with regulations.

D9.1.1.5

Upon receipt of the letter of intent, the LSO will perform an inspection of the laboratory and laser equipment.

D9.1.1.6

Based on a review of the letter of intent, the results of the inspection, the LSO will make his recommendations to the RLSC who, in turn, will authorize deactivation of the laboratory.

D9.1.1.7

Upon deactivation, all signs and labels, indicating where laser use was authorized for use shall be removed.

D9.1.1.8

AT THIS POINT, FURTHER USE OF LASER EQUIPMENT BY THE SUBLICENSEE AND INDIVIDUAL WORKERS OF THAT SUBLICENSE IS STRICTLY PROHIBITED.

D9.1.1.9

The LSO will label all laser equipment with a "Security Seal" to prevent any further use. These security seals will only be removed at the expressed approval of the LSO.

D9.1.1.10

The term of deactivation of an authorized laser use area will be a MINIMUM OF FIFTEEN DAYS AND A MAXIMUM OF UP TO TWO YEARS (or until the sublicense is due for renewal). At the end of a deactivation period the sublicense may request, in writing, to renew the deactivated status of the laboratory(s) for another term.

D9.1.1.11

During the period in which a laser use area is deactivated, the sublicense will remain in an active status. If there are still active laboratories on the sublicense, all current rules, regulations and policies governing that sublicense (relative to the active laboratories) remain in

effect. Since deactivated laboratories are no longer considered laser use areas, the requirements for inspections no longer apply. However, the sublicensee is still responsible for the retention of ALL records and files which were generated for that laboratory.

D9.1.2

A sublicensee may REACTIVATE a sublicense at any time AFTER the initial fifteen day period if the following criteria are met:

D9.1.2.1

A TTU Form LS-2, Laser Amendment Application, must be filled out and delivered to the LSO.

D9.1.2.2

Any and all changes in work areas, storage areas, etc. must be reflected on the amendment application and accompanied with a diagram.

D9.1.2.3

The LSO will review the request and inspect the laboratory area(s) and make his recommendations to the Chairperson of the RLSC.

D9.1.2.4

After the Chairperson has approved the reactivation of the laser laboratory, it will, again, be subject to the posting, required records, safety procedures, and survey/safety check requirements as stipulated by local, state, federal, and TTU regulations and policies.

D9.1.2.5

At this time, the laser equipment may again be used and stored in that laboratory(s). However, the laser equipment will be subject to a survey conducted by the LSO to ensure the laser(s) meet all state and local requirements.

D10 DEACTIVATION/REACTIVATION OF EQUIPMENT

D10.1

Should a sublicensee foresee a period of time in which they do not plan to use specific laser equipment, the laser may be deactivated, by meeting the following criteria:

D10.1.1

TTU form LS-2 Laser Amendment Application will be submitted to the LSO to deactivate and a letter of intent that will include:

D10.1.1.1

A statement that the laser deactivated will be stored and secured against any use.

D10.1.1.2

A statement that all associated laser hazards are secure and contained to ensure compliance with regulations.

D10.1.1.3

Upon receipt of the amendment application and letter of intent, the LSO will confirm deactivation of the laser equipment and its storage area.

D10.1.1.4

Based on a review of the amendment application, the results of the confirmation, the LSO will make his recommendations to the Chairperson of the RLSC who, in turn, will authorize deactivation of the laser.

D10.1.1.5

Upon deactivation, all signs and labels, indicating where the laser was authorized for use shall be removed.

D10.1.1.6

AT THIS POINT, FURTHER USE OF THE LASER EQUIPMENT BY THE SUBLICENSEE AND INDIVIDUAL WORKERS OF THAT LASER EQUIPMENT IS STRICTLY PROHIBITED.

D10.1.1.7

The LSO will label the laser equipment with a "Security Seal" to prevent any further use. These security seals will only be removed at the expressed approval of the LSO.

D10.1.1.8

The term of deactivation of authorized laser equipment will be a minimum of sixty days.

D10.1.1.9

During this period in which the laser is deactivated, the sublicense will remain in an active status. If there are still active lasers on the sublicense, all current rules, regulations, and policies governing that sublicense (relative to the active lasers) remain in effect. Since the deactivated laser is no longer considered active, the requirements for inspections no longer apply. However, the sublicensee is still responsible for the retention of ALL records and files which were generated for that laser.

D10.2

A sublicensee may REACTIVATE a laser at any time AFTER the initial sixty-day period if the following criteria are met:

D10.2.1

TTU Form LS-2, Laser Amendment Application, must be made to the LSO.

D10.2.2

Any changes in work areas, storage areas, etc. must be reflected on the amendment application.

D10.2.3

The LSO will review the request and inspect the laboratory and make recommendations to the Chairperson of the RLSC.

D10.2.4

After the Chairperson has approved the reactivation of the laser equipment, it will, again be subject to the posting, required records, safety procedures, and survey/safety check requirements as stipulated by federal, state, and local TTU regulations and polices.

D10.2.5

At this time, the laser equipment may be used and stored in that particular laboratory. However, the laser will be subject to a inspection conducted by the LSO to ensure the unit(s) meet all state and local requirements.

D11 RESPONSIBILITIES OF THE SUBLICENSEE

D11.1

The sublicensee has the following obligations:

D11.1.1

To assure the safe operation of the licensed laser(s) by authorized laser personnel and account for any misuse, accidents, or injuries to persons or property;

D11.1.2

To submit an application for a laser sublicense or necessary amendments to update the information in the latest sublicense before any work with lasers. There shall be no use of lasers without first obtaining a sublicense or appropriate amendment from the RLSC and approval for laser operation from the LSO;

D11.1.3

To ensure registration of **all** laser(s) under their authority, with the LSO (each laser(s) purchased, donated, received, or otherwise constructed);

D11.1.4

To maintain records in accordance with national, state, and local regulations. This shall include, but is not be limited to: laser eye protection inspections, incident/accident reports, LSO laser lab inspections, registration, inventory forms, and other records concerning the laser(s) under his/her control;

D11.1.5

To ensure that laser users have general laser safety training, specific hazard laser training, and SOP training for class IIIB and IV lasers. The sublicensee will provide the SOP training;

D11.1.6

To receive approval for operation of a laser system before the installation of a laser and after modifications have been made. All new or modified (i.e. installation setups that are different from approved application) lasers must first be approved by the LSO before any operating of the particular laser unit commences;

D11.1.7

To report any actual or suspected incidents resulting from a laser operated under his/her authority to the LSO. If necessary, the sublicensee shall immediately obtain appropriate medical attention for any worker involved in a laser accident;

D11.1.8

To provide to the LSO and maintain standard operating procedures (SOP) for all laser equipment under their authority;

D11.1.9

To prohibit operation of the laser when adequate control of laser hazards are not met or when personnel are not properly trained;

D11.1.10

To report to the LSO any inoperative lasers due to disassembly or destruction;

D11.1.11

To provide all lab personnel with the appropriate personal protection equipment (PPE) required;

D11.1.12

To provide all lab personnel with the appropriate training and emergency procedures specific to the laser being used;

D11.1.13

To correctly post work areas and all laser-producing equipment;

D11.1.14

To report possible incidents and actual exposures to the LSO;

D11.1.15

To report all lasers being transferred, sold, or decommissioned.

D12 RESPONSIBILITIES OF USERS AND OPERATORS

D12.1

To comply with all applicable safety rules and laser program requirements and those specified by the RLSC/LSO and to be familiar with all standard operating procedures and emergency procedures for the laser equipment under his/her control.

D12.2

To use and operate only those laser(s) which are listed on the sublicense.

D12.3

To maintain documentation of training with dates and signature.

D12.4

To report any departures from established SOPS to the sublicensee and LSO.

D12.5

To report all possible incidents and actual exposures to the LSO.

D13 PROGRAM REQUIREMENTS

D13.1

Purchase, Transfer, Shipping and/or Delivery

D13.1.1

Ordering lasers or laser equipment

D13.1.1.1

Requestor will contact the LSO via email.

D13.1.1.2

The Requestor will provide the following information:

- a) Sublicensee
- b) Description of item
- c) Manufacturer/Vendor
- d) Model and Serial Number
- e) Quantity
- f) Purpose
- g) Location of intended use

D13.1.1.3

The LSO will:

- a) Verify status of sublicense;
- b) Document information received;
- c) Contact Purchasing and grant approval.

D13.1.2

Transfer of laser equipment

D13.1.2.1

Requestor will contact the LSO and Property/Surplus Manager

D13.1.2.2

Requestor will provide the following information:

- a) Laser specifications;
- b) To whom the equipment will be transferred;
- c) Time frame for the transfer.

D13.1.2.3

The LSO will:

- a) Verify status and document information, and
- b) Contact Property/Surplus Manager and grant approval

D13.1.3

Shipping and Delivery

D13.1.3.1

Requestor will contact the LSO

D13.1.3.2

The LSO will:

- a) Verify status of sublicense and paperwork;
- b) Document information received;
- c) Contact Central Warehouse and grant approval.

D13.2

Facilities (25 TAC §289.301(v)(3))

D13.2.1

Laser work areas(s) will have restricted access from non-authorized personnel.

D13.2.2

Laboratories will have heat-chemical resistant materials in the beam paths (when applicable).

D13.2.3

Laser work areas and lab entrances will be posted with the correct warning signs. (signs available from Laser Safety)

D13.2.4

All signage (sublicense, emergency numbers, etc.) shall be posted in prominent view.

D13.2.5

Laboratories will have all windows covered with appropriate materials.

D13.2.6

Laser dye, solvent, and gas laboratories will have ventilation, fume hoods, and gas cabinets capable of handling and storing the chemicals being utilized in order to comply with regulatory limits.

D13.3

Signage (25 TAC §289.301(v)(3))

D13.3.1

Laser equipment will be labeled with manufacturer and class designation.

D13.3.2

Laser equipment will have labels with warning, output, duration, medium, and wavelength.

D13.3.3

Laser protective housing and enclosures will be labeled during normal and servicing operations.

D13.3.4

Labels will be specific to the hazards of the laser determined by the LSO.

D13.3.5

Signage must be posted during maintenance and servicing operations and as stated in the Standard Operating Procedures, SOP's.

D13.4

Control Area and Access

D13.4.1

Laser work areas(s) will have restricted access from non-authorized personnel.

D13.4.2

Class IIIB and Class IV laser laboratories will have safety interlocks or alternate control methods approved by the LSO.

D13.4.3

All costs for installations and materials will be assumed by the sublicensee or their department.

D13.5

Training

D13.5.1

Training is available in 3 levels:

D13.5.1.1

Basic Level 1 – Fundamentals of laser principles;

D13.5.1.2

Administrative Level 2 – State regulations, TTU policies, and a brief review;

D13.5.1.3

Hazard Level 3 – Any additional training required by RLSC and LSO.

D13.5.2

Researchers are required to take Laser Training Levels 1 and 2 if they meet the following stipulations:

D13.5.2.1

No training or experience;

D13.5.2.2

No documentation of training within the last five years.

D13.5.3

Researchers and Post-Doctorates are required to take Laser Training Level 2 if they meet the follow stipulations:

D13.5.3.1

Have extensive training or experience;

D13.5.3.2

Have LSO approval.

D13.5.4

Students and Other Personnel are required to take Laser Training Level 1 if they meet the following stipulations:

D13.5.4.1

No training or experience;

D13.5.4.2

No documentation of training within the last five years.

D13.6

Personal Protective Equipment (PPE)

D13.6.1

All laboratory personnel will be trained on the proper use of the following by Environmental Health & Safety personnel:

D13.6.1.1

Laser eyewear

- a) It will be in good condition and comfortable;
- b) It will be labeled with wavelength and optical density; and
- c) It will be inspected every year.

D13.6.1.2

Protective clothing

- a) It will be tightly woven material.
- b) It will be long sleeved.

D13.6.1.3

Chemical resistant gloves for handling of dyes and solvents.

D13.6.1.4

Various forms of shielding appropriate for the hazard.

D13.6.1.5

Hearing protection if work environment exceeds regulatory limits.

D13.7

Instrumentation

D13.7.1

Laser equipment will have protective housing.

D13.7.2

Laser safety interlocks for all class IIIB and IV.

D13.7.3

Laser equipment will have either a key switch or a computer code.

D13.7.4

Laser laboratories will have optical attenuators

D13.7.5

Laser equipment will have operational lights, alarms, and devices to notify others that the laser is in "on."

D13.8

Standard Operating Procedures

D13.8.1

The items listed are recommended to be included in the SOP's for each laser. The information can be revised in part to reflect major modifications that affect the laser's performance and operation.

D13.8.1.1

General Information:

- a) Information of the laser owner;
- b) Inventory control (TTU ID Number).

D13.8.1.2

System Information:

- a) Description;
- b) Location;
- c) Class.

D13.8.1.3

Hazards Summary:

- a) Beam information;
- b) Non-Beam information.

D13.8.1.4

Required Control Measures:

- a) Access Controls;
- b) System Controls;
- c) Personnel Controls.

D13.8.1.5

Alignment Procedures:

- a) By whom;
- b) Conditions;
- c) Can be general for research purposes with the RLSC approval;
- d) Buddy Policy required for Class IIIB and IV laser laboratories.

D13.8.1.6

Emergency Instructions

D13.8.1.7

All laser operators must sign the TTU form, LS-8 SOP Training Acknowledgement, to document that they have been trained on the SOP of the laser.

D13.9

Modification

D13.9.1

A laser or laser system that requires modification that significantly changes the SOP and performance shall not be operated until approved by the LSO.

D13.9.2

Modifications not reported to the LSO are in violation of the SOP approved by the RLSC and terms of the sublicense.

D13.10

Usage Logs

D13.10.1

The usage logs must be dated and initialed by operator each time the laser equipment is operated. This log should include notes of adjustments, operation conditions, maintenance, servicing, and problems.

D13.11

Record Keeping

D13.11.1

The laser sublicensee should keep the following for documentation and inspection purposes in one notebook. The records shall be available during routine monitoring of the lab by Laser Safety personnel and/or regulatory agencies.

D13.11.1.1

Standard Operating Procedures (SOP)

D13.11.1.2

Signatures of SOP and PPE Training

D13.11.1.3

Usage Log

D13.11.1.4

Sublicensee Information

- a) Sublicense – All Sublicensees should have a current copy.
- b) Amendments/Renewals – All copies of personnel / laser changes.
- c) Past Inspection Reports – All inspection reports sent from the LSO.
- d) LSO Memos – All memos from the LSO are available to personnel.
- e) Laser Inventory – All current laser inventories for inspections.

D13.12

General Services

D13.12.1

All laser activity must be suspended until these services have been performed:

D13.12.1.1

All laboratories must be surveyed (visual inspection) for any possible hazards within 24 hours of the scheduled cleaning or other services. The lab shall remain in order until after the services, and it is the responsibility of the sublicensee to ensure this. Records of the visual surveys must be kept.

D13.12.1.2

Exposure of general service personnel to preventable hazards will result in the suspension of general services and a probationary period, at which time the status of the sublicensee will be determined by the RLSC.

D13.13

Custodial Services

D13.13.1

All laser activity must be suspended until these services have been performed:

D13.13.1.1

To obtain special custodial service (i.e., scrubbing, stripping, and finishing floors), call Custodial Services (744-1866).

D13.13.1.2

Prior to scheduling the cleaning, the following preparations must be made:

- a) The floor must be cleared of all obstacles such as boxes, books, containers, and chemical-labeled items. This must be done by authorized personnel. Visual surveys of the lab must be performed within 24 hours;
- b) Custodial Services will schedule the work and call to confirm the date with the requestor;
- c) The custodians will leave a checklist in the laboratory. The checklist must be completed and signed by the lab personnel;
- d) Laser laboratories requesting cleaning service will be furnished with a Request for Custodial Service door card. The door card must be signed by the sublicensee or LSO, and left on the outside of the door on the day the work is to be accomplished;
- e) The sublicensee or a worker on that sublicense is required to be in the lab during the cleaning of all Class IIIB and IV laser laboratories.

D13.13.1.3

To obtain routine custodial service, call Custodial Services (744-1866) to receive a door card. Routine custodial service includes only sweeping floors, empty trash containers, and replace paper in paper dispensers.

- a) The Sublicensee will complete, sign and date a door card.
- b) Place the card on the outside of the laboratory door before 6:00 PM on the day of the routine cleaning. These cards are only good for one day. These cards assure the custodians that there are no laser hazards.
- c) The sublicensee or a worker IS NOT required to be in the lab during the routine cleaning. Routine cleaning will probably be scheduled between 6:30 PM and 8:00 PM.

D13.14

Building, Maintenance, and Construction (BM&C Service)

D13.14.1

All laser activity must be suspended until these services have been performed:

D13.14.1.1

The LSO or sublicensee can give clearance for BM&C to perform work in an authorized laser use/storage area. The laboratory must be surveyed within 24 hours of the scheduled work.

D13.14.1.2

The sublicensee or a worker IS required to be in the lab during the BM&C services of all Class IIIB and IV laser laboratories.

D13.15

Other Services

D13.15.1

All laser activity is suspended until these services have been performed.

D13.15.1.1

Departmental technicians may enter and perform routine duties provided they have the required laser training requirements, and are granted permission by both the sublicensee and the LSO.

D13.15.1.2

Company technicians and servicemen servicing or checking items on any laser equipment must have the permission of the LSO. The Sublicensee will be required to have the lab surveyed within 24 hours prior to their visit. All laser hazards should be rechecked which would be unfamiliar to the technicians and servicemen. Records of these surveys must be kept.

D13.15.1.3

The sublicensee or a worker is required to be in the lab during the services.

D14 LAB PERSONNEL

D14.1

Authorized Personnel

D14.1.1

Personnel such as faculty, students and other professionals, usually research or laboratory assistants or workers that may be engaged in education, laboratory research, and research support activities may work with lasers but only after completing the required safety training programs and the express approval of the RLSC.

D14.1.1.1

The names of authorized personnel will be listed on the sublicense. Individuals not listed on the sublicense are not authorized personnel.

D14.2

Non-Authorized Personnel

D14.2.1

Faculty, students, and other professionals and non -TTU personnel which have not had TTU Laser Safety Training nor the express approval of the RLSC or whose names do not appear on a given laser sublicense.

SECTION C-III: LASERS

D15 BASIC LASER CHARACTERISTICS

D15.1

Lasers

D15.1.1

Laser is an acronym for **L**ight **A**mplification by the **S**timulated **E**mission of **R**adiation. The major components of a laser are: the excitation mechanism, active medium, and an optical cavity. In general, there are four major laser types: solid state, semi-conductor, gas and liquid (dye). The laser light emits non-ionizing electromagnetic radiation that is ultraviolet, visible, or infrared light.

D15.1.1.1

Pulsed Lasers – a laser that delivers energy in the form of a single pulse or train of pulses which is delivered in less than .25 seconds. Pulsed Lasers are expressed as the total energy per pulse (joules).

D15.1.1.2

Continuous Wave Lasers – a laser whose output is operated in a continuous mode for at least a period of .25 seconds. Continuous Wave Lasers are expressed as the average power (watts).

D15.2

Intensity Terms

These are important laser terms that describe degrees of intensity which a particular laser is capable of and are also, used in regulatory standards.

Radiance – The laser energy per unit area of the beam.

Irradiance – The laser power per unit area of the beam

D15.3

Classification

D15.3.1

ANSI and LIA Classification

D15.3.1.1

The American National Standards Institute (ANSI 2000) has developed four categories of hazard potential. The classification scheme is based on the ability of optical emissions from a laser system to produce injury to personnel. The higher the classification number, the greater the hazard potential.

The Laser Institute of American (LIA) Laser Safety Guide describes each class as follows:

D15.3.2

Class I – Lasers or laser systems that do not, under normal operating conditions, pose a hazard.

D15.3.3

Class II – Low-power visible light lasers or laser systems that, because of the normal human aversion response (i.e. blinking, eye movement, etc.), do not normally present a hazard, but may present some potential for hazard if viewed directly for extended periods of time (similar to many conventional light sources).

D15.3.4

Class IIIA – Lasers or laser systems that normally would not injure the eye if viewed for only momentary periods (within the aversion response period) with the unaided eye, but may present a greater hazard if viewed using collection optics.

D15.3.4.1

Class IIIA lasers must carry a caution label. Another group of Class IIIA lasers have DANGER labels and are capable of exceeding permissible exposure levels for the eye in 0.25 seconds and still pose a low risk of injury.

D15.3.5

Class IIIB – Lasers or laser systems that will produce eye damage if viewed directly. This includes intrabeam viewing of specular reflections. Normally, Class IIIB lasers will not produce a hazardous diffuse reflection.

D15.3.6

Class IV – Lasers or laser systems that produce retinal damage from direct or specular reflections, but may also produce hazardous diffuse reflections. Such lasers may produce significant eye and skin radiation hazards as well as fire hazards.

D15.4

Hazards

D15.4.1

Beam Hazards

D15.4.1.1

Beam

Direct beam viewing is dependent on the laser classification. The hazard increases beginning with Class II as minimal to Class IV as very dangerous.

D15.4.1.2

Beam Reflections

These types of reflections can sometimes occur when modifications are made to Class I through Class III; however it is highly dependent on the laser environment. For this reason, the LSO should always be consulted. Class IIIB and IV hazards include specular and diffuse reflections which are dependent on the materials, objects, and lenses in the laser area as well as the wavelengths of the beam. The determinations of these are:

- a) *Specular Reflection* – The reflection is mirror-like due to smooth surfaces being less than the incident wavelength.
- b) *Diffuse Reflection* – This type of reflection is much more scattered due to the irregularities of the surface.

D15.4.2

Non-Beam Hazards

These hazards vary widely and are specific to the materials and the experiments involved with the laser system.

D15.4.2.1

Physical – Factors that contribute to injury are: fire, explosions and electrocutions from arc and filament lamps, capacitors, wiring, power supply's, circuits, solvents, and gases.

D15.4.2.2

Chemical – Various chemical agents include dyes, solvents, gases, and laser-generated airborne contaminants (dusts, mists, fumes, and smokes).

D15.4.2.3

Radiation – The types of radiation's vary from infrared, ultraviolet, x-ray, and visible which the laser produces. The radiation is dependent on the wavelength of the laser in the electromagnetic spectrum.

D15.5

Biological Effects

Biological effects are dependent on the laser beam properties and vary with duration, wavelength, photon energy, target tissue, and tissue condition. Therefore, all effects have to be weighed on a case by case basis. Safety and prevention are the best protection against personal injury.

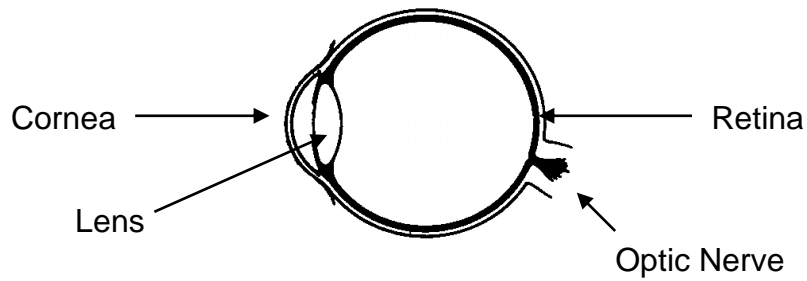
D15.5.1

Eye

D15.5.1.1

Injuries to the eye are primarily due to two main types of biological effects which may or may not occur separately. Biological effects to the eye are dependent on exposure conditions, wavelength, and irradiation levels. The main tissue types of the eye which suffer these biological effects are the cornea, lens and retina.

Figure 1: Diagram of Eye Structure



D15.5.1.2

Photochemical – High energy laser light photons may interact with molecules in the eye tissue causing chemical bonds to be broken. The injury depends on the tissue of the eye affected.

D15.5.1.3

Thermal – Heat dissipation is a major factor in causing to the eye. Heat flow could travel horizontally along the same tissue or vertically through different depths of underlying tissues.

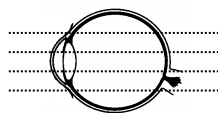
D15.5.1.4

Summary – Types of eye damage from laser radiation are

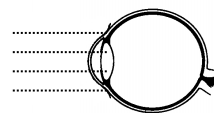
- Cornea >>> Corneal Burn
- Lens >>> Cataracts
- Retina >>> Decreased Vision/ Vision Loss
- Optic Nerve >>> Blindness

D15.5.1.5

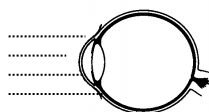
Electromagnetic Radiation to the Eye



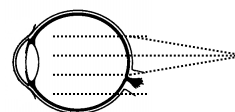
Microwaves and Gamma



Near Ultraviolet



Far Ultraviolet &
Far Infrared



Visible & Near Infrared

D15.5.2

Skin

Skin tissue is at risk from laser exposure. The effects to the skin are considered secondary; the higher the power of the laser - the greater the risk to the skin.

D15.5.2.1

Thermal – It is an actual burn to the skin; the severity of the burn is dependent upon the penetration of the skin tissue.

D15.5.2.2

Ultraviolet – Due to the intense ultraviolet beam exposure, the skin will be affected. Typically, this affect is equivalent to a sunburn.

D15.5.2.3

Photosensitivity – This effect may occur when laser personnel are currently on medications that would cause sensitivity to light. If medications warn against avoiding sunlight, then laser use should also be avoided.

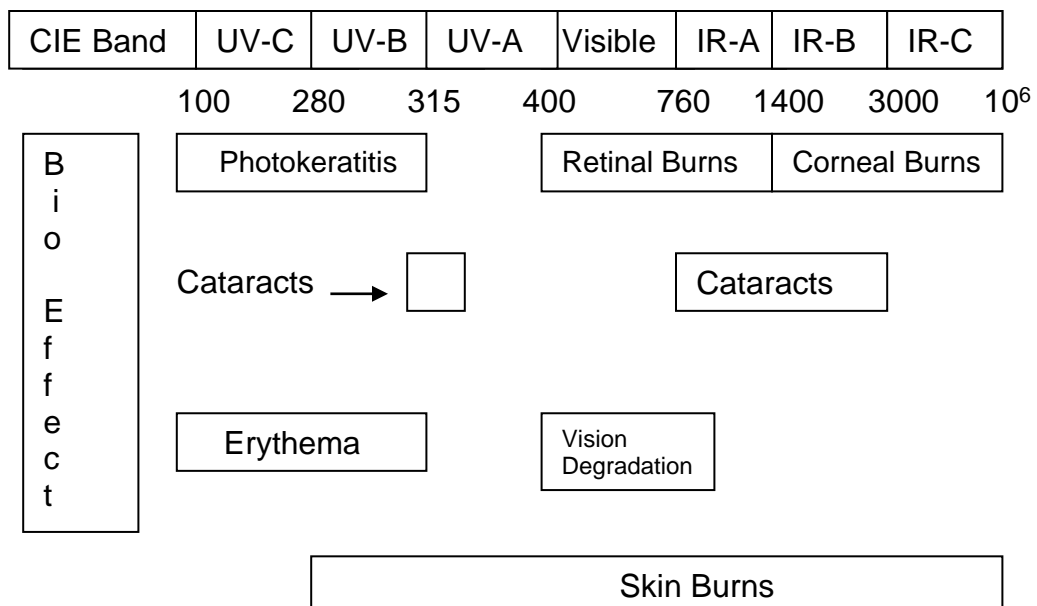
D15.5.2.4

Summary – Types of skin damage from laser radiation are

- Sunburn
- skin burns
- skin cancer, and
- skin aging

D15.5.3

Eye vs Skin Exposures



D16 SPECIFIC LASER REQUIREMENTS

D16.1

Class IIIB and IV Lasers

D16.1.1

All Class IIIB and IV lasers require the following five items to be in full compliance of 25 TAC §289.301. Exemptions will be determined by substituting engineering and administrative controls reviewed by the RLSC and the LSO.

D16.1.1.1

Maximum Permissible Exposure (MPE) – The level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin. Parameters that determine the MPE are wavelength, duration, exposure conditions (point or extended source, cw or pulsed, pulse width, pulse repetition frequency). MPE are given in units of radiant exposure (J/cm^2).

D16.1.1.2

Nominal Hazards Zone (NHZ) – The space within which the level of direct, reflected, or scattered radiation during operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the applicable MPE level.

$$NHZ = \frac{1}{N} \left\{ \frac{4P}{B (MPE)} - a^2 \right\}^{1/2}$$

N = Divergence in radians
 P = Power in watts
 $B = 3.1415$
 a = aperture in cm

D16.1.1.3

Accessible Emission Limits (AEL) – The maximum accessible emission level permitted within a particular laser class. AEL is in units of μW 's.

AEL = MPE x (area of limiting aperture)

D16.1.1.4

Optical Density (OD) – The logarithm to the base ten of the reciprocal of the transmittance. The OD will be labeled on the eyewear for each laser.

$$OD = \log \left\{ \frac{E_i}{MPE} \right\}$$

E_i = incident beam irradiance in W/cm^2

D16.1.1.5

Interlock – A switch that, when activated, will interrupt normal operation of a laser by closing a shutter or de-energizing the system.

D16.2

Infrared Lasers

D16.2.1

Fire resistant materials are to be used in and around the laser work area.

D16.3

Fiber Optic Lasers

D16.3.1

The use of a tool shall be required for the disconnection of a connector of the laser fiber optic cable for servicing and maintenance purposes, if the connector is not within a secured enclosure. All connectors shall bear the appropriate label.

D16.4

Constructed Lasers

D16.4.1

All “constructed lasers” built from separate components must comply with the 21 Code of Federal Regulations (CFR) Part 1040, Federal Laser Product Performance Standard. Contact the LSO for more specific information.

SECTION IV: EMERGENCY PROCEDURES

INTRODUCTION

This section outlines basic emergency procedures. An emergency situation or accident can arise from the use, the misuse, or abuse of laser equipment. This section is intended to enhance a sublicensee’s and worker’s ability to react properly to laser accidents.

Due to the broad scope of possible accidents at TTU, a comprehensive listing of all steps to be followed for each type of accident is impracticable. Instead, a researcher must use the following basic procedures and apply them to his/her individual situation. The best advice for protection against laser accidents is to prepare for them.

It is the responsibility of each sublicensee to develop and ensure that personnel working under their supervision have reviewed a practical emergency plan. This plan is to include all required telephone numbers and is to be posted in each laser work area. (Reference TTU - Operating Procedure 78.01 Vol.III)

D17 GENERAL INFORMATION

D17.1

A laser incident* at TTU is defined as any accident, single exposure, or suspected exposure as set forth in 25 TAC §289.301.

D17.1.1

Users will report all laser incidents.

D18 ORGANIZATION AND AUTHORITY

D18.1

The LSO is responsible for investigating any laser incident at TTU.

D18.1.1

The LSO will promptly report all investigation findings to the RLSC and to the Texas Bureau of Radiation [reference **25 TAC §289.301(xx)**] for direction and action.

D18.1.2

If preliminary findings of an incident presented to the RLSC indicate there is probable cause of neglect or violation of state, federal, or local regulations or policies, the sublicensee involved will attend the next RLSC meeting to present his/her account of the incident.

D18.1.3

In the event of a major emergency situation the LSO shall have the authority to bring the situation under control.

D18.5

The LSO has the responsibility to see that each laser sublicensee/worker:

- Recognizes a laser emergency;
- Has the training to prevent or confine a laser accident;
- Has the training to recognize possible risks of exposure.

D18.6

Each sublicensee is responsible to assist the LSO in controlling and/or investigating a laser accident. Furthermore, the sublicensee is responsible to assist the laser exposure victim(s) in getting timely medical attention.

D19 FIRES, EXPLOSIONS, OR MAJOR EMERGENCIES

D19.1

The laser sublicensee should:

- Notify all persons in the area to leave at once and turn off all electrical laser equipment.
- Notify the Lubbock Fire Department, UPD, TTU Fire Marshall, the LSO and other supervisory personnel. Give them the address and the location of the fire.
- Caution firemen about the current situation in the area. Be ready to advise them on the location of laser(s) and other equipment or chemicals, and provide any other information that may be needed to avoid hazardous exposure of personnel
- Be available to evaluate or help evaluate the extent of damage to materials and equipment.

D19.1.2

All sublicensees and workers will be required to file an incident report with the LSO.

D19.1.3

If the fire is minor (individual decision) and there are no chemical hazards involved, a sublicensee or worker may attempt to put out the fire with approved firefighting equipment.

D20 INCIDENTS: POSSIBLE EXPOSURE OR INJURY

D20.1

The laser sublicensee should:

- Immediately remove affected person(s) from the area and notify the LSO.
- Secure the area.
- Accompany the affected persons(s) to the nearest emergency center immediately for clinical observation. Inform the attending medical personnel that injuries occurred as the result of a laser accident. Be prepared to answer any questions concerning the accident or type of laser involved.

D20.1.1

Assist the LSO in obtaining all details of the incident.

D20.2

Persons involved in the incident will not be permitted to work with the laser equipment until exposure results have been received and the LSO has determined that exposure limits are not exceeded.

D20.3

The LSO will provide reports to the RLSC and regulatory agencies.

D21 LOSS OR THEFT

D21.1

Any loss or theft of laser(s) equipment shall be immediately reported to the LSO and TTU police.

D21.2

The LSO will provide required notification to the Bureau of Radiation Control.

D21.3

Laser equipment involved in an accident, fire, flood, etc. MAY NOT BE USED until tested by the LSO and found to be in proper and safe operating condition. The LSO will determine the extent of damage and analyze the recovery plan.

D22 EMERGENCY PHONE NUMBERS

TTU RADIATION SAFETY OFFICE.....	742-3876
LSO (HOME)	298-4621
CHAIRMAN, RADIATION LASER SAFETY COMMITTEE (HOME)	828-5787

LUBBOCK FIRE DEPARTMENT 765-5757
TTU FIRE MARSHAL (HOME) 799-1701
TTU POLICE DEPARTMENT 742-3931
CAMPUS EMERGENCY DIAL 9911
TEXAS BUREAU OF RADIATION CONTROL (BRC) (512) 835-7000

IF TTU RADIATION EMERGENCY PERSONNEL CANNOT BE CONTACTED CALL:

BRC 24 HOUR EMERGENCY PHONE NUMBER(512) 458-7460
BRC-REGION II RADIATION CONTROL (CANYON) (806) 655-7151

Field Safety Manual

February 2022

FOREWORD

Texas Tech University is dedicated to the safety of all members of its community regardless of location. The Field Safety Manual is constructed under the remit of the Department of Environmental Health and Safety and provides a guide to the planning and execution of safe research and education experiences in field locations (e.g., non-traditional, off-campus locations).

When working in an off-campus location all rules, regulations, guidelines, and safety protocols established by agency responsible for the work area (Federal, State, County of City Government, or private entity) must be followed and accounted for during the hazard and risk assessment process.

Title IX at Texas Tech

Texas Tech is committed to providing its students, faculty, and staff with an educational and workplace environment free from any form of unlawful discrimination. The Texas Tech community is dedicated to fostering and supporting a culture of mutual respect and communication. Texas Tech University does not tolerate discrimination or harassment of students based on or related to sex, race, national origin, religion, age, disability, protected veteran status, or other protected categories, classes, or characteristics. While sexual orientation and gender identity are not protected categories under state or federal law, it is Texas Tech University policy not to discriminate on this basis. Actions related to admission, discipline, housing, extracurricular and academic opportunities shall not be made based on a student's protected status. Discriminatory behavior is prohibited regardless of the way it is exhibited, whether verbally, in writing, or electronically displayed or conveyed. Individuals who violate these policies and laws are subject to disciplinary action, up to and including expulsion.

Examples of the types of discrimination and violence that are strictly prohibited by Texas Tech include but are not limited to: sexual harassment, the failure to provide equal opportunity in athletics, discrimination in a school's science, technology, engineering, and math (STEM) courses and programs, discrimination based on pregnancy.

In addition to Title IX, certain Clery specific crimes are also considered to be Title IX violations and will be handled by the university as mandated under both statutory requirements. These include but are not limited to sexual misconduct, domestic violence, dating violence, and stalking.

[Title IX website](#)

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HELPFUL TELEPHONE NUMBERS AND LINKS

Emergency: In the event of an emergency call 911.

[National Park Service Camping Information](#)

General Outdoor Safety: For more information on outdoor and recreational safety including North America Hunting Season and regulations, contact the [U.S Forest Service](#). 800-832-1355

General Health: [The Centers for Disease Control and Prevention \(CDC\)](#) offers a website that describes many topics related to travel, both domestic and international

U.S. Department of Labor – Occupational Safety & Health Administration: Assists with design, implementation and evaluation of health and safety programs in the workplace

Disease: The [Centers for Disease Control and Prevention \(CDC\)](#) provides detailed information about many diseases that may occur in the U.S. and internationally and risks of disease in general, and specific to the field location and its environment may be researched.

State Departments of Health Services and Infection Disease Control: All states in the U.S. have departments dedicated to providing information and guidance on state level (general and specific) health and disease risks. The [Texas Department of State Health Services Infectious Disease Control Unit](#) provides information in Texas, Tel: 512-458-7676; Toll Free: 1-888-963-7111.

Travel Health & Outbreaks: Information on international and global health and disease risks, including outbreaks of infectious diseases and international travel health recommendations are provided by the [World Health Organization \(WHO\)](#).

Travel Advisories: Travel advisories are announced through the [U.S. Department of State](#). Current travel warnings, public announcements, and consular information sheets

[National Weather Service](#)

[National Weather Service forecasting](#)

[National Weather Service Flood Safety](#)

[CDC Lightning Safety](#)

E1 PURPOSE

To set forth policies, procedures and practices of informing employees and students at Texas Tech University about the health hazards associated with activities conducted in [field sites](#).^d

The traditional campus resources such as Environmental Health and Safety, Texas Tech Police, Office of Emergency Management, and Office of Risk Management are typically not available at remote field sites. Field work should be carefully planned prior to departure to the field site(s)^d.

Due to the constantly changing conditions of field research, the emphasis on proper training and preparedness is of utmost importance for all people entering the field. All fieldwork warrants a pre-trip training regarding foreseen hazards, appropriate precautions, communication options, and emergency procedures.

It is the policy of Texas Tech University to conduct all institutionally sponsored activities safely and in a manner that protects the health and well-being of all participants. All participants in field-based activities have a responsibility to promote a safe working environment, and all activities will be designed, conducted, and operated in a manner that reasonably protects human health and safety. Adherence to these principles is necessary for the University to achieve its mission.

E2 ACRONYMS AND DEFINITIONS

E2.1

Acronyms

ANSI- American National Standards Institute
cc – engine capacity in cubic centimeters
DOT- Department of Transportation
GPS- Global Positioning System
DEFRA- Department for Environment, Food and Rural Affairs
PPE- Personal Protective Equipment
SPF- Sun Protection Factor
TTU- Texas Tech University

E2.2

Definitions

Benchmark - something that serves as a standard by which others may be measured or judged, or a point of reference from which measurements may be made.

Designated Contact – An individual not accompanying the field excursion supplied with all Field Safety Plan information. This individual will conduct the established check-in communications with the field group and act on the field group’s behalf should an emergency arise. Individual must have 24 hour / 7 days a week availability and be able to execute emergency procedures if needed.

Fauna - animal life especially the animals characteristic of a region, period, or special environment

Field Group – group of individuals actively engaged in research activities at the field site

Field Safety Briefing – must occur prior to departure when students are participating and should include a review of the hazard and risk assessment, provision of emergency contact information, emergency procedures, and the schedule of work.

Field Site – Any site where field work or research is being conducted in an outdoor environment and may include (but is not limited to) field stations, natural reserves, private lands, public lands or parks, wilderness areas, coastline, or waterways, including those owned and managed by Texas Tech University System, and more controlled sites such as construction areas, excavations, green houses, agricultural fields, commercial facilities and mines.

Field-Site Kit - a collection of materials appropriate to the location and nature of field-activities

Field Trip Leader – designated individual responsible for the safety of all field group personnel, as well as the safety of all equipment, vehicles and structures involved

Flora - plant, bacterial, or fungal life especially such life characteristic of a region, period, or special environment

Fording Points - a place where a river or other body of water is shallow enough to be crossed by wading.

Go / No Go Criteria - an individual group determination based on possible risks to the field group during the planned research time.

Hazard Assessment - a process of identifying hazards, evaluating the risks presented by those hazards, and managing the risks of the hazards to be performed by incorporating appropriate hazard controls into the experimental design process.

Trekking poles - common hiking accessory that function to assist walkers with their rhythm, to provide stability, and reduce strain on joints on rough terrain

E3 PRE-PLANNING

E3.1

Risk and [Hazard Assessments](#)^d

E3.1.1

[Field Trip Leader\(s\)](#)^d of the field-activity are responsible for conducting a risk and [hazard assessment](#)^d for each field-based activity that will establish the viability for members of the Texas Tech University community to safely participate in the proposed activity.

The assessment will establish criteria for participation in the activity and identify hazards, and their risks, for participants. The assessment will also establish [“go/no go” criteria](#)^d and [benchmarks](#)^d for continuation or withdrawal from a field environment. The assessment will identify risks and hazards that must be addressed in the Field Safety Plan.

Appendix EA contains a Field Research Risk Assessment Tool.

E3.2

Field Safety Plan

E3.2.1

Leaders of the field-activity are responsible for creating a Field Safety Plan that must include:

E3.2.1.1

A clear definition of [field site\(s\)](#)^d to be visited, defined on maps included in the document and/or by providing GPS coordinates.

E3.2.1.2

Routes to, from and in between [field sites](#)^d.

E3.2.1.3

Timeline of proposed work.

E3.2.1.4

Local emergency contact information, including Police/Sherriff Departments and appropriate State and Federal Offices (National Forest Service, National Park Service offices, State Park Headquarters).

E3.2.1.5

Assessment of potential field hazards.

E3.2.1.6

Establishment of [Go / No Go Criteria](#)^d and [benchmarks](#)^d.

E3.2.1.7

Identification of required protective and emergency equipment.

E3.2.1.8

Standard operating procedures for all field activities being conducted.

E3.2.1.9

A list of all field participants and emergency contact information.

E3.2.2

Field Safety Plan must be read and signed by all field participants. The plan shall be sent to EHS for additional review and routing to the cognizant committee/department, as needed.

E3.2.3

A copy of the Field Safety Plan must be given to the [Designated Contact](#)^d (e.g., Department Chair) prior to the [field group](#)^d departing for the [field site](#)^d.

E3.3

Equipment

E3.3.1

Field researchers must assemble a [field-site kit](#)^d with materials appropriate to the location and nature of field activities. A list of items in the kit should be part of the Field Safety Plan, and the contents of the kit must be checked for completeness, functionality, and compliance prior to departure on every trip. A list of kit items is included in Appendix EB.

E3.3.2

Items required for inclusion in the kit are:

E3.3.2.1

The Field Safety Plan with emergency procedures and protocols

E3.3.2.2

Information on Institutional Insurance Policies

E3.3.2.3

Insurance information for vehicles and personnel,

E3.3.2.4

Any required permits including TTU permits and permits from local enforcement agencies,

E3.3.2.5

Appropriate communication equipment (e.g., radio, cell, or satellite phone),

E3.3.2.6

Appropriate PPE (safety glasses/goggles, gloves, hard hat, sturdy work boots, etc.),

E3.3.2.7

First aid kit of adequate size for the group and location of [field site\(s\)](#)^d,

E3.3.2.7(a)

Repack first aid kits prior to each field excursion.

E3.3.2.7(b)

Replace any used or expired items.

E3.3.2.7(c)

Customize your kit for your destination, tasks, group size and level of training.

E3.3.2.7(d)

Pack extra gloves.

E3.3.2.7(e)

At least two field participants must be trained in first aid and CPR.

E3.3.3

Items that should be considered for inclusion dependent on [field-site](#)^d:

E3.3.3.1

Insect repellent (DEET 30-50%)

E3.3.3.2

Sunscreen (at least SPF 30), sun hat (three to seven-inch brim), long sleeves, and/or other SPF blockers

E3.3.3.3

Spare clothes, including jackets, hats, and blankets for cold climates.

E3.3.3.4

Flashlight or headlamp

E3.3.3.5

Map, compass, GPS

E3.3.3.6

Extra food/snacks

E3.3.3.7

Matches or fire starter

E3.3.3.8

Signal/mirror, whistle

E3.3.3.9

Knife or multi-tool; duct tape for basic repairs

E3.3.3.10

Extra batteries

E3.3.3.11

Other equipment specific to the educational and/or research mission of the trip.

E3.4

[Field Safety Briefing^d](#)

E3.4.1

Each department and/or instructor is responsible for conducting appropriate [Field Safety Briefing^d](#) / Training prior to the field excursion. The briefing must discuss the Field Safety Plan,

all field operations, potential hazards, use of protective and emergency equipment and emergency procedures.

E3.4.2

All participants in research-oriented field activities should complete a risk and [hazard assessment](#)^d as part of their on-going professional development and engagement with the responsible conduct of research requirements.

E3.4.3

Attendance and participation in the [Field Safety Briefing](#)^d must be documented.

E3.5

Medical Treatment and/or Evaluation

E3.5.1

Field activity participants must obtain any recommended vaccinations and make medical preparations appropriate for the location of the [field site](#)^d.

Contact TTU Student Wellness Center, the Health Sciences Center or appropriate travel health clinic to learn about the required and recommended vaccinations for your intended location.

E.5.1.1.1

Preparations for handling animals that are recognized carriers of infectious diseases or being in location(s) that are known to be hazardous must be described in the Field Safety Plan. Consult with IACUC if needed.

E3.5.1.2

All participants with chronic ailments (e.g., diabetes, asthma) or are susceptible to acute reactions to particular situations (e.g., allergies) or take daily medications are recommended to share their potential health concerns with a trusted partner in the group (this may include the [Field trip leader](#)^d).

E4 FIELD HAZARDS

Animal use or handling falls under the purview of the Institutional Animal Care and Use Committee (IACUC). See [TTU OP 74.11](#).

This document identifies common field hazards, describes common risks for each type and possible mitigation and emergency responses. The hazards listed are not comprehensive and other risks may arise. [Field trip leaders](#)^d are expected to identify and list all risks during the pre-planning process.

E4.1

Vehicles

E4.1.1

Vehicle Storage

E4.1.1.1

Do not allow non-employees or children into storage structures.

E4.1.1.2

Vehicles must be stored away from structures housing livestock.

E4.1.1.3

Vehicles must not be stored with fuel storage tanks.

E4.1.1.4

Vehicles must be parked/stored to allow easy entrance and exit from storage structure.

E4.1.1.5

Maintain clear, well-lit working spaces in and around vehicle and machinery storage buildings. Eliminate slips, trips, and falls.

E4.1.1.6

Vehicle keys must be secured if the vehicle is to be left unattended or unsupervised.

E4.1.1.7

Check that all structures, including windows, doors, and gates are secured and locked upon departure.

E4.1.2

Vehicle Maintenance

E4.1.2.1

The vehicle selected for each field activity should be appropriate for the terrain, road conditions and other predicted hazards to be encountered during fieldwork.

E4.1.2.2

It is recommended that departmental or TTU motor pool vehicles are used for all field excursions.

E4.1.2.3

The vehicle should be current on oil changes and manufacturer service schedule.

E4.1.2.4

The vehicle should be equipped with a fully pressurized spare tire, jack, tire-lever, functioning flashlight, and appropriate safety signage.

E4.1.3

Use of All-Terrain Vehicles (ATVs) and Related Vehicles / Equipment

E4.1.3.1

The National Safety Council has developed recommendations for using ATVs. The recommendations include:

E4.1.3.1(a)

All personnel using small vehicles in the field must take training courses prior to use and demonstrate competency on the vehicle type under similar conditions that will be present in the field.

E4.1.3.1(b)

ATVs with an engine size of 70cc to 90cc should be operated by people at least 12 years of age. ATVs with an engine size of greater than 90cc should only be operated by people at least 16 years of age.

E4.1.3.1(c)

Wear appropriate riding gear: DOT-, Snell ANSI-approved helmet, goggles, gloves, over-the-ankle boots, long-sleeve shirt, and long pants.

E4.1.3.1(d)

Read owners' manuals carefully.

E4.1.3.1(e)

Never carry a passenger on a single-rider ATV, and no more than one passenger on an ATV specifically designed for two people.

E4.1.3.1(f)

Any added attachments affect the stability, operating and braking of the ATV.

E4.1.3.1(g)

Vehicle attachments should be evaluated for safe usage prior to installation.

E4.1.3.1(h)

Do not operate the ATV on streets, highways, or paved roads.

E4.1.4

Vehicle Handling

E4.1.4.1

Reduce vehicle speeds to meet the safety hazards of rock conditions, and monitor speed and vehicle distancing to avoid sudden braking and aquaplaning

E4.1.4.2

Reduce vehicle speed when entering standing water, streams, and rivers to avoid mechanical damage and becoming stranded (e.g., engine flooding, loss of control).

E4.1.4.3

Unless appropriately equipped (e.g., 4- or all-wheel drive) avoid water-saturated off-road terrain to minimize risk of being stranded.

E4.2

Machinery and Equipment

E4.2.1

All tools, equipment, and machinery must be checked for proper functioning as described by the manufacturer before and after each use.

E4.2.2

Machinery and equipment should be serviced and maintained according to the manufacturer recommended schedule.

E4.2.3

All electrical (power) tools must be properly grounded or double insulated and all guards or shields must be in place.

E4.2.4

All users of machinery and equipment must wear the necessary personal protective equipment (PPE) and make sure that clothing has no strings or loose ends that could be caught by machinery. Long hair must be tied back to prevent entanglement.

E4.2.5

The [field site](#)^d must be checked for hazards prior to use of equipment and vehicles, with particular emphasis on checking for presence and height of electrical lines, aerial impediments (e.g., tree limbs, overhangs, etc.), ensuring unobstructed working space and that other fieldworkers are outside the minimum recommendations and/or maintaining safe distances from field operations.

E4.2.6

Field participants must be trained on specific equipment use prior to using equipment independently.

E4.2.7

Do not operate any equipment that is damaged, loose, missing parts, etc. Notify the [Field Trip Leader](#)^d immediately.

E4.2.8

Loading and Unloading Vehicles and Moving Equipment to [Field Site](#)^d

E4.2.8.1

Ensure that all loads are secured using straps, chains, or lines prior to putting a vehicle in motion.

E4.2.8.2

Ensure that appropriate equipment for unloading and necessary safety equipment to avoid injury is available at the [field site](#)^d.

E4.2.8.3

Mark equipment as “too heavy” if manual loading/off-loading is not possible.

E4.2.8.4

Apply appropriate control measures when lifting, moving, and carrying equipment.

E4.3

Boats and Other Watercraft

E4.3.1

One member of the field team must hold all appropriate certificates and credentials for assuming responsibility of the boat (watercraft) to be used. This includes tickets appropriate to the size of the craft, its navigation and safe use.

E4.3.2

Ensure boat is sound before setting out and that no damage has occurred in transit.

E4.3.3

Life jacket/buoyancy aid must be worn by all persons when using a boat, kayak, canoe, or other aquatic vessel.

E4.3.4

Ensure safe anchoring prior to cutting the engine.

E4.3.5

Ensure the fuel tank is horizontal and stable. Open pressure release valve when the motor is running.

E4.3.6

Never smoke near inflatable boats or engines.

E4.3.7

If the boat length exceeds the wavelength, the boat cannot ride the waves during inclement weather. Shelter should be sought.

E4.4

Terrain

E4.4.1

Identify the terrain types prior to departure and prepare accordingly.

E4.4.2

Mountains

E4.4.2.1

When preparing for work at a different altitude, follow these general precautions:

- a) Organize your trip ahead of time. Plan for an extra day for participants to acclimate to the elevation change.
- b) It is best practice to have a medical evaluation prior to leaving for a field excursion at high altitudes.
- c) Stay well-hydrated, rested, and educate yourself on the sign of altitude illnesses.
- d) Travel with a group if you are able. The use of a buddy system is very effective in recognizing HAI early.
- e) Gradual Initial Exposure: Graded ascent to high altitude is preferred over rapid exposure to high altitude.
- f) Ongoing Exposure: After 2-3 days spent at altitudes around 3500 m, travelers should increase their sleeping elevation no more than 600 m per day. Gaining more elevation during the day is acceptable so long as overexertion is avoided, and the sleeping elevation does not exceed 600m gained. In addition, an extra night of acclimatization is recommended every 300-900m gain in sleeping elevation.

E4.4.2.2

Slope

When ascending a steep slope, follow these general precautions:

- a) Shorten [trekking poles](#)^d.
- b) Take small steps.
- c) Ensure secure footing prior to placing weight on the next step.
- d) Walk in switchbacks, slightly weaving to the left and right.
- e) Step on flat surfaces.
- f) Sturdy footwear that provides ankle support should be worn to minimize the risk of falling.

When descending a steep slope, follow these general precautions:

- a) Keep your knee joints loose.
- b) Sturdy footwear that provides ankle support should be worn to minimize the risk of falling.
- c) Don't arrest your descent speed.
- d) Use trekking poles.
- e) Place your heel down first then your toes to ease pressure on your feet.
- f) Lean back slightly so your center of gravity shifts backward (i.e., toward the mountain top).
- g) Walk in switchbacks, slightly weaving to the left and right.
- h) Use side steps to descend by turning your feet perpendicular to the slope and taking small steps sideways.
- i) Step on flat surfaces.

E4.4.3

Waterbodies (lakes, oceans, rivers)

E4.4.3.1

Life jacket/buoyancy aid should be worn by all persons whenever the waterbody presents a fall hazard (e.g., unknown underwater terrain, quick moving water).

E4.4.3.2

The temperature of the waterbody must be considered when selecting appropriate PPE.

E4.4.4

Deserts

E4.4.4.1

The weather pattern and temperature fluctuations of the desert being visited must be documented in the Field Safety Plan. Deserts typically have extreme temperature changes during a day.

E4.4.4.2

Additional preventative measures to prevent dehydration and sun overexposure must be employed.

E4.5

Weather and Climate

E4.5.1

Be prudent and check the weather forecast prior to leaving for a [field site](#)^d. Prevention of climate induced health risk is always better than treatment.

E4.5.2

Heat-Related Danger

E4.5.2.1

See Appendix EC for Heat Stress Related Illness information from the CDC. This one-page reference document can be included in your Field Safety Plan.

E4.5.3

Cold-Related Danger

E4.5.3.1

See Appendix ED for Cold Stress Related Illness information from OSHA. This one-page reference document can be included in your Field Safety Plan.

E4.5.4

Severe Weather

E4.5.4.1

The use of weather alarms (stand-alone radios, or Apps on smart devices) is recommended.

E4.5.4.2

Field personnel shall use the 30-30 rule when you see lightning. After you see lightning, start counting to 30. If you hear thunder before you reach 30, the thunderstorm is within six miles and there is a need to seek shelter and wait 30 minutes until the storm passes.

E4.5.4.2(a)

If lightning is present within six miles while working at higher elevations or in exposed regions, move to lower elevations, forested areas or depressions and stay clear of tall, isolated trees.

E4.5.4.2(b)

If caught in an electrical storm lie flat face down on the ground and cover your head if in an open area. Do not sit on ground.

E4.5.4.3

In the event of a hail-warning seek shelter to minimize risk of personal injury.

E4.5.4.4

Unless pursuing severe-weather surveillance and monitoring activities in the case of severe weather warnings seek appropriate shelter, or if time permits, identify a safe route to leave the area of the warning.

E4.5.5

Rain and Flooding Hazards

E4.5.5.1

Do not enter creeks or [fording points](#)^d unless the water depth can be verified against a flood gauge.

E4.5.5.2

Do not enter water when the depth gauge meets or exceeds vehicle clearance.

E4.5.5.3

Do not walk through moving water. Six inches of moving water can make you fall. If you must walk in water for field activities, walk where the water is calmest. A walking stick can be used to check the firmness of the ground in front of you.

E4.5.5.4

Unless necessary for environmental safety (toxicity) the use of long-water boots is discouraged.

E4.5.5.5

Do not wade into streams, rivers, ponds, or lakes unless there is a buddy present on the shore.

E4.6

Fauna and Flora

E4.6.1

All field workers must recognize that they are entering the natural habitat of the native [flora](#)^d and [fauna](#)^d; you are their guests. It is every workers responsibility to minimize the impact of their presence and to leave minimal evidence of their visit.

E4.6.2

[Fauna](#)^d

E4.6.2.1

Carefully look for insects or hazardous animals (e.g., snakes, scorpions, spiders) before placing your hands, feet, or body in areas where these creatures may live or hide (wood piles, crevices, etc.).

E4.6.2.2

Wear insect repellent (30-50% DEET), but only if it will not endanger any susceptible animals being handled, especially birds.

E4.6.2.3

Carry a first aid kit with you on any excursion so you can treat bites or stings. If the pest is poisonous or if the bite appears inflamed, seek medical attention immediately.

E4.6.2.4

Thoroughly shake all clothing and bedding before use.

E4.6.2.5

Avoid contact with sick or dead animals.

E4.6.2.6

Minimize the amount of time you use lights after dark as they may attract pests and animals.

E4.6.2.7

Location-specific animal hazards should be addressed in the Field Safety Plan and during the [Field Safety Briefing](#)^d.

E4.6.3

[Flora](#)^d

E4.6.3.1

Do not eat any wild plants as they may be poisonous or carry parasites.

E4.6.3.2

Wear gloves while handling plant materials.

E4.6.3.3

Plants may be coated with any airborne pollutant present in the area - avoid brushing against plants with bare arms/legs.

E4.6.3.4

Be aware of any plants with thorns, spines etc.

E4.6.3.5

Be aware of low, over-hanging branches.

E4.6.3.6

Be aware of tree roots and creepers that may cause you to trip.

E4.7

Disease and Pathogens

E4.7.1

Field participants must decontaminate field materials prior to field trip and before departure from the [field site](#)^d.

E4.7.2

Potential Diseases

E4.7.2.1

Hantavirus: The [CDC has detailed information about hantavirus.](#)

E4.7.2.2

Lyme Disease: The [American Lyme Disease Foundation](#) provides information about the disease.

E4.7.3

More information about poisonous plants, visit the [FDA's Poisonous Plant Database.](#)

E4.7.4

Impure water

E4.7.4.1

Be aware of health risks from water borne pathogens (e.g., Hepatitis 'A', Weil's Disease, Polio, and toxic cyano-bacteria. The [CDC provides information waterborne diseases.](#)

E4.7.4.2

Wear waterproof gloves.

E4.7.4.3

Avoid drinking contaminated water

E4.7.5

Remote/Overseas Locations

E4.7.5.1

In remote/overseas locations be careful of eating food prepared by other people - particularly meats or fish and salads.

E4.7.5.2

In remote/overseas locations - Be wary of accepting ice in drinks.

E4.7.5.3

Be aware that some fields are cordoned off due to soil borne pathogens. These are easily spread from field to field if you walk or drive through them.

E4.7.5.4

Do not enter fields with DEFRA notices on them, even if the landowner gives permission. Consult DEFRA for further information.

E4.7.5.5

Researchers travelling internationally for field work are encouraged to notify EHS prior to departure to address safety concerns.

E4.8

Chemicals and Biological Materials

E4.8.1

Chemicals

E4.8.1.1

Handle chemicals as described in the Chemical Hygiene Plan. This includes following proper transportation procedures for hazardous materials as outlined in CHP Section A20.1.

E4.8.1.2

Any researcher using laboratory chemicals at a [field site](#)^d must submit a [Waste Determination Form](#) to EHS prior to departure to the field site to ensure appropriate segregation, collection, and transportation back to campus, if required.

E4.8.1.3

Additional measures including extra secondary containment, absorbent pads, and waste containers should be outlined in the Field Safety Plan.

E4.8.1.4

If gas cylinders are required for field activities, proper cylinder transportation must be followed. Regulators must be removed, valve closed, and cylinder cap firmly in place prior to transport. Students or faculty should not transport toxic, highly toxic, reactive, pyrophoric, or corrosive gases in vehicles. Cylinders moved in vehicles cannot be inside the passenger compartment and must be secured in cargo bed or trunk so they cannot move during transport. Do not allow cylinders to be exposed to high temperatures.

E4.8.2

Biological Materials

E4.8.2.1

Handle biological materials as described in the Biosafety Manual.

E4.8.3

Agro Chemicals

E4.8.3.1

Seek information from landowner as to when crop spraying is likely and when entry to field will be safe. Do not enter fields until safe to do so. Be aware that any skin contact is hazardous.

E4.8.3.2

Avoid pools and puddles in freshly sprayed fields which may contain chemicals.

E4.8.3.3

Keep arms and legs covered. Ensure waterproof protective gloves or gauntlets and long pants and closed-toed shoes are worn.

E4.9

The Public

E4.9.1

Private Property

E4.9.1.1

Try to contact property owners or those responsible for the property management before arriving. Be honest about the reasons you seek access and how much time you will need.

E4.9.1.2

Do not enter private land, property, or buildings unaccompanied or without expressed, preferably written permission, from the appropriate person of authority. Ensure landowners and their employees know who you are and what you are doing.

E4.9.1.3

If accompanied, acknowledge that it is their territory; let them lead the way.

E4.9.1.4

Take special care when documenting findings, particularly of sensitive information.

E4.9.1.5

Try not to react to dirty or smelly surroundings. Do not underestimate the importance of body language.

E4.9.1.6

Maintain an orderly work site. Keep your materials confined to the work site. You are a visitor to another's property.

E4.9.2

Unexpected Behavior

E4.9.2.1

Be aware of local cultures pertaining to land use and access. Be honest and transparent when justifying your request for access or when seeking information.

E4.9.2.2

If persons on property show signs of drug or alcohol impairment or are aggressive, do not enter.

E4.9.2.3

Do not turn your back on someone who is behaving aggressively and keep your distance. Stay calm, speak gently and slowly, and avoid aggressive body language and stances.

E4.9.2.3(a)

Do not be enticed into an argument. Talk yourself out of problems; placate rather than provoke.

E4.9.2.3(b)

Identify potential escape routes. Try to get away as quickly as possible. Move towards a place where you know there will be other people.

E4.9.2.3(c)

Consider carrying a personal alarm.

E4.9.3

Strangers and Public Places

E4.9.3.1

Research and vet individuals you may meet and work with or interview.

E4.9.3.2

Schedule meetings at neutral locations or where neither party could be at risk.

E4.9.3.3

Where possible conduct any interviews with an observer.

E5 PERSONAL SAFETY

E5.1

It is the responsibility of each field participant to uphold the safety rules outlined by the [Field Trip Leader](#)^d.

E5.1.1

Behavior

E5.1.1.1

Consider cultural sensitivities and norms when preparing for field work, including selection of field clothing and display of signs, identifiers etc.

E5.1.1.2

Carry documents providing permission to work in a particular locality and personal identification.

E5.1.1.3

Field participants should always act in a professional manner. Horseplay shall not be tolerated.

E5.1.1.4

Field participants should carry a Personal first-aid kit.

E5.1.1.5

Clean hands frequently. Always wash hands prior to eating, taking medications, applying first aid treatment, etc.

E5.1.2

Attire and Personal Protective Equipment

E5.1.2.1

Appropriate clothing must be worn. Wear clothes made of tightly woven materials. Long pants and long sleeves should be worn with sturdy, solid, closed-toe footwear that provides ankle support are required. Confine long hair and loose clothing.

E5.1.2.2

Hearing protection (noise attenuating earmuffs or ear plugs) are required for personnel using loud equipment (e.g., chainsaws, tractors, etc.).

E5.1.2.3

Safety glasses must be worn when using any equipment that may produce flying debris (e.g., rock chisel, chainsaw, etc.)

E5.1.2.4

Hard hats and protective footwear (hard toed boots/slip-on protection a.k.a. “clackers”) must be worn as directed or needed.

E5.1.2.5

Rain gear is recommended during inclement weather

E5.1.2.6

Work gloves are recommended for field activities, especially when it involves rock or soil sampling.

E5.1.2.7

Additional PPE items may include hearing protection, respirators/self-rescuers, high-visibility/reflective safety vest, safety belts and lanyards, harnesses, gloves and chemical- or fire-resistant clothing (coveralls).

E6 ESTABLISHING CAMPSITES

E6.1

Campsites

E6.1.1

All sites used for camps must be adequately drained. They must not be subject to periodic flooding.

E6.1.2

The camp must be located so the drainage from and through the camp will not endanger any domestic or public water supply.

E6.1.3

All sites must be adequate in size to prevent overcrowding of necessary structures. The principal camp area where food is prepared and served and where sleeping quarters are located must be at least 200 feet apart.

E6.1.4

The grounds and open areas surrounding the shelters must be maintained in a clean and sanitary condition free from rubbish, debris, wastepaper, garbage, or other refuse.

E6.1.5

Do not camp or sleep near obvious animal nests or burrows.

E6.2

Refuse Disposal

E6.2.1

When working at a field site where garbage bins are not available, use fly-tight, rodent-tight, impervious, cleanable, or single service containers for the storage of garbage.

E6.2.1.1

Keep garbage containers stored away from your campsite or work area. Food crumbs and debris may attract insects and animals.

E6.2.1.2

Garbage containers must be kept clean.

Appendices

[Chemical Hygiene](#)

[Biosafety](#)

[Radiation Safety](#)

[Laser Safety](#)

[Field Safety](#)

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BG Biobarrel Use	BG-1
BH Biosafety Links	BH-1
CA Radiation Reference Information	CA-1

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Appendix AA

Texas Tech University Compatible Storage Group Classification System

Should be used in conjunction with specific storage conditions taken from the manufacturer's label and MSDS.

Storage Groups

Store chemicals in separate secondary containment and cabinets

- ① Compatible Organic Acids
- ② Compatible Organic Bases
- ③ Non-Reactive Flammable and Combustible, including solvents
- ④ Not intrinsically Reactive or Flammable or Combustible
- ⑤ Compatible Oxidizers including Peroxides
- ⑥ Compatible Inorganic Bases
- ⑦ Compatible Inorganic Acids not including Oxidizers or Combustible
- ⑧* Incompatible with ALL other storage groups
- ⑨ Compatible Pyrophoric & Water Reactive Materials
- ⑩* Poison Compressed Gases
- ⑪* Compatible Explosive or other highly Unstable Material

*Storage Groups 8,10 and 11: Consult EHS Department for specific storage - consult manufacturer's MSDS

If space does not allow Storage Groups to be kept in separate cabinets the following scheme can be used with extra care taken to provide stable, uncrowded and carefully monitored conditions. Notice the secondary containment between each storage group.

The diagram illustrates the storage arrangement for 11 storage groups. The top two rows show groups 1 through 7, with two bottles per group in separate secondary containment bins. The bottom row shows groups 8 and 9, each in its own separate secondary containment bin. Group 8 is labeled 'STORAGE GROUP 8' and group 9 is labeled 'STORAGE GROUP 9'.

All Storage Group 8 chemicals must have separate containment.

Storage Group 9 is not compatible with any other storage group.

SOURCE: Adapted from Stanford University's ChemTracker Storage System. Used with permission from R. Kevin Creed, Stanford University.

Chemicals are segregated into 11 different categories depending on the compatibility of that chemical with other chemicals. If you feel a chemical is misclassified or have other questions regarding chemical storage and classification, please contact EHS by email at ehs.lab.safety@ttu.edu or call 806-742-3876.

CHEMICAL SEGREGATION

Chemicals are to be segregated into 11 different categories depending on the compatibility of that chemical with other chemicals.

The Storage Groups are as follows:

Group 1 – Compatible Organic Acids

Group 2 – Compatible Organic Bases

Group 3 – Non-Reactive Flammable and Combustible, including solvents

Group 4 – Not intrinsically Reactive or Flammable or Combustible

Group 5 – Compatible Oxidizers including Peroxide

Group 6 – Compatible Inorganic Bases

Group 7 – Compatible Inorganic Acids not including Oxidizers or Combustible

Group 8 – Incompatible with ALL other storage groups

Group 9 – Compatible Pyrophoric & Water Reactive Materials

Group 10 – Poison Compressed Gases

Group 11 – Compatible Explosive or other highly Unstable Material

The following link will take you to the chemical classification list. This is not a complete list of chemicals, but is provided to give examples of each storage group:

CHEMICAL CLASSIFICATION LIST

Appendix AB

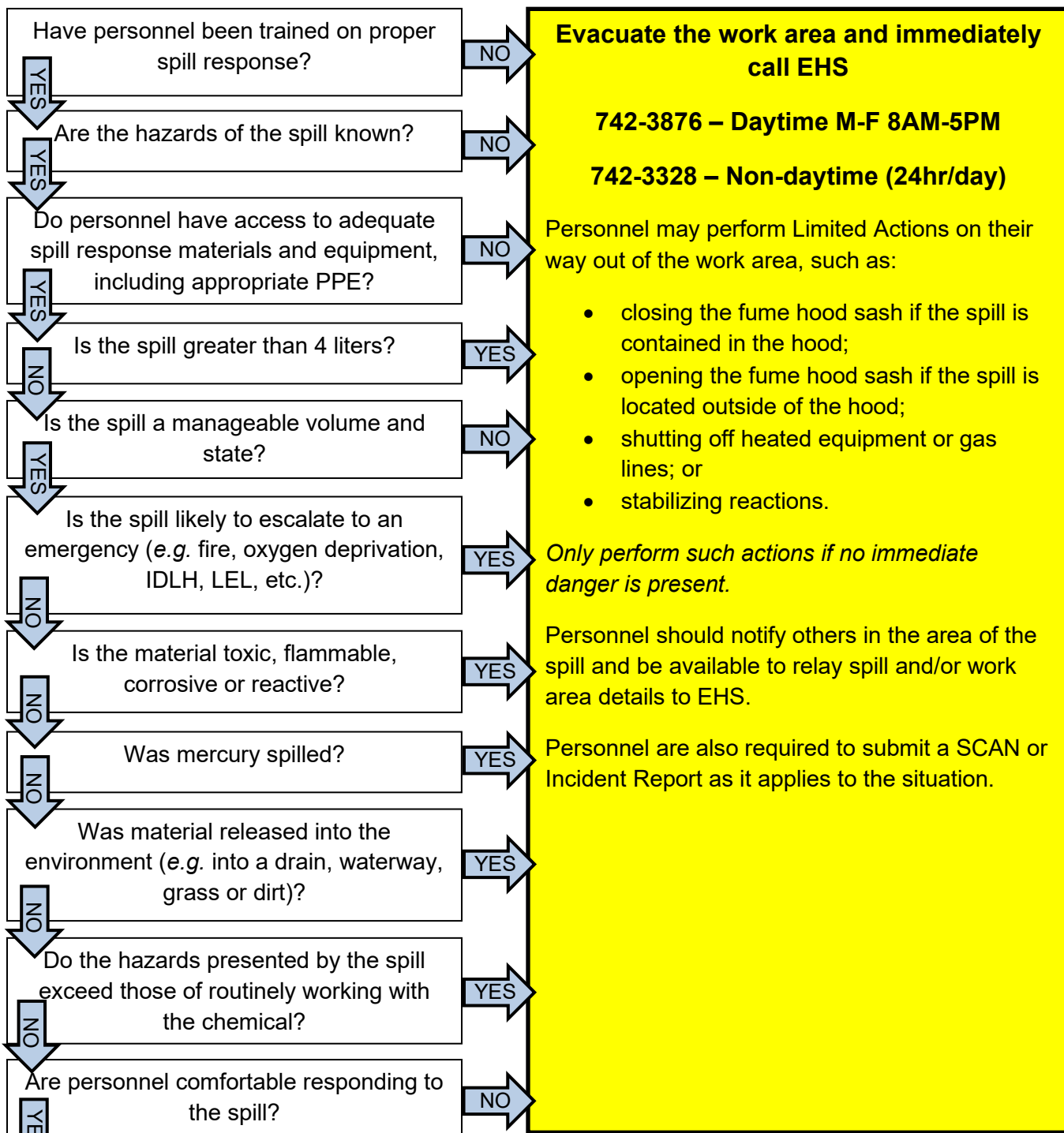
Laboratory Safety Survey Checklist can be found on the [EHS Tools and Templates page](#).

Appendix AC



DOES YOUR SPILL REQUIRE EHS RESPONSE?

Follow the flow chart to determine if EHS should respond to your spill.



Evacuate the work area and immediately call EHS

742-3876 – Daytime M-F 8AM-5PM

742-3328 – Non-daytime (24hr/day)

Personnel may perform Limited Actions on their way out of the work area, such as:

- closing the fume hood sash if the spill is contained in the hood;
- opening the fume hood sash if the spill is located outside of the hood;
- shutting off heated equipment or gas lines; or
- stabilizing reactions.

Only perform such actions if no immediate danger is present.

Personnel should notify others in the area of the spill and be available to relay spill and/or work area details to EHS.

Personnel are also required to submit a SCAN or Incident Report as it applies to the situation.

Lab personnel may clean up the spill themselves using the guidance provided in Appendix AC of the Lab Safety Manual and the chemical Safety Data Sheet. Submit a SCAN report to EHS after cleanup is complete.



Basic Spill Response Equipment

Spill kits in work areas should be appropriate to the hazards present. Some potential components of spill kits are listed below:

- Absorbents
 - Paper towels
 - Pig pads
 - Dams for large spills
 - Commercial absorbent powders
 - Clay kitty litter
- Neutralizers
 - Acid Neutralizer (included in EHS provided spill kit)
 - Alkali Neutralizer
 - Solvent Neutralizer
- Disinfectants (see Section B7.2 of the University Laboratory Safety Manual)
 - Freshly prepared 10% bleach solution
 - Alcohols (ethanol or isopropanol)
 - Quaternary ammonium salts
- Personal Protective Equipment
 - Household rubber gloves
 - Splash goggles or face shield
 - Lab apron or coat
- Tools for Clean-up
 - Forceps, tongs or other tools to pick up and collect broken glass
 - Broom and dust pan
 - Plastic bags
 - Rigid container with lid to collect broken glass

NOTE: Use disposable clean up supplies when possible because contaminated tools will be considered hazardous waste.



Basic Chemical Spill Response Steps

1. Notify other personnel in the laboratory to stay clear of the spill area.
2. Decontaminate any victim at the nearest safety shower or eyewash unit for a minimum of 15 minutes. Take other appropriate action as described in the SDS.
3. Notify your supervisor or appropriate personnel to the spill.
4. Limit or restrict access to the area as necessary.
5. Wear clean PPE appropriate to the degree of hazard presented by the spill. This may include a dust mask, lab apron, additional gloves, face shield, etc.
6. Gather all spill kit materials.
7. Surround the spill with an appropriate neutralizer or absorbent to keep the material from spreading.
8. Do not neglect furniture, equipment and vertical surfaces (i.e., cabinets, walls, doors) when cleaning a spill.
9. Cover the spill area completely with absorbent. Follow manufacturer instructions if using a commercial absorbent.
10. If the spill contains a biohazard, cover the spill with absorbent pads or paper towels then saturate with an appropriate disinfectant and allow adequate contact time for disinfection before cleaning. Disinfect the area a second time after the absorbent material has been removed.
11. Gather the contaminated clean-up materials (including broken glass and contaminated tools and PPE) into a closeable bin and label as hazardous waste. Broken glass disposed of in a broken glassware bin must be decontaminated before disposal.
12. It is prudent to mop the spill area after cleaning the spill.
13. Submit a Waste Pick Up request for the container in a timely manner.
14. Submit a SCAN report <http://www.depts.ttu.edu/ehs/about/scan.php> to EHS detailing the incident.
15. Request a new spill kit from EHS at 806-742-3876 or ehs.lab.safety@ttu.edu if the EHS-provided spill kit was used for clean-up.

Appendix AD

Use and storage of compressed, liquified, or cryogenic gases

Background

TTU laboratory operations may require the use of compressed, liquified, or cryogenic gases. While all gases contain substantial potential energy in their containers, depending on the particular gas, there is also a potential for exposure to toxic, corrosive, flammable, reactive, or oxygen depleting materials. Anyone using a gas must be familiar with its hazards; reading the Safety Data Sheet (SDS) is an excellent introduction to the safe handling, use, and storage of a compressed, liquified, or cryogenic gas. Additionally, all laboratories and research projects employing gases must comply with the provisions of this Appendix.

The language in this Appendix is intended to set out current minimum standards for the safe use of compressed gases and provide additional provisions to implement in the future. Basic compliance is the bare minimum required for laboratory operations and is indicated by terms such as will, shall, must. *Better* compliance represents a step up in safety procedures, policies, and practices. *Best* compliance is the highest standard and ensures that lab operations fully align with requirements set out by National Fire Protection Association (NFPA) and Occupational Safety and Health Association (OSHA). Both *better* > d *best* compliance elements will identified with arrow bullet points (➤).

All laboratories will be required to meet the standards of *better* compliance within two years of the implementation of this Appendix.

Building and experimental design proposing the use of compressed, liquified, or cryogenic gases shall involve representatives from EHS and the Fire Marshals to ensure that (1) building and floor limitations on compressed gas quantities are followed and (2) the laboratory space is appropriately sized and equipped to accommodate these materials.

Prohibited activities

The following activities are prohibited:

- Dispensing of any type of gas into another container (apart from cryogenic materials).
- Leaving experiments using toxic, extremely toxic, flammable, oxidizing, corrosive, or reactive/ pyrophoric, gases unattended. This does not apply to gas systems that supply analytical devices, gas systems used in exhausted cabinets and hoods, or gas systems used in laboratories with gas monitoring sensors that can alert an individual outside the lab of a release.

Ordering

- All compressed, liquified, or cryogenic gases are considered hazardous materials and must be identified as such when ordered through TechBuy.
- Labs wishing to order flammable, oxidizing, toxic, extremely toxic, reactive/pyrophoric, unstable, or corrosive gases must consult with EHS prior to placing an initial order.

Gas Inventory

Laboratories will maintain an inventory of the following gas types stored or in use in the lab space. The inventory will include the gas type, number of containers, date of expiry for container certification, and container size. This information will be provided to EHS on January 1 and July 1 of each year.

- Flammable
- Toxic and extremely toxic
- Reactive/ pyrophoric
- Oxidizing
- Corrosive
- Unstable
- Cryogenic gases in quantities greater than 5 liters¹

Training

All individuals using gases in the laboratory will complete the following training prior to working with or moving a gas container:

- Laboratory safety
- Compressed gas safety
- Liquid nitrogen safety (if using or transferring liquid nitrogen)

Individuals using any type of gas container or manifold system must be able to demonstrate that they can turn on and off gases that they intend to use. All individuals using hazardous gas types (flammable, corrosive, oxidizing, reactive/ pyrophoric, unstable, and toxic/ highly toxic) must be specifically trained on the hazards of these gases, means to detect releases, methods employed to mitigate the hazards, and emergency procedures in the event of a release.

Transport

Moving cylinders and gas containers presents several risks; containers can be heavy, bulky, and difficult to move by hand and the valve assembly can become damaged if the cylinder is dropped or struck. The following provisions address transportation of gas containers.

3rd Party transport

Compressed, liquified, and cryogenic gases are considered hazardous materials for purposes of transportation by freight carriers (by air, rail, marine, or over the road). All freight transportation of these materials must be cleared through [EHS Materials Shipping](#).

Vehicle transport

- Texas Tech University vehicles, not personal vehicles, will be used to transport gas containers.
- Gas containers may not be transported in the same compartment of the vehicle as the driver or passengers.

¹ This refers to total quantity of cryogenic gases in the work area, not just the amount in one container.

- Gas containers will be secured to prevent movement during transport.
- Containers must be transported with valves closed and protected.
- Gas containers shall not be allowed to be exposed to high temperatures during transport.
- Incompatible gases shall be segregated during transportation (see segregation information below).

Hand transport

- Large gas containers must be transported using dollies or carts that allow the container to be secured during movement.
- Containers must be transported with valves closed and protected.
- Gas containers shall not be allowed to be exposed to high temperatures during transport.
- Incompatible gases shall be segregated during transportation (see segregation information below).
- Freight elevators are preferred for moving gases between floors; gas containers shall not be transported with the non-laboratory personnel in elevators.
 - *Better:* Flammable, corrosive, toxic, and cryogenic gases shall be transported in an empty elevator.²
 - *Better:* a portable oxygen meter may be used when gases are being transported in confined spaces such as elevators as a means of detecting potential leaks.
 - *Best:* a portable multi-gas meter that can measure O₂ and flammability and specific gases may be used when gases are being transported in confined spaces such as elevators as a means of detecting potential leaks.

Storage of gases

As gases represent a larger hazard in smaller spaces, the amount of gas containers in a laboratory space shall be kept to a minimum. As long as the quantity limitations set out below are not exceeded, labs should keep no more than two spare containers of each gas type in the lab space.

- *Better:* One spare cylinder for each gas type may be kept in the lab space.³

Gas containers that are not regularly used must not be stored in occupied laboratory spaces.

General

- Store gases in cool, dry, well ventilated, and secure area.
- Gases must not be stored where they would impede exit from the space or building (i.e., away from emergency exits, not under stairs, etc.).
- Hazard warnings indicating gas use shall be posted at entrances to laboratory or storage space.

² NFPA 45 A 8.3.3.1

³ NFPA 45 10.1.6.3 & 10.1.6.4

Quantities

The National Fire Protection Association (NFPA) sets limits on quantities of gases that can be stored or used inside a building.⁴ These limits are difficult to translate to individual lab spaces since they are based on the construction features of the building like firewalls, fire doors, and fire suppression systems. To simplify the application of gas storage guidelines to laboratories, TTU has adopted the following storage limitations for laboratory spaces of 750 square feet or greater.

The table below, and accompanying adjustments, represent the maximum allowable quantity (MAQ) of a particular gas type that may be stored and used in a laboratory space. For example, the maximum quantity of an oxidizing gas for storage or use in a third floor, 700 sf lab that was stored in vented cabinets would be 1,500 scf x 0.5 [for third floor location] x 0.5 [for <750 sf of lab space] x 2 [for vented cabinets] = 750 scf.

<i>Gas Type</i>	<i>Class (DOT codes)</i>	<i>MAQ for storage room or lab space >750 sf</i>	<i>Notes</i>
Cryogenic	Inert (2.2)	5 liters ⁵	
Flammable	Gas (2.1)	1,000 scf	
	Liquified (2.1)	150 lb	
	LP (2.1)	300 lb	
Inert	Gas (2.2)	NL	
	Liquified (2.2)	NL	
Oxidizing	Gas (2.2, 5.1)	1,500 scf	
	Liquified (2.2 5.1)	150 lb	
Corrosive	Gas (2.2, 8)	810 scf	
	Liquified (2.2 8)	150 lb	
Pyrophoric	Gas	50 scf	
	Liquified	4 lb	
Toxic	Gas (2.3)	810 scf	
	Liquified (2.3)	150 lb	
Highly Toxic	Gas (2.3)	20 scf	
	Liquified (2.3)	4 lb	
Unstable	Gas, 3 or 4 detonable	10 scf	
	Gas, 3 non-detonable	50 scf	
	Gas, 2	750 scf	
	Liquified, 3 or 4 detonable	1 lb	
	Liquified, 3 non-detonable	2 lb	
	Liquified, 2	150 lb	

Table notes and adjustments to MAQ.

- NL- no limits on quantities to be used or stored
- MAQ- maximum allowable quantity

⁴ NFPA 55, Table 6.3.1.1.

⁵ This is not a maximum limit of cryogenic gas that can be used or stored in this space. It is the threshold that triggers the need for an oxygen sensor.

<i>Adjustment to MAQ</i>	<i>Multiplier</i>
Storage: materials are stored in a dedicated gas storage room or approved gas cabinet.	2.0
Lab use: lab space is in basement or second floor	0.75
Lab use: lab space is in sub-basement or third floor	0.50
Lab use: lab space is on fourth floor or above	0.125
Lab use/ storage: lab space or non-dedicated gas storage room <750 square feet	0.50
Lab use: gas being used is in an approved cabinet, gas cabinet, or exhausted enclosure	2.0
Lab use: lab is an instructional (teaching) lab ⁶	0.10

Rooms devoted to gas storage should not exceed the quantity limitations outlined above.

- *Best:* Gas storage rooms shall meet all requirements set out by NFPA.

Security

- The contents and hazards of a gas container shall be readily apparent to lab personnel through labeling or signage. Cylinders must be labeled as to contents and DOT hazard class.⁷
- Gas containers must be secured upright for storage or use. Straps, chains attached to a solid object, or a cylinder stand are appropriate for securing cylinders. Multiple cylinders of compatible gases may be tightly nested and secured with a single chain or strap.
 - *Best:* Gas cylinders are individually secured and not nested.
 - *Best:* Where multiple gas types are aggregated, the location for each gas type is identified with signage.
- Cylinders in storage must be closed and capped.

Segregation

Flammable, corrosive, oxidizing, reactive/ pyrophoric, unstable, and toxic/ highly toxic gas types are considered hazardous gas types. Each cylinder or container of a hazardous gas type must be separated from any other cylinder or container of a hazardous gas type by at least 20 feet or by a container-height fire barrier with ½ hour fire resistance.⁸ For gases with separation restrictions, that restriction may be reduced to 5 feet if one gas is in a gas cabinet and reduced to zero if both gases are in a gas cabinet.⁹

Use of gases

Note that all provisions for safe storage of gases apply, as appropriate, to the use of gases as well.

Setup

- Researchers should set up experiments to minimize the amount of gas needed.

⁶ NFPA 55, 10.1.6.7

⁷ NFPA 55 7.1.7

⁸ NFPA 55 Table 7.1.10.2 & 7.1.10.2.2

⁹ NFPA 55 7.1.10.2.3

- Regulators for cylinders will be selected in accordance with the type of gas being used. An experienced individual or the gas vendor must be consulted to provide information on the appropriate regulators for each gas type employed and how to set up and attach the regulator.
- Grease, Teflon tape, oil, soapy water, or other materials shall not be used on regulator threads.
- Pressure regulators must have two gauges (inlet and outlet side).¹⁰
- Gas cylinders shall be located so they may not obstruct egress from the lab space. If a gas cylinder or cryogenic container is located adjacent to an egress point, the lab space must have a second egress point.¹¹
- Gas systems will be checked for leaks prior to use. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
- Manifolds and piping used to distribute gases will be selected with the gas type and pressure in mind and be assembled and installed by a competent person in accordance with NFPA 54 and 55 and manufacturer's specifications.
- Piping used to distribute gases shall be labeled as to the gas type at the supply and discharge point.¹²
- Manual shut valves for gases will be within 6 feet of the point of use.¹³
- Flow control or excess flow valves should be incorporated in gas delivery design in a way that minimizes the potential volume of releases from the experimental apparatus.
- Exhaust from gas-fed experimental apparatus must be considered as having the same hazard of the supply gas and be appropriately monitored and/or vented.
 - *Better*: Exhaust gas composition is monitored and categorized to determine actual hazard.



Use

- Cylinder valves, not regulator valves, will be used to turn gas on and off. Cylinder valves shall be operated by hand- do not use wrenches or other tools.
- Users will wear safety glasses when pressurizing regulators and lines. Turn gas on slowly and ensure gauge faces are facing away from individuals.
- Gas container valves will be off, unless in use.
- Gas containers and associated equipment shall be regularly inspected for damage or loose connections.

Emergency procedures

- Laboratories will develop emergency procedures to address releases of gases used in the laboratory. These procedures will contain information on the hazards of the gases

¹⁰ NFPA 45 10.1.5.2

¹¹ NFPA 45 5.3.1 (5) & 5.3.1 (6)

¹² NFPA 45 10.2.5

¹³ NFPA 45 10.2.3

used, means of detecting releases, procedures to shut down experimental apparatus, and notification requirements.

- TTU Fire Marshal will be provided an inventory of hazardous gas types found in each building.
- In the event of a release of a hazardous gas type, lab personnel must call 9-911 from a campus phone or 911 from a cell phone. Shut off sources of energy and ignition and evacuate the lab promptly. If it is safe to do so, attempt to close the cylinder valve. Notify the DSO and building manager of the issue and do not re-enter the lab space until it has been cleared by emergency responders or EHS personnel.
- All incidents and near-misses associated with gas use will be reported to EHS within 24 hours.

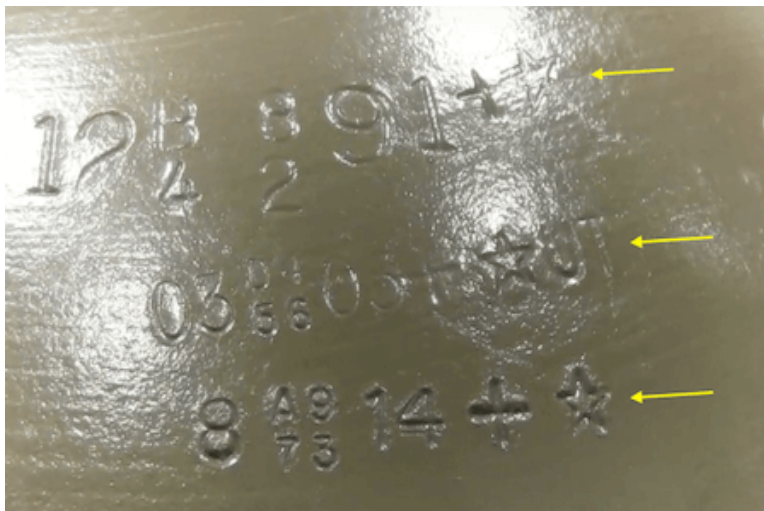
Security

Storage areas and laboratories using hazardous gas types must take measures to secure gas containers, prevent unauthorized use, and ensure that all containers are accounted for.

Gas specific requirements

General

Gas containers must be regularly recertified to be refilled or used for transportation. Cylinders have the date of their last testing embossed in the steel or aluminum, generally around the neck of the bottle. Some cylinders have multiple dates displayed as they have been recertified multiple times.



The following example explains how to read the testing dates. Cylinder test dates are stamped in a month_INSPECTOR CODE_year format. The photo to the left shows several date stamps- the initial stamp at the top is dated 12/91 with a B842 inspector code between the month and the year. The next date stamp is 03/05 and final stamp is 08/14. Some dates will have stars or + signs stamped behind them. Hydrostatic tests are

valid for 5 years; if the test date has a star behind it, the test is valid for 10 years.

- Laboratories may not accept cylinder deliveries of cylinders with invalid test dates.
- Laboratories may not store cylinders with test dates that have expired more than 7 years ago.
 - *Better:* Laboratories may not store cylinders with test dates that have expired more than 3 years ago.

Flammable gases

- Flammable gases will have a flashback arrestor as part of the regulator to ensure that flame cannot propagate back into the tank. For piping longer than 50 feet, a second flashback arrestor must be installed at the point of use.
- Labs employing flammable gases will regularly inspect piping and manifolds and perform leak testing annually. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
 - *Better:* Labs employing flammable gases will regularly inspect piping and manifolds and perform leak testing quarterly. The method of leak detection employed, the date conducted, and the individual conducting it will be documented.
 - *Better:* Laboratories employing flammable gases will install a % LEL monitor that will provide a local alarm of gas releases.
 - *Better:* Laboratories employing flammable gases will employ local ventilation at locations in the gas delivery system where leaks are more likely (regulator, manifolds, etc).
 - *Best:* Laboratories employing flammable gases will install a flammable gas monitor that will provide a local alarm of gas releases and notify outside personnel.
- Flammable gas cylinder valves should only be opened ½ to ¾ turn.
- Acetylene gas will be used at less than 15 pounds of pressure.

Corrosive gases

- *Better:* Corrosive gases should be used in fume hoods where possible.
- *Best:* Corrosive gases are stored and used in vented cabinets.
- *Better:* Where possible, gas-specific monitors will be employed to provide a local alarm of gas releases.
 - *Best:* Laboratories employing corrosive gases will install a gas monitor that will provide a local alarm of gas releases and notify outside personnel.
- *Better:* Laboratories employing corrosive gases will employ local ventilation at locations in the gas delivery system where leaks are more likely (regulator, manifolds, etc).
- Non-empty corrosive gas containers will be returned to the supplier no later than the expiration of their hydrostatic test date. Labs using these gases will implement tracking to ensure this occurs.
 - *Best:* Non-empty corrosive gas containers will be returned to the supplier within 3 years of shipping date.¹⁴
- Labs employing corrosive gases will regularly inspect piping and manifolds and perform leak testing twice per year. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
 - *Better:* Labs employing corrosive gases will regularly inspect piping and manifolds and perform leak testing quarterly. The method of leak detection

¹⁴ NFPA 45 A10.1.2

employed, the date conducted, and the individual conducting it will be documented.

- Hydrofluoric acid and hydrogen bromide gases must be returned to the supplier within 2 years of shipping date.¹⁵ Labs using these gases will implement tracking to ensure this occurs.

Toxic and extremely toxic gases

These gases present an extreme hazard to laboratory personnel, particularly for gases like carbon monoxide or hydrogen sulfide that have poor warning properties. Toxic and extremely toxic gases should be used in lab spaces equipped with appropriate safety features to limit the hazards.

- Laboratories employing toxic and extremely toxic gases will employ local ventilation at locations in the gas delivery system where leaks are more likely (regulator, manifolds, etc).
 - *Better:* Toxic and extremely toxic gases should be used in fume hoods where possible.
 - *Best:* Toxic and extremely toxic gases are stored in an NFPA 55 compliant gas room or used from approved gas cabinets, or exhausted enclosures.¹⁶
- For gases with poor warning properties, gas-specific monitors will be employed to provide a local alarm of gas releases.
 - *Best:* Laboratories employing toxic and extremely toxic gases will install a gas monitor that will provide a local alarm of gas releases and notify outside personnel.
- Non-empty toxic and extremely toxic gas containers will be returned to the supplier no later than the expiration of their hydrostatic test date. Labs using these gases will implement tracking to ensure this occurs.
 - *Best:* Non-empty toxic and extremely toxic gas containers will be returned to the supplier within 3 years of shipping date.¹⁷
- Labs employing toxic and extremely toxic gases will regularly inspect piping and manifolds and perform leak testing twice per year. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
 - *Better:* Labs employing toxic and extremely toxic gases will regularly inspect piping and manifolds and perform leak testing quarterly. The method of leak detection employed, the date conducted, and the individual conducting it will be documented.

Oxidizing gases

- No oils or greases will be used on oxidizing gas fittings.
- *Better:* Laboratories employing oxidizing gases will employ local ventilation at locations in the gas delivery system where leaks are more likely (regulator, manifolds, etc).

¹⁵ NFPA 45 A10.1.2

¹⁶ NFPA 45 10.1.4.1

¹⁷ NFPA 45 A10.1.2

- Labs employing oxidizing gases will regularly inspect piping and manifolds and perform leak testing annually. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
- *Better:* Labs employing oxidizing gases will regularly inspect piping and manifolds and perform leak testing quarterly. The method of leak detection employed, the date conducted, and the individual conducting it will be documented.
- *Better:* Labs using oxygen will install an oxygen sensor that will provide a local alarm of gas releases.
- *Best:* Laboratories using oxygen will install a gas monitor that will provide a local alarm of gas releases and notify outside personnel.

Reactive and pyrophoric gases

These gases present an extreme hazard to laboratory personnel; they should be used in lab spaces equipped with appropriate safety features to limit personnel exposure to the hazards.

- Pyrophoric and reactive gases should be used in fume hoods and away from combustible materials.
- *Best:* Pyrophoric and reactive gases larger than lecture size must be used from sprinklered safety cabinets.¹⁸
- *Best:* These gases must be stored in an NFPA 55 compliant gas room or used from approved gas cabinets, or exhausted enclosures.¹⁹
- Where possible, gas-specific monitors will be employed to provide a local alarm of gas releases.
- *Best:* Laboratories employing pyrophoric and reactive gases will install a flammable gas monitor that will provide a local alarm of gas releases and notify outside personnel.
- Non-empty pyrophoric and reactive gas containers will be returned to the supplier no later than the expiration of their hydrostatic test date. Labs using these gases will implement tracking to ensure this occurs.
 - *Best:* Non-empty pyrophoric gas containers will be returned to the supplier within 3 years of shipping date.²⁰
- Labs employing pyrophoric and reactive gases will regularly inspect piping and manifolds and perform leak testing twice per year. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
 - *Better:* Labs employing pyrophoric and reactive gases will regularly inspect piping and manifolds and perform leak testing quarterly. The method of leak detection employed, the date conducted, and the individual conducting it will be documented.

Unstable gases

The laboratory use of these gases will be evaluated by EHS on a case-by-case basis.

¹⁸ NFPA 45 10.1.4.3

¹⁹ NFPA 45 10.1.4.1

²⁰ NFPA 45 A10.1.2

Inert gases (both compressed and cryogenic)

Inert gases do not present the hazards of the gases listed above, but they often have poor warning properties and can displace available oxygen in laboratory spaces if they are released. This is particularly true of cryogenic gases which expand to fill a volume 600 to 800 times that of the container if released.

- Individuals working with cryogenic gases must have insulated gloves and face shields as part of their PPE ensemble.
- Laboratories with more than 10 full-sized inert gas cylinders in use or storage will install an oxygen sensor that will provide a local alarm of gas releases.
- Areas where cryogenic gases are dispensed will have an oxygen sensor installed.
- Laboratories using or storing cryogenic gases will install an oxygen sensor that will provide a local alarm of gas release based on the size of the cryogenic gas container and the square footage of the room. For each 150 square feet of laboratory space, 1 liter of cryogenic gas may be stored or used without the installation of an oxygen sensor.
 - *Better*: Laboratories employing oxygen sensors as noted above will install a gas monitor that will provide a local alarm of gas releases and notify outside personnel.
- Labs employing inert gases will regularly inspect piping and manifolds and perform leak testing annually. The method of leak detection employed, the date conducted, and the individual conducting it will be documented. Flames may not be used for leak detection.
 - *Better*: Labs employing inert gases will regularly inspect piping and manifolds and perform leak testing quarterly. The method of leak detection employed, the date conducted, and the individual conducting it will be documented.
 - *Better*: Laboratories employing inert gases will employ local ventilation at locations in the gas delivery system where leaks are more likely (regulator, manifolds, etc).

Cylinder disposal

Gas cylinders are likely to be regulated as both hazardous waste and hazardous materials for transportation. Coordinate with the gas vendor to remove surplus or unneeded gas containers.

- Damaged cylinders must be removed from the laboratory promptly. Contact EHS to coordinate removal and appropriate disposal.
- Empty gas containers will be marked as such and removed from the lab as soon as possible.
- Handle and store empty gas cylinders as if they are full.

Appendix and lab practices review

A Chemical Hygiene Plan and associated laboratory SOPs are not static documents; they should gradually improve over time as regulations change, new best practices come online, and labs gain familiarity with experimental tools.²¹ The contents of this appendix will be reviewed annually by the ILSC and updated to (1) reflect changes in regulation or best practices and (2) lab practices in place across TTU. As *better* and *best* practices become the norm across

21 29 CFR 1910.1450(e)(4)

campus, those standards will become the new baseline safety standard for use of compressed, liquified, and cryogenic gases.

Laboratories will annually review experimental practices associated with gas use, review lessons learned from incidents and near misses, and identify areas where lab practices could change to meet the *better* or *best* practices in this Appendix.

Appendix AE



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TRAPS FOR VACUUM LINES

Always place an appropriate trap between experimental apparatus and the vacuum source. The vacuum trap:

- Protects the pump, pump oil, and piping from the potentially damaging effects of the material;
- Protects personnel from materials in the apparatus; and
- Prevents vapors and related odors from being emitted back into the work area or vacuum system exhaust.

Improper trapping can allow vapor to be emitted from the exhaust of the vacuum system resulting in potential personnel exposure and/or entry into the work environment.

Proper Trapping Techniques

All lines leading from the equipment to the vacuum source must be equipped with a trap or filter as appropriate.

Particulates

- Vacuum lines should be fitted with filtration capable of efficiently trapping the particulates in the size range being generated.

Aqueous or Non-Volatile Liquids

- A filter flask at room temperature is sufficient for vacuum lines using aqueous or other non-volatile liquids.
- An in-line hydrophobic filter may be added for additional protection to the vacuum system.

Solvents and Other Volatile Liquids

- A cold trap (see Figure 2) of sufficient size and cold enough to condense vapors generated followed by a filter flask capable of collecting fluid that could be aspirated out of the cold trap should be used.
- A cold trap using a cooling bath of dry ice and isopropanol or ethanol is sufficient for most volatile liquids (temperatures as low as $-78\text{ }^{\circ}\text{C}$). Glycols may also be used as the bath liquid.
- Avoid using an acetone-dry ice cooling bath. The alternatives mentioned above are less flammable, less prone to foaming and splattering and less likely to degrade trap components (*i.e.* O-rings, plastic).
- Use caution when handling dry ice and preparing cooling baths. Wear splash goggles, cryogenic gloves, and a lab apron when handling cryogenic liquids to avoid any skin exposure.

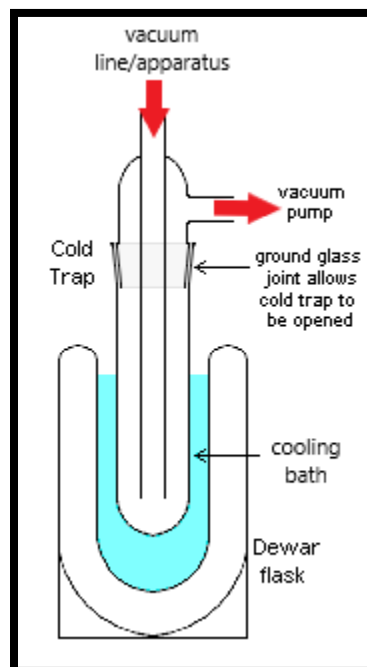


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- Dry ice and liquified gases used in cooling baths should always be open to the atmosphere. Never use them in closed systems where they may develop uncontrolled pressures.
- Perform procedures in a well-ventilated area. Never lower the head into a dry ice chest as asphyxiation can occur.
- Add dry ice slowly to the bath liquid to avoid foaming.
- Check cold traps frequently to make sure they do not become plugged with frozen material.
- A cold trap using liquid nitrogen may only be used with sealed or evacuated equipment. If the system is opened while the cooling bath is in contact with the trap, oxygen may condense from the atmosphere and react explosively with any organic material present.
- Wrap Dewar flasks and cold traps with screens, friction tape, or a metal jacket.
- Select equipment used at low temperatures carefully because temperature can dramatically change the characteristics of materials.
- After completion of a procedure using a cold trap under pressure, isolate the trap from the vacuum source, remove from the cooling bath and vent to atmospheric pressure in a safe and environmentally acceptable manner.

Figure 2: An example of a cold trap in a vacuum line immersed in a cooling bath.



Highly Reactive, Corrosive or Toxic Gases

- A sorbent canister or scrubbing device capable of trapping the gas should be used.
- Chemical traps for specified chemicals are available from laboratory supply vendors. These traps contain neutralizers that mitigate the hazards of the chemical being collected.

Glassware

- Glassware under vacuum should be kept behind a shield or closed hood sash, taped or resin (plastic) coated.
- Check glass vessels for star cracks, scratching and etching marks each time a vacuum apparatus is used.
- Use only round-bottom or thick-walled (e.g. Pyrex) evacuated reaction vessels specifically designed for operations at reduced pressures.
- Do not use glass vessels with angled or squared edges in vacuum applications unless specifically designed for that purpose (e.g. extra thick glass).
- Repaired glassware should be inspected under polarized light before use in vacuum or thermal operations.
- Never evacuate thin-walled, Erlenmeyer or round-bottom flasks larger than one liter.



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- Glass components of rotary evaporators should be made of Pyrex or similar glass. Enclose apparatus in a shield. Gradually increase rotation speed and vacuum to the flask whose solvent is to be evaporated.
- Glass vacuum desiccators should be made of Pyrex or similar glass and be completely enclosed in a shield or wrapped with friction tape in a grid pattern so as not to conceal the contents. Never carry or move an evacuated desiccator.

Dewar Flasks

- Dewar flasks are under high pressure and can collapse from thermal or mechanical shock. Shield Dewar flasks using a layer of fiber-reinforced friction tape or by enclosure in a wooden or metal jacket. This reduces the risk of flying glass should the container collapse.
- Use metal Dewar flasks when there is a possibility of breakage.
- Styrofoam buckets with lids are a safer alternative for short-term storage and transport of cryogenic liquids.

Other Vacuum Considerations

- An in-line hydrophobic filter may be added to any vacuum line for additional protection to the vacuum system.
- Assemble vacuum apparatus to avoid strain. Joints should allow various sections to be moved without transmitting strain to the flask neck(s).
- Support heavy apparatus by the bottom as well as by the neck.
- Equipment or apparatus under pressure should be located behind a blast shield or inside a closed fume hood.
- If solvents or corrosive substances are drawn into the pump, change the oil before further use to prevent damage to the vacuum. Oil contaminated with solvents and corrosive substances must be handled as hazardous waste.
- Oil and pumps contaminated with mercury must be handled as hazardous waste. Contact EHS immediately at 742-3876 for disposal.
- Keeping a log of pump usage may be desirable to guide length of oil use and potential contaminants in the pump oil.

References

CDC/NIH. *Biosafety in Microbiology and Biomedical Laboratories*. 5th ed. (2009). Appendix A. <https://www.cdc.gov/biosafety/publications/bmbl5/>.

National Research Council. *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version*. (2011). <https://www.nap.edu/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical>.

Appendix AF



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HAZARDOUS WASTE DISPOSAL

- A. In any discussion of hazardous waste, addressing the concept of waste minimization is a must. Minimizing the amount of waste generated can be accomplished in a number of ways. Some are described below.
1. Surplus chemicals can be exchanged among labs, sections, or departments. This applies not only to 'virgin' materials, but to the end products of processes or experiments which could be of use to someone else.
 2. Materials may be distilled to recover them to a point of usability, if not to the original user, to another user on campus. This is greatly facilitated by segregating potential wastes to the extent practical at the point of generation.
 3. Substitution of a less hazardous material for one requiring special handling will not only cut disposal costs, but reduce hazards in the laboratory as well.
 4. Microscale operations reduce the waste volume by proportionately reducing the amount of chemicals input for the reaction.
 5. Steps must be taken to ensure faculty and staff members do not depart until all substances in their work areas are clearly marked as to contents. Compliance with the [Texas Hazard Communication Act \(TAC § 502\)](#) will eliminate most problems of this type, however, the cost of analysis for the identification and hazard classification of unknowns is high enough to make this a cost effective endeavor.
- B. Once it has been determined that the substance can't be exchanged, recycled, or neutralized, contact EHS to arrange for it to be picked up for entry into the waste stream. Waste pickups are made on Tuesday and Thursday of each week. Wastes should not be allowed to accumulate as this presents health and environmental hazards. When requesting EHS to arrange for a waste pick up, you will need to enter in your request online at www.ehs.ttu.edu and have the following information available:
1. Name and telephone number of person requesting pick up
 2. Department and room number where waste is located
 3. Department and room number of requestor, if different than above
 4. A TTU email account
 5. Type of waste
 6. Size of container
 7. Are the containers properly labeled with an orange EHS "Waste" sticker
 8. Has the Transfer of Chemical, Bio Waste, and/or Universal Waste form been completed
 9. Any other information that you feel the person picking up the waste should know.



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- C. EHS has developed labels in various sizes to be affixed to each container of hazardous waste once collection has begun. These labels are available from EHS at no cost. The following areas of the label shall be filled out by the generator.

Contents - List all wastes in the container. (Has to be the full name. Abbreviations and formulas are not acceptable)

Building - Your facility.

Room # - Self-explanatory.

Accumulation Start Date - The date you first placed any waste in the container.

Hazard - Check the appropriate block for the hazard(s) associated with the waste.

- D. When filling out the Request for Transfer of Chemicals form, ensure that the names used in the '*Chemical Description*' block match those on the waste container labels and that there is an appropriate entry in each column with the possible exception of '*Remarks*' and '*Transaction Number*'. The information for the '*Hazardous Characteristics*' column can usually be obtained from the original container or the MSDS; however, if the required information cannot be obtained from either of those sources or from a reference, contact EHS for assistance. All other entries are self-explanatory.

Appendix AG



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GUIDANCE FOR WRITING CARCINOGEN, MUTAGEN, AND TERATOGEN PROCEDURES

Written procedures for work with carcinogens, mutagens, and teratogens shall include the following information as a minimum:

1. Chemical of concern.
 - a. What chemical will be used?
 - b. Identify whether it is a carcinogen, a mutagen, or a teratogen.
 - c. Are there other hazards associated with the chemical? i.e., corrosive, reactive, flammable, toxic, irritant.

2. Physical form of chemical.
 - a. Solid, liquid, or gas?
 - b. Will the form change during the process? i.e., solid placed in solution or liquid phasing into a vapor.

3. Quantity on-hand in the laboratory and the amount used in each procedure.
 - a. How much is present and how is it stored?
 - b. How much will be used for each repetition of the process?

4. Laboratory and specific location(s) in the lab where the chemical will be handled or used.
 - a. Where will it be measured, mixed, etc.?
 - b. Where will the process in which it is used take place?
 - c. Are these areas clearly marked?
 - d. Is the laboratory posted?

5. Administrative controls employed to limit exposure.
 - a. Will all lab workers be using/handling it?
 - b. Will all lab workers be present when it is used/handled?

6. Engineering controls employed to limit exposure.
 - a. Will the use/handling be done in a hood?
 - b. Will the process take place in a hood?

7. Personal protective equipment (PPE) employed to limit exposure.
 - a. Will lab workers be wearing gloves, goggles, face shield, etc.?
 - b. Is the PPE on hand appropriate for this chemical?



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8. Laboratory security measures.
 - a. Are non-essential personnel barred from the lab when operations with this chemical take place?
 - b. Is the storage location for the chemical secure?

9. Medical surveillance.
 - a. Does an OSHA substance-specific standard regarding this chemical exist?
 - b. Has EHS performed exposure monitoring that indicates surveillance is necessary?

10. Informed consent.
 - a. Has every worker in the laboratory been made aware of all the hazards associated with this chemical?
 - b. Have all been trained regarding the necessity of the exposure control portions of this procedure and the potential consequences of failure to comply?
 - c. Is the training documented and acknowledged by signatures of the lab workers?

Include any other information or procedures specific to this chemical or laboratory that may have a bearing on the safety and health of lab workers.



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PROCEDURES FOR WORK WITH CARCINOGENS, MUTAGENS, AND TERATOGENS

- It is the responsibility of the lab workers to be aware of hazards associated with any chemical they use. Information is available from Material Safety Data Sheets found in _____.
- All new workers in the laboratory who will work with carcinogens, mutagens, and teratogens will be trained by one of the following people _____.
- For any chemical used in the laboratory, the lab worker is responsible for being aware of known or suspected hazards. For each known carcinogenic, mutagenic, or teratogenic chemical to be used, the lab worker should identify these and other hazards (i.e. corrosive, reactive, flammable, toxic, irritant) based on available MSDS recommendations available in the laboratory.
- The lab worker should be aware of the physical form of the chemical and any potential phase changes during the experiment.
- The lab worker should be aware of the quantity on hand to be used.
- Opened containers of carcinogens, mutagens, and teratogens should be stored in the labeled area under the hood and used in the hood as indicated in the laboratory.
- Sealed containers of carcinogens, mutagens, and teratogens should be stored according to their hazards.
- Usage of these compounds should be limited to lab workers trained in their safe usage.
- Lab workers should wear Personal Protective Equipment (PPE) including, but not limited to gloves, lab coat, hair restraints, goggles, and any other PPE recommended by the MSDS that is deemed appropriate.
- When working with hazardous chemicals, only group members should be in the lab. To prevent unauthorized usage of chemicals, access must be limited. Access to this lab can be acquired through _____.
- If OSHA monitoring is required, it should be performed by EHS.
- Every lab worker is to receive training in the safe handling of hazardous chemicals and is to document this by signing an informed consent document.
- If you have any questions, please ask _____.

Appendix AH



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PEROXIDE FORMING COMPOUNDS

It is recommended that peroxide forming chemicals be checked for the formation of peroxides or disposed of one year after opening. If peroxides are present, remove the peroxides or dispose of the chemical. These recommendations are from Stephen R. Rayburn, *The Foundations of Laboratory Safety*, 1990 and Jay A. Young, *Improving Safety in the Chemical Laboratory*, 1991.

List of Peroxide Forming Compounds¹

This is not an all inclusive list. It is the responsibility of the laboratory to identify peroxide forming chemicals.

Acetal	Tetrahydrofuran
Acrylic acid	Tetrahydronaphthalene
Butadiene	Vinyl acetate
Chlorobutadiene (chloroprene)	Vinyl chloride
Chlorotrifluoroethylene	Vinyl ethers
Cumene	Vinyl pyridine
Cyclohexene	Vinylidene chloride
Cyclooctene	
Cyclopentene	
Diaactylene	
Dicyclopentadiene	
Diethyl ether	
Diethylene glycol dimethyl ether (diglyme)	
Dioxane (<i>p</i> -dioxane)	
Divinyl acetylene	
Ethyl acrylate	
Ethylene glycol dimethyl ether (glyme)	
Furan	
Isopropanol	
Isopropyl ether	
Methyl acetylene	
Methyl cyclopentane	
Methyl methacrylate	
Methyl-isobutyl ketone	
Potassium amide	
Potassium metal	
Sodium amide (Sodamide)	
Styrene	
Tetrafluoroethylene	



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Detection and Inhibition of Peroxides²

Peroxide Test Strips

Commercially purchased test strips can be used for the detection of peroxide formation (follow the manufacturer's instructions).

Please note that these methods are BASIC protocols. Should a researcher perform one of these methods, all safety precautions should be thoroughly researched.

Ferrous Thiocyanate Detection Method

Ferrous thiocyanate will detect hydro peroxides with the following test:

1. Mix a solution of 5 ml of 1 % ferrous ammonium sulfate, 0.5 ml of 1 N sulfuric acid and 0.5 ml of 0.1 N ammonium thiocyanate (if necessary decolorize with a trace of zinc dust)
2. Shake with an equal quantity of the solvent to be tested.
3. If peroxides are present, a red color will develop.

Potassium Iodide Detection Method

1. Add 1 ml of a freshly prepared 10% solution of potassium iodide to 10 ml of ethyl ether in a 25 ml glass-stoppered cylinder of colorless glass protected from light (both components are clear).
2. A resulting yellow color indicates the presence of 0.005% peroxides.

Inhibition of Peroxides

1. Storage and handling under an inert atmosphere is a useful precaution.
2. Addition of 0.001 % hydroquinone, diphenylamine, polyhydroxyphenols, amino phenols or aryl amines may stabilize ethers and inhibit formation of peroxides.
3. Dowex-1© has been reported effective for inhibiting peroxide formation in ethyl ether.
4. 100 ppm of 1-naphthol is effective for peroxide inhibition in isopropyl ether.
5. Hydroquinone is effective for peroxide inhibition in Tetrahydrofuran.
6. Stannous chloride or ferrous sulfate are effective for peroxide inhibition in dioxane.



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References

1 Copied from *Prudent Practices in the Laboratory*.

2 Copied from the *CRC Handbook of Lab Safety*, 2nd Ed.

Appendix A1



Environmental Health *and* Safety

EXPOSURE ASSESSMENT

1. Assessment versus Monitoring –
Exposure assessment is that portion of the exposure evaluation performed by the laboratory supervisor which involves a judgment based on materials being used, the manner of their use, and personal knowledge of the procedures being performed. Exposure monitoring is that portion of exposure evaluation performed by the CHO, or other persons trained in industrial hygiene sampling techniques, which involves gathering data with direct or indirect reading instruments or equipment. Both methods evaluate employee exposure to some contaminant, with assessment being used as the screening method to determine if monitoring is necessary.
2. Assessment Procedures –
An initial assessment of all laboratory procedures should be performed using the attached checklist. It may include such factors as the amounts and characteristics of the materials used, the frequency and duration of use, and the effectiveness of engineering controls and protective equipment. No exposure monitoring is indicated if laboratory employee exposures to substance(s) regulated by OSHA do not exceed the action level or PEL specified in 29 CFR 1910 subpart Z. Exposure monitoring would be indicated when there is reason to believe exposure levels for the substance(s) used in the areas indicated routinely exceed the action level or PEL.

EXPOSURE ASSESSMENT CHECKLIST	YES	NO
1. Is the procedure performed in a closed system?		
2. Can the procedure be performed inside a lab hood or other containment?		
3. Is the lab hood performing to established standards?		
4. If the substance is highly toxic, is it handled fewer than three times per week, for less than an hour per occurrence?		
5. Have all employees remained free of any of the signs or symptoms associated with overexposure to the substance?		
6. Does historical monitoring data indicate acceptable exposure levels?		
7. Does the written procedure address required personal protective equipment, emergency equipment and actions, work practices, and housekeeping?		
8. Is personal protective equipment appropriate to the hazard?		
<u>If you answered 'NO' to any of these questions, contact the CHO for further evaluation to be performed.</u>		

Appendix AJ



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EQUIPMENT DECONTAMINATION FORM

Equipment from laboratories where hazardous materials, recombinant DNA and/or potentially infectious materials are stored and/or manipulated must be decontaminated before repair, maintenance or removal from the laboratory. It is the responsibility of the PI to ensure that all equipment is properly and adequately decontaminated before it is removed from the work area for surplus or repair. Leave the completed form with the equipment after decontamination for EHS approval. Call EHS at 742-3876 to schedule inspection and clearance of your equipment. (Click [here](#) for a fillable PDF version of this form).

EQUIPMENT LOCATION AND DESCRIPTION

Department: _____ Building: _____ Room: _____

Equipment Description: _____ TTU Inventory Number: _____

Serial Number: _____ Make & Model: _____

EQUIPMENT DESTINATION AND USAGE

This equipment is to be:

- Repaired or Maintained
- Relocated
- Surplus
- Discarded
- Other – Please specify:

If the equipment is being discarded, please indicate the manner in which it will be disposed of below.

This equipment:

- Has never been used with hazardous materials and was last cleaned:
Note: The equipment is required to be cleaned with warm soapy water regardless of use.
- Has been used with the following type(s) of material:
Please list details regarding nature of hazard where applicable.
 - Chemical(s):
 - Biological Agent(s):
 - Radioactive Material(s):

EQUIPMENT DECONTAMINATION PROCESS

- This equipment was decontaminated by a third party.
Attach proof of decontamination provided by the company and PO used for payment to this form.
- This equipment was decontaminated by laboratory personnel.
Attach decontamination procedure to this form.

Name and Title of Personnel

Signature Date

EHS Review and Approval

To be filled out by EHS

Comments: _____

Reviewer: _____ Title: _____

Signature

Date

Appendix AK

LABORATORY DECOMMISSIONING CHECKLIST

BUILDING:				
ROOM:				
PI:				
SURVEY DATE:				
VACATE DATE:				
Section	Area of Interest	Requires completion		
A	General Lab Hazards	Y	N	N/A
1	Remove absorbent material and tape from lab surfaces; dispose of according to hazards in area. Disinfect/decontaminate the lab surface.			
2	Dispose of unwanted paperwork - shred confidential documents.			
3	Empty all drawers and cabinets. Dispose of unusable materials, decontaminate everything else. Divide as give/keep and label boxes.			
4	Dispose of broken glass accordingly.			
5	All extra boxes, trash, packing materials are to be disposed of.			
6	Sweep and mop laboratory with appropriate disinfectant.			
7	Wipe down all laboratory benches, shelves, storage areas, etc. with appropriate disinfectant.			
8	Empty and decontaminate all auxiliary storage areas, cold rooms, alcoves, walk-in freezers, etc.			
9	Carefully evaluate shared storage areas, refrigerators, freezers, cold rooms for materials. Properly arrange transport, transfer or disposal of materials.			

B	Equipment	Y	N	N/A
1	Disinfect and decontaminate ALL equipment for EHS inspection and clearance. Refer to section 9 of the Biosafety Manual for more information.			
2	Remove all thermometers and loose items from equipment. Decontaminate and prepare the equipment according to final destination.			
3	Empty all items from freezers and refrigerators; disinfect and decontaminate inside and outside of unit.			
4	Submit Equipment decontamination forms to EHS for inspection and clearance.			
C	Chemical Hazards	Y	N	N/A
1	Check all cabinets, hoods, drawers, etc. for chemical storage.			
2	Prepare all chemical waste for EHS waste pick up.			
3	Label secondary containers of chemicals to be moved according to the storage group the container is for. Include any pertinent hazard information.			
4	Contact EHS regarding transport of the chemicals to be moved to a new location.			
5	Contact EHS regarding the transfer of any unopened/opened chemicals to a different PI.			
6	Dispose of all mercury thermometers as hazardous waste.			
7	Return empty gas cylinders to the vendor. Contact EHS for disposal of non-returnable gas cylinders.			
8	Cap and secure tanks containing gas. Contact EHS regarding transfer to new campus location or return to the vendor.			
9	Contact EHS for destruction of DEA Controlled Substances.			
10	Contact EHS to discuss chain of custody for keys to lockable storage cabinets.			

D	Biological Hazards	Y	N	N/A
1	Decontaminate all work surfaces, door knobs, draw handles, etc. with an effective antimicrobial cleaner.			
2	Disinfect of all biological waste by autoclaving or schedule a waste pick up with EHS.			
3	Dispose of sharps in appropriate container and a scheduled a waste pick up with EHS.			
4	Disinfect all equipment. Laminar hoods and biosafety cabinets require fumigation by a third party. See section 9 of the Biosafety Manual for details.			
5	Empty and disinfect all refrigerators, freezers, cold rooms, incubators, etc. Wipe down all interior/exterior surfaces and components with disinfectant.			
6	Contact EHS for transfer of biological materials. The recipient may need to obtain IBC approval.			
7	Contact EHS regarding the transport of biological materials. If the materials are under an IBC protocol, a new protocol is needed for on-campus transfers.			
8	Contact EHS for destruction of Select Agents			
E	Radiation Hazards	Y	N	N/A
1	Notify the Radiation Safety Officer of the move. The RSO will direct decommissioning of the laboratory.			

F	Laboratory - Specific Considerations in Decommissioning	Y	N	N/A
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

If you have any questions or require assistance at any point in time during the move, do not hesitate to contact EHS at 806-742-3876. Please do not work with chemical, biological or radioactive hazards during non-business hours so that EHS can quickly address any issues/emergencies which may arise.

Appendix AL

FORMS

The following forms are included in this section as printable documents for your convenience. These forms are also available on the EHS website. The Near-Miss Form (SCAN) and the Hazardous Waste Pick-Up Form are only available on-line through the EHS website. Please contact EHS with any questions at 806-742-3876.

Link for Near-Miss reporting (SCAN):

<http://www.depts.ttu.edu/ehs/about/scan.php>

SCAN QR-Code



Link for Incident Reporting (damage to property or person, exposure):

<https://www.texastech.edu/offices/risk-management/>

Risk Management QR-Code



Link for Hazardous Waste Pick-Up request:

<https://www.depts.ttu.edu/ehs/forms/waste-request.php>

Waste Request QR-Code



Forms included in Appendix AL:

- Initial Investigation of Overexposure Form

Submit form via fax to 806-742-3895 or scan and email to ehs.lab.safety@ttu.edu.
For questions, call 806-742-3876, Environmental Health & Safety, Administrative Support Center, Rm 122.

INITIAL INVESTIGATION OF POSSIBLE OVEREXPOSURE

(To be completed by PI/Lab Supervisor/Departmental Representative)

Date of incident: _____ Date of interview: _____

Name of Person: _____ Telephone No.: _____

Department: _____ Immediate Supervisor _____

Name of Chemical(s) in use: _____

If available, attach relevant MSDS to this report.

Time and Date of Incident : _____

Length of exposure (hour/minutes): _____ Amount of Chemical involved in ounces: _____

Control measures used at time of incident: _____

Laboratory Hood or Splash Shield: _____

Personal Protective Equipment: ___Gloves ___Goggles ___Face Shield ___Lab coat ___Other

Description of Incident _____

Witnesses: _____

Location of injuries or sites of contact, e.g. eyes, skin: _____

Additional Information: _____

PHYSICIAN'S WRITTEN OPINION FOR MEDICAL CONSULTATION

(To be completed by Attending Physician)

Physician's Name: _____ Employee Name: _____

Company: _____ Date of Visit: _____

Description of incident: _____

Result of medical examination*: _____

* This written opinion shall not reveal specific findings of diagnosis unrelated to occupational exposure.

Medical examination revealed employee to be at an increased risk as a result of exposure to a hazardous chemical in the workplace: _____

Recommended medical follow up: _____

Comments: _____

The above referenced employee has been informed by me of the results of this consultation and related medical condition that may require further examination or treatment.

Physicians Signature

Date

Appendix BA

Biological Laboratory Requirements

The checklists below will be referenced as needed by the IBC to evaluate a space for special research. Other references as mentioned in B5.2, B5.3, and B5.4 will also be referenced to properly evaluate containment needs. EHS and the IBC will also reference these checklists during certification of lab spaces and annual inspections.

Biosafety Level 1 (BSL1) see B9.2.2.1

Biosafety Level 2 (BSL2) see B9.2.2.2

Animal Biosafety Level 1 (ABSL1) see B9.2.3.1

Animal Biosafety Level 2 (ABSL2) see B9.2.3.2

Arthropod Containment Level 1 (ACL1) see B9.2.3.3

Arthropod Containment Level 2 (ACL2) see B9.2.3.4

Plant Containment Level 1 (PCL1) see B9.2.3.5

Plant Containment Level 2 (PCL2) see B9.2.3.6

The checklists can be found on the [EHS Tools, Templates, & Posters](https://www.depts.ttu.edu/ehs/academicsafety/lab/tools-templates.php) page:
<https://www.depts.ttu.edu/ehs/academicsafety/lab/tools-templates.php>

CDC Import Permit Program

BSL2

https://www.cdc.gov/cpr/ipp/inspection/docs/Import_Permit_Checklist_BSL-2.pdf

BSL3

https://www.cdc.gov/cpr/ipp/inspection/docs/Import_Permit_Checklist_BSL-3.pdf

ABSL2

https://www.cdc.gov/cpr/ipp/inspection/docs/Import_Permit_Checklist_ABSL-2.pdf

ABSL3

https://www.cdc.gov/cpr/ipp/inspection/docs/Import_Permit_Checklist_ABSL-3.pdf

ACL2

https://www.cdc.gov/cpr/ipp/inspection/docs/Import_Permit_Checklist_ACL-2.pdf

ACL3

https://www.cdc.gov/cpr/ipp/inspection/docs/Import_Permit_Checklist_ACL-3.pdf

Appendix BB

CHARACTERISTICS OF COMMON DISINFECTANTS

	Sodium Hypochlorite (Bleach) 5.25%	Phenols	Quaternary Ammonium Compounds (Quats)	Hydrogen Peroxide	Alcohols	Iodophors
Usable Concentration	1% to 20%	As directed	As directed	3%-8%	60-80%	As directed
Shelf Life	Unmixed: Expiration on container Mixed: 24hours	Check expiration on container	Check expiration on container	Check expiration on container	Check expiration on container	When solution is pale yellow to colorless
Inactivated by Organic Matter	YES	YES	YES Except 4th-generation quats	YES	NO	YES
Irritant	YES	YES	YES	YES, >6%	YES	YES
Other Health Concerns & Hazards	REFER TO SDSs					
Corrosive	YES			YES, >10% Not appropriate for use with certain metals.	NO	YES
Residue	YES	YES	YES	NO	NO	YES
Protective Controls	PPE and ventilation.					
Toxicity	Toxic to aquatic organisms.	Toxic to all animals including aquatic organisms. Remains persistent in the environment. Subject to disposal restrictions.	Toxic to aquatic organisms.			Toxic to aquatic organisms.

Disinfection chart adapted from Cleaning for Health. <http://www.cleaning-for-health.org/disinfectant-chart/> and the CDC [Guideline for Disinfection and Sterilization in Healthcare Facilities](#). 2008.

Appendix BC

SELECT AGENT LINKS

Center for Disease Control & United States Department of Agriculture Select Agent Information
<https://www.selectagents.gov/>

Bureau of Industry & Security - Export Administration Regulations (EAR)
<https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear>
Microorganism & Biological Toxin location - Chapter 1 Sections 1C351-1C354

Appendix BD

BIOLOGICAL SAFETY CABINETS

Placement:

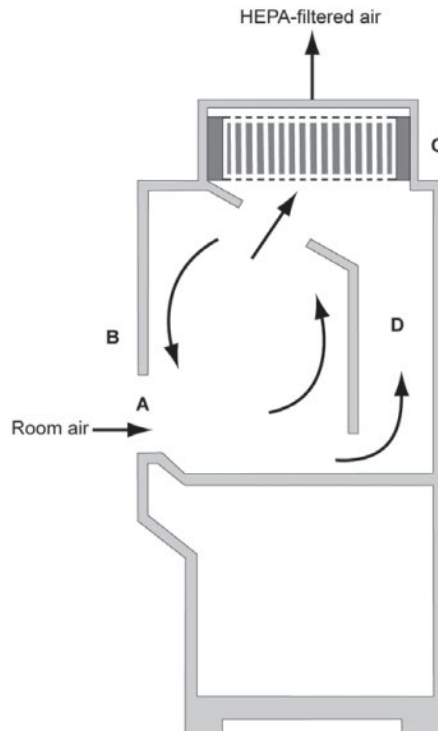
https://absa.org/wp-content/uploads/2019/05/NIH-BSC-Placement_Dos_and_Donts.pdf

Additional information can be found in Appendix A of the BMBL, pg. 370-395. Figures have been taken from Appendix A of the BMBL.

Class I

- Protect personnel and the environment but not research materials.
 - Provide an inward flow of unfiltered air, similar to a chemical fume hood, which protects the worker from the material in the cabinet. The environment is protected from biological contamination by HEPA filtration of the exhaust air before it is discharged into the laboratory. Cabinet can also be ducted to the outside via the building exhaust. See Figure 1.
- Can be used for handling BSL 1, 2 and 3 materials.
- Cannot be used with volatile or toxic chemicals unless ducted to the outside with proper environmental protection measures in place.

FIGURE 1. Class I BSC: A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Exhaust plenum



Class II

The National Sanitation Foundation and American National Standards Institute have set forth a standard for certification of Class II BSCs. This standard, NSF/ANSI 49, covers the basic requirements for design, construction and performance parameters to provide protection and a variety of other standards, such as electrical safety and noise level, in addition to evaluation and decontamination procedures.

- 4 types of Class II BSC: A1, A2, B1, B2 and C1
- Provide personnel, environment, and product protection.
 - Air is drawn around the operator into the front grille of the cabinet, which provides personnel protection. In addition, the downward laminar flow of HEPA-filtered air within the cabinet provides product protection by minimizing the chance of cross-contamination along the work surface of the cabinet. Because cabinet air passes through the exhaust HEPA filter, it is contaminant-free (environmental protection).
- Can be used for handling BSL 1, 2 and 3 materials.

Type A: Figures 2 and 3.

- 70% air is recirculated in cabinet; 30% air is exhausted into the laboratory
- A1: 75 FPM air intake; biologically contaminated ducts/plenums are positively pressured to room; not for use with toxic or volatile chemicals or gases regardless of ducting
- A2: 100 FPM air intake, biologically contaminated ducts/plenums are negatively pressured to room; not for use with toxic or volatile chemicals or gases if exhausted to room – if chemicals are to be used, additional measures to protect the environment may be needed.
 - Previously, there had been a Type B3 cabinet; this cabinet type has been eliminated by the National Sanitation Foundation and units which are listed as B3 are categorized as type A2; new A2 units are not equivalent to B3 unless connected the building exhaust.

Type B: Figures 4, 5 and 6.

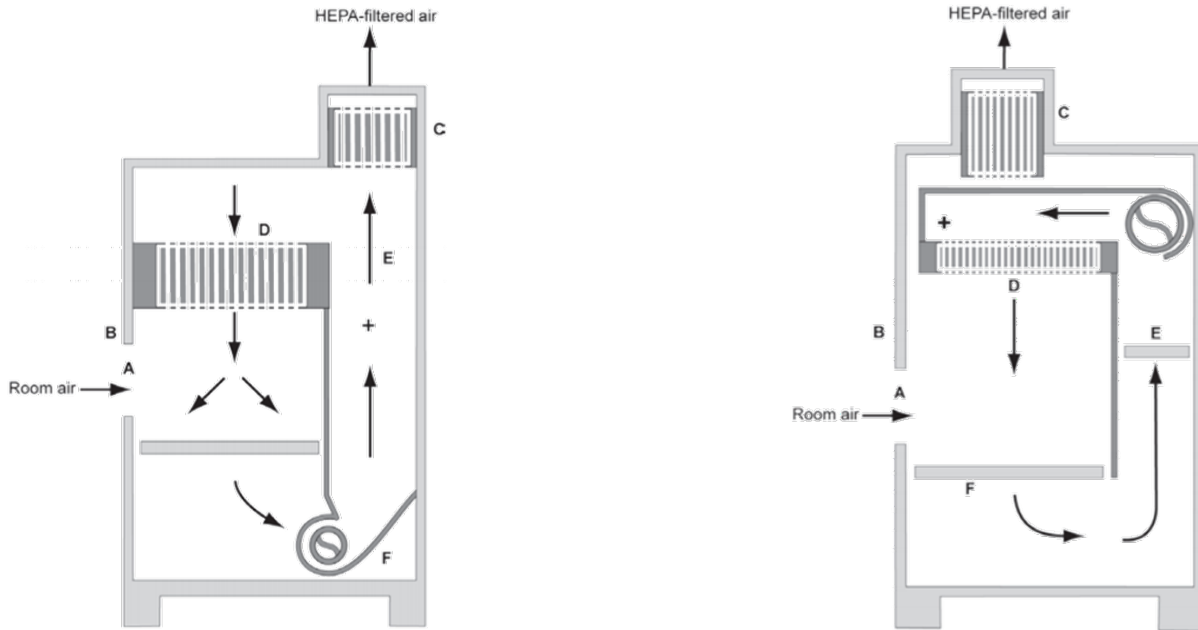
- 100 FPM air intake
- Exhausted air must be ducted to the outside of the building
 - offers protection to the environment from biologicals
 - environmental protection from chemicals requires additional measures
- B1: 40% of air is recirculated and 60% is exhausted; biologically contaminated plenums are negative to the room or surrounded by negative pressure plenums; chemical use is restricted, contact EHS.
- B2: 0% of air is recirculated and 100% is exhausted; biologically contaminated ducts are under negative pressure or surrounded by negative pressure ducts or plenums; chemical use is allowed so long as additional measures are in place to protect the environment.

Type C1: Figure 7

- 100 FPM air intake
- 30% recirculated, 70% exhausted. Exhaust cabinet air must pass through a dedicated, internal cabinet duct to the outside through a blower and HEPA filter; may be ducted to switch from A2 equivalent to mimic function of B1 cabinet.

Left: FIGURE 2. Class II, Type A1 BSC: A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Supply HEPA filter; E) Common plenum; F) Blower/fan.

Right: FIGURE 3. Class II, Type A2 BSC: A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Supply HEPA filter; E) Positive pressure common plenum; F) Negative pressure plenum



Left: FIGURE 4. Class II, Type B1 BSC: A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Supply plenum; E) Supply HEPA filter; F) Blower/fan; G) Negative pressure exhaust plenum (ducted to building)

Right: FIGURE 5. Class II, Type B1 BSC Classic style: A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Supply HEPA filter; E) Negative pressure exhaust plenum (ducted to building exhaust); F) Blower/fan; G) additional HEPA filter for supply air

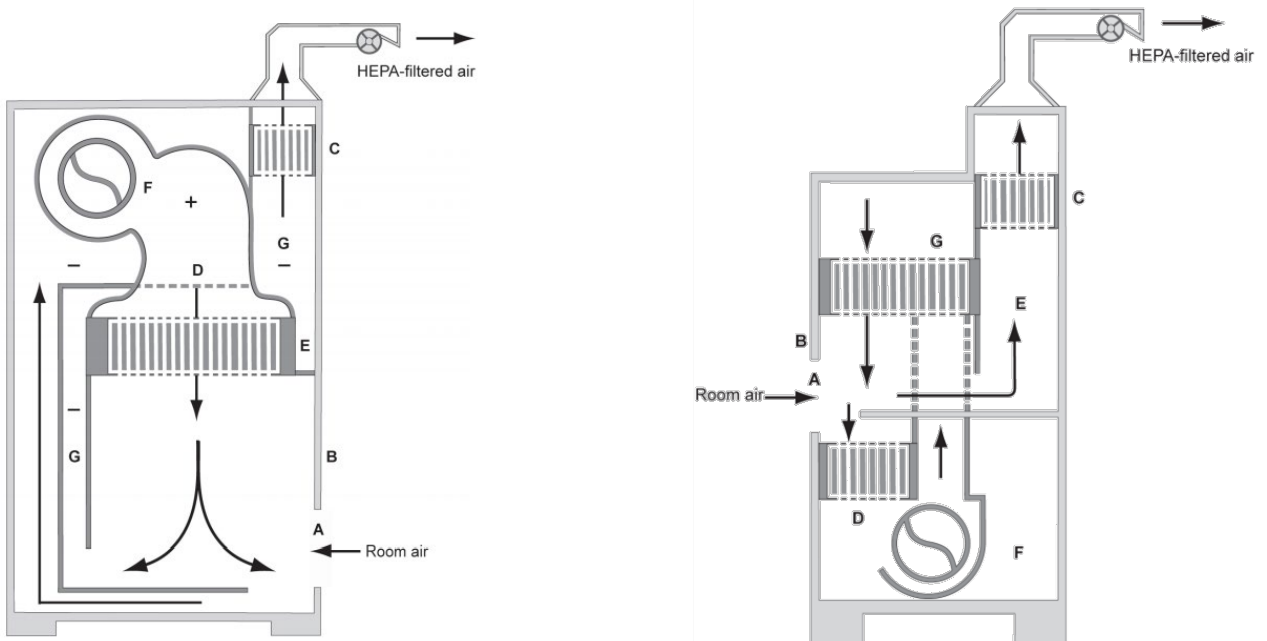


FIGURE 6. Class II, Type B2 BSC: A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Supply HEPA filter; E) Negative pressure exhaust plenum (ducted to building exhaust with additional filters for chemical use).

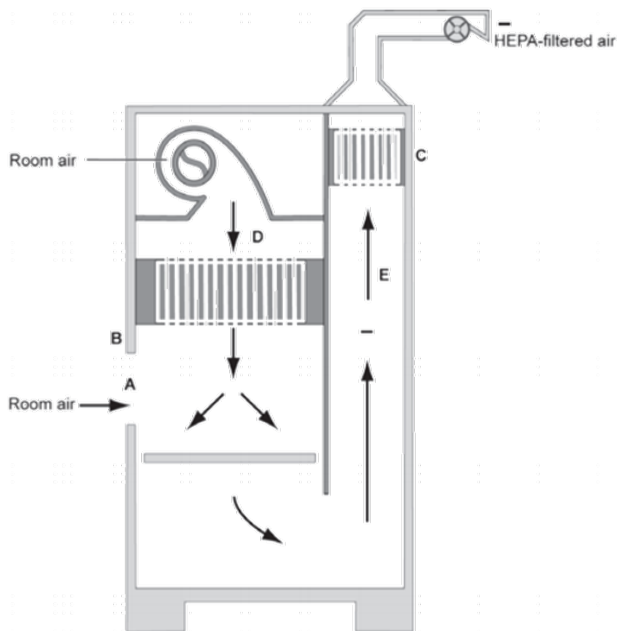
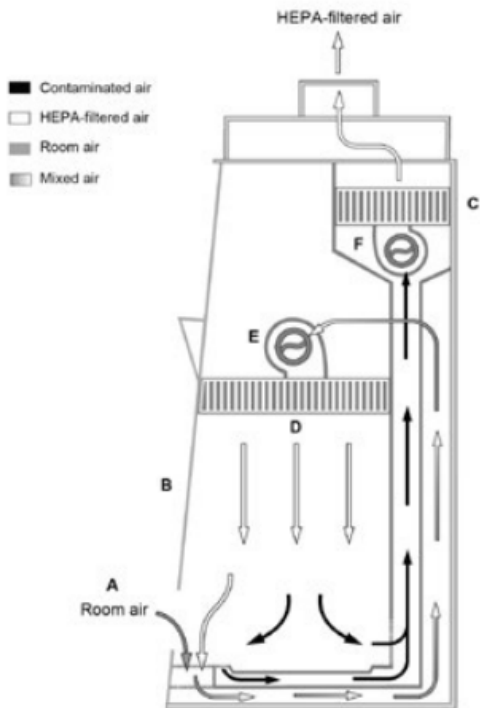


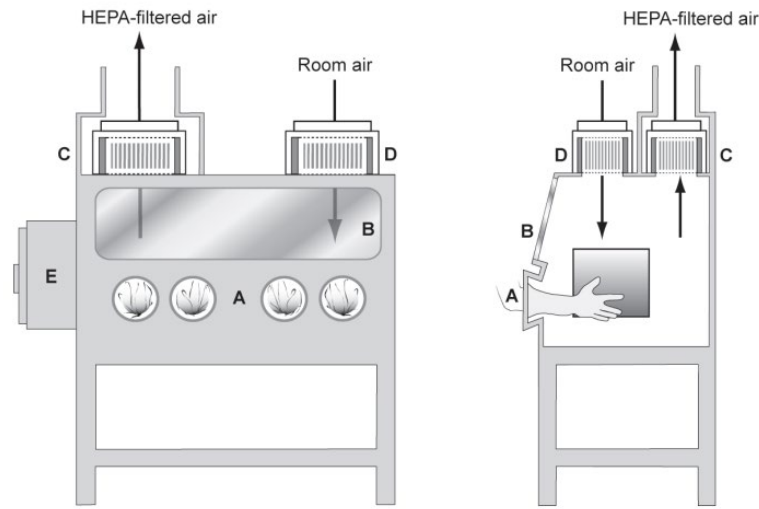
FIGURE 7. Class II, Type C1 BSC A) Front opening; B) Sash; C) Exhaust HEPA filter; D) Supply HEPA filter; E) Supply Blower, F) Exhaust Blower.



Class III

- Also called a glove box or total containment cabinet
- Designed for work with highly infectious agents that require BSL4 containment
- Provides the highest level of personal, environmental, and product protection
 - The cabinet is gas-tight with a non-opening view window, and has rubber gloves attached to ports in the cabinet that allow for manipulation of materials in the cabinet. Air is filtered through one HEPA filter as it enters the cabinet, and through two HEPA filters before it is exhausted to the outdoors.

FIGURE 8. Class III: A) Glove ports; B) Sash; C) Exhaust HEPA filter (double HEPA or HEPA then incinerated and exhausted outside the building; D) Supply HEPA filter; E) autoclave or pass-through box



Appendix BE

Periodic Autoclave Testing & Reporting

Environmental Health & Safety

SOP No. 5.4

	Print Name	Initial	Title	Date
Author	Rebecca Maloney		Biosafety Mngr.	
Reviewed by	Heather Coats		Training & Outreach Mngr.	
Authorized by	Matt Roe		Director, EHS	

DATE CREATED: NOV 2016

LAST REVISED: 16JUN2021

REVISION NO.: 2

Purpose

Materials that may be considered biohazardous, including contaminated equipment and lab ware, must be rendered non-infectious prior to washing, storage, or disposal. To ensure health and safety, it is a matter of Texas law that all biohazardous materials, items potentially contaminated with such materials, items that could be mistaken for medical or biohazardous waste (e.g., agar plates used to grow non-pathogenic microbes) or items that have come in contact with biological materials must be decontaminated prior to disposal.

“Moist heat in the form of saturated steam under pressure is the most widely used and the most dependable means to destroy microorganisms¹.” Operational standards require that the autoclave reach a temperature of not less than 121° C (250° F) for 30 minutes at 15 pounds per square inch pressure to effectively sterilize the load contents. A variety of factors can affect the efficiency of an autoclave; therefore, regular testing of autoclaves to ensure sterilization conditions for temperature, time, and pressure are reached is crucial to insure sterilization and regulatory compliance. Information regarding autoclave use and testing can be found in detail in section B.8.4 of the Texas Tech University Biosafety Manual.

Responsibilities

It is the responsibility of the principal investigator for each lab that uses an autoclave to develop lab-specific internal standard operating procedures for each autoclave/steam sterilizer for which they are responsible. The procedure must address each of the following cycle parameters:

- Time
- Temperature
- Pressure
- Type of waste
- Type of container(s)
- Closure on container(s)
- Pattern of loading
- Water content
- Maximum load quantity
- Internal periodic testing to insure the equipment is in working condition

This standard operating procedure (SOP) outlines the elements that should be considered and included as appropriate in lab-specific autoclave procedures. This lab procedure should also include a means to ensure that training, recordkeeping, and testing is conducted for each autoclave in a lab or used by their lab personnel. All personnel using autoclaves must be adequately trained by their PI or lab supervisor. Never allow untrained personnel to operate an autoclave. Please refer to section B.8.4 of the Texas Tech University Biosafety Manual for more details regarding autoclave use and regulations prior to drafting a laboratory-specific SOP. **The EHS-provided Autoclave Training is required for all autoclave users.**

Summary of Recommended Standard Practices

- Review the operator's manual for instructions prior to operating the unit. Different makes and models have unique characteristics. Never exceed the maximum operating temperature, pressure and load volume of the autoclave.
- Wear the appropriate personal protective equipment (safety glasses, lab coat and heat-resistant gloves) when loading and unloading the autoclave. Often a pulse of hot steam escapes when the hatch is opened. Stand on the back side of the hatch and not too close when opening an autoclave.
- Place autoclavable bags on their side in a secondary containment to retain any leakage that might occur - never place autoclave bags directly in the autoclave chamber. The secondary containment vessel must be constructed of material that will not melt or distort during the autoclave process.
 - Polypropylene is a plastic used for such secondary containers. It is capable of withstanding autoclaving but is resistant to heat transfer. Materials contained in a polypropylene pan will take longer to autoclave than the same material in a stainless-steel pan.)
 - Autoclave bags shall be loosely secured with autoclave tape or a twist tie. Knotting or twisting closed the top of the bag will interfere with proper autoclaving of the contents.
- Lab personnel must use heat-sensitive tape or other device to visually check that optimal temperatures have been achieved on each container in a load that is processed.
- Load parameters for every load or biohazardous waste must be recorded by personnel on the record sheet. Please see attached log sheet.
- Autoclaves will be evaluated at least annually with a biological indicator by EHS. A laboratory may voluntarily self-test more frequently if desired at their own expense.
- Autoclaves which process biowaste shall be evaluated by laboratory personnel monthly or at the following applicable frequency:
 - for laboratories of more than 50 pounds but less than or equal to 100 pounds per month, testing shall be conducted at least once per month;
 - for laboratories of more than 100 pounds but less than or equal to 200 pounds per month, testing shall be conducted at least biweekly; and
 - for laboratories of more than 200 pounds per month and persons that treat medical wastes off-site, testing shall be conducted at least weekly.
- EHS will supply the biological indicators for required state testing.
- It is recommended that testing be performed on a Friday so that the weekend can be used for required incubation time. This minimizes the number of potentially failed autoclave runs in the event of a positive test.

- A report form must accompany all vials.
- Autoclaves require testing after installation and any service.
- Testing of units on main campus should coordinate the test date with the biological safety officer. Please submit questions, comments, or other assistance to EHS at safety@ttu.edu or call EHS at 806-742-3876.

Use of Biological Indicators

EHS will be assisting in monitoring autoclave performance by providing bioindicators for state-required testing. In most cases, EHS will incubate the BI after the cycle and provide results to the users. Certain remote campuses will incubate their BI and provide the test results to EHS. Biological indicators (BIs) contain *G. stearothermophilis* spores and a nutrient broth and are supplied in a serializable pouch bearing chemical indicators.

- **Do not open or adjust the pouch closure.** The pouch serves as a “challenge pack” and will help contain the bio-indicator material in case of accidental breakage.
- Currently, EHS provides Steris Dual Species Self-Contained BIs that can be used to assess a variety of autoclave settings including 121C/30min gravity steam sterilization cycles for packaged items (i.e., biowaste). Please inquire about other cycles as needed.
- More than one BI may be required to test an autoclave depending on capacity.
- Avoid running BIs on Fridays or the day before a scheduled university closure to allow for incubation during the work week.

Instructions for indicator use are outlined below.

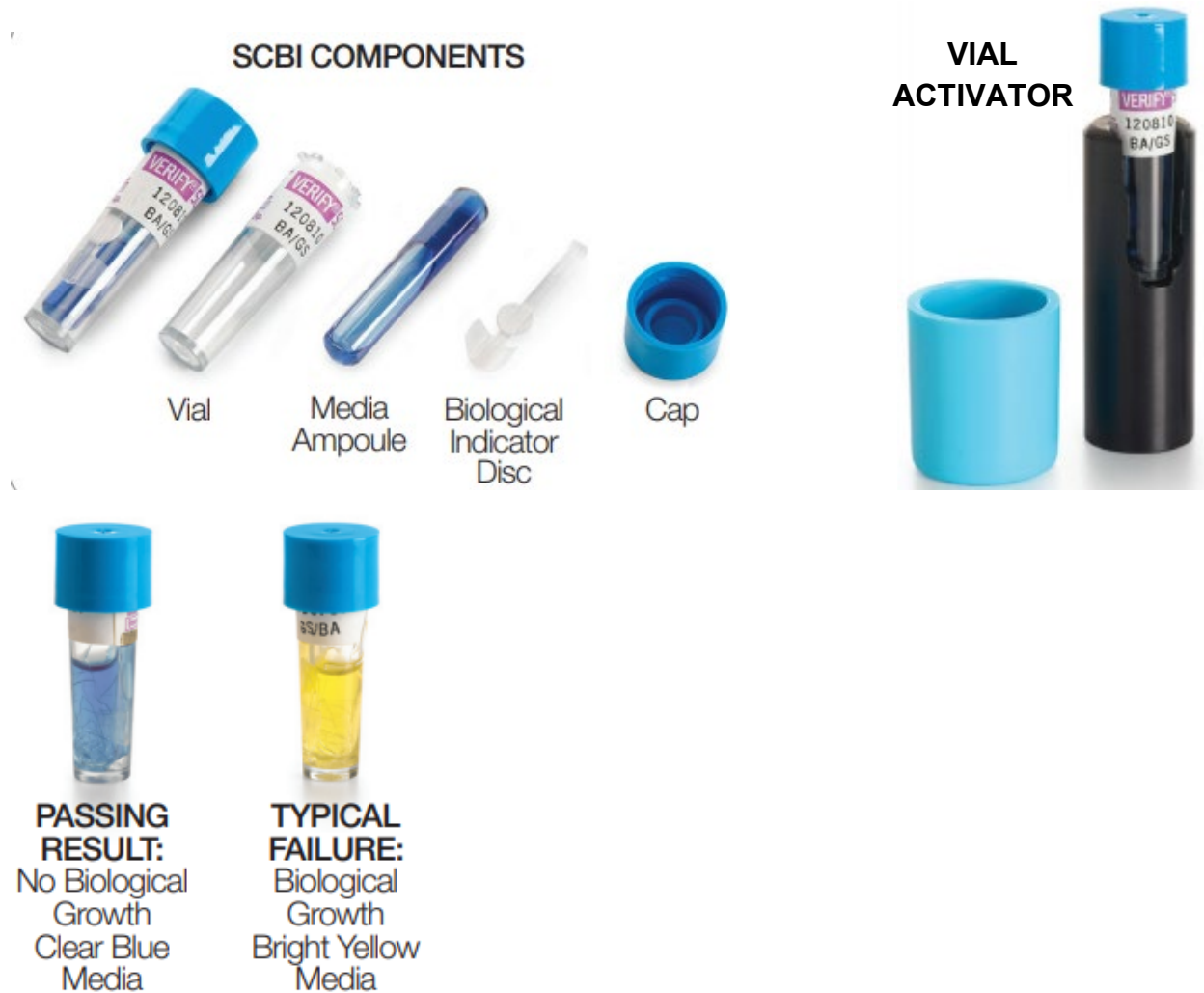
1. Do not open the pouch. Place the pouch in the most challenging location for sterilization (refer to your model’s instruction manual). Run a biowaste cycle. Other cycle options for testing are as follows: pre-vac, gravity 30, wrapped, or other cycle recommended by manufacturer for testing.
2. After completion of the cycle:
 - a. For on campus locations, remove the pouch from the load and notify EHS for vial pick-up.
 - b. For those on remote campuses that incubate their own BIs, remove the BI from the pouch. Observe the chemical process indicator for color change (blue to brown) on both the vial and the pouch.
 - c. Seal the BI by using the activator set to close the lid to the vial. Label the vial with the autoclave tested. The BI is properly activated when the culture media is released from the crushed media ampoule and the spore disc contacts the media. Repeat step ‘c’ for the positive control BI (unautoclaved BI from same lot). Transfer test BIs and control BI to an incubator set between 55C-59C.
 - d. Evaluate vials after 24hrs. A color change from blue/purple to yellow or presence of turbidity are indicative of a failed test. If the control BI does not turn yellow, should be considered invalid and repeated. Heat exposure outside the manufacturer’s guidelines can result in damage to the media components that results in a tan appearance to the media ampoule; this is an invalid result.
 - e. Document results on the report form.

Failed Tests

In the event a test fails or is otherwise invalid proceed as follows:

1. Post an "Out of Service" sign on the autoclave. Contact the service contract personnel to initiate a service call.
2. Do not use the autoclave until it has been inspected, repaired and successfully challenged with a biological indicator.

Testing Components and Results



References

1. Rutala, W.A., Weber, D.J., Healthcare Infection Control Practices Advisory Committee. CDC. Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008.
2. Texas Tech University Biosafety Manual.



TEXAS TECH UNIVERSITY

Environmental Health *and* Safety

Periodic Autoclave Testing Report Form

If using EHS assistance for incubation, please complete this form and submit with the test vial.

If you have questions, comments or need assistance in incubation, please contact ehs.lab.safety@ttu.edu

STERILIZER TEST DATA

Please fill in all information requested for complete and accurate results.

Principle Investigator Name: _____

Office Phone: _____ Office Fax: _____

Operator Name (in CAPS): _____

Operator Signature: _____

Building Name: _____ Room No.: _____

Sterikon Vial ID: _____ Date of Test: _____

Make: _____ Asset Tag No.: _____

Model: _____ Serial No.: _____

Temperature: _____ degree C/F Exposure time: _____ minutes Pressure: _____ psi

Autoclave is used to sterilize the following items: _____

Lab Process involves: _____ BSL Level: _____

FOR EHS USE ONLY – DO NOT WRITE BELOW THIS LINE

Date Received: _____

Test Results:

- Positive
 Negative (No Growth)
 Invalid (No growth in Control)
- Autoclave Passed
 Autoclave Failed
 Retest required

Evaluated by (PRINT): _____ Date: _____

Signature: _____

Appendix BF

Appendix BG

Use of EHS-provided Biobarrels

Environmental Health & Safety

SOP No. 6.5

	Print Name	Initial	Title	Date
Author	Rebecca Maloney		Biosafety Manager	18FEB2021
Reviewed by	Eric Quintela		Environ. Protection Manager	26MAR2021
Authorized by	Matt Roe		Director, EHS	29MAR2021

DATE CREATED: 08FEB2021

LAST REVISED:

REVISION NO.:

PURPOSE

This SOP describes the proper use and preparation of EHS-provided biological waste barrels (biobarrels) for biowaste management at Texas Tech University. Biobarrels are generally used in areas that lack autoclaves for biowaste treatment. Waste disposed of in biobarrels is transferred to a third-party vendor for treatment and final disposal.

NOTES

Biobarrels are not the primary or singular means of biowaste containment in an area in most instances. Biobarrels are supplied with biohazard liner; this liner is required for use and to be used as a liner only. Proper waste segregation is required for use of EHS biobarrels. Improper use endangers biobarrel users, downstream biobarrel handlers, and costs the university money when biobarrels are overweight and/or used for non-biohazardous items.

Failure to comply with biobarrel use requirements use may result in issuance of corrective actions and/or delayed pick-up. Serial non-compliance may result in revocation of biobarrel services in areas of elective biobarrel use when other approved methods of biowaste management are accessible.

PROTECTIVE EQUIPMENT

Campus area will dictate PPE (i.e. clinic vs lab). Standard PPE applies when utilizing biobarrels:

- ✓ laboratory coat or other outer protective garment as required by the area-specific requirements
- ✓ eye protection (goggles or safety glasses) as required by the area-specific requirements
- ✓ latex or nitrile gloves

PROCEDURE

I. ACCUMULATION OF BIOWASTE – IMMEDIATE AREA OF GENERATION

1. Waste items are disposed of in the immediate area of generation into smaller biowaste-labeled receptacles lined with biohazard-labeled polypropylene bags or Keeper™ boxes.
 - a. Solid biowaste disposal is the primary purpose for biobarrels. Liquids should be kept to a minimum in biobarrels. If you need advice on options for disposing of

you liquid biowaste, contact EHS at 806.742.3876 to speak with the Biological Safety Officer.

- b. Chemicals, other hazardous waste, and non-biohazardous waste are not disposed of in biobarrels. Disposal of these materials in the biobarrels will result in revocation of biobarrel services.
2. When area accumulation reaches $\frac{3}{4}$ full, secure the top of the bag; transfer the bag to a leak-proof container to transport the waste to the biobarrel.
 - a. DO NOT compress biological waste in the bags. This causes contamination to the worker, often compromises the bag, and can result in unnecessary exposure.
 - b. Transport bags with containment to prevent spills and unintentional exposure (It's also required by the BMBL.).
 - c. Disinfect the inside of the transfer container and area biowaste receptacles regularly and anytime a spill is evident.

II. ACCUMULATION OF BIOWASTE – BIOBARRELS

1. Remove the lid to the biobarrel, add your bag, then secure the lid back in place.
 - a. Biobarrels shall remain closed except when waste is actively being added to the biobarrel.
2. You may continue using the same biobarrel until the bag is $\frac{3}{4}$ full or it weighs 40 lbs. You can use a simple home scale to estimate weight of the biobarrel; weighing is best completed with 2 people.
 - a. There is no minimum weight requirement to request a biobarrel pick up.
 - b. Biobarrel weights cannot exceed 40lbs. This is a requirement of the waste management vendor and exceeding the limit results in fines that can be passed on to the generator (i.e., biobarrel user).
 - c. Biobarrel cannot be filled beyond $\frac{3}{4}$ full. The head space in the biobarrel allows the user to safely tie off the biobarrel liner for pick-up and prevents excessive weight.
 - d. Do not compress biological waste in the biobarrel. This practice can cause unnecessary contamination to the worker, often compromises the individual biobags or biobarrel liner, and can result in exposure.
 - e. If you accidentally overfill your biobarrel, simply remove a bag or two and transfer to another biobarrel. Containing your waste in the smaller bags allows this to be done safely.

III. PREPARING YOUR BIOBARREL FOR EHS PICKUP

Plan ahead – there is no minimum required weight in the biobarrel to request a waste pickup. When your biobarrel has reached the conditions outlined in Section II.2 above or you are otherwise ready for EHS pickup, follow the steps below.

1. Place a waste request online through the EHS website:
<https://www.depts.ttu.edu/EHS/>. The form is located under the Quick Links > Request Forms > Submit a Waste Request.
 - a. Select the Biological Waste option and complete the form. You will receive an email regarding your request if submission was successful.
2. Before EHS arrives at your area to pick up your biobarrel, take the following steps to make sure your barrel is ready to go.
 - a. Weigh your biobarrel to make sure it is not over 40lbs.
 - b. Tie off your biobarrel liner and secure the lid.

EMERGENCY PRE-PLANNING

- Post SOPs for managing biological spills and exposures near the location of the biobarrel.
- Keep a biological spill kit near the biobarrel.

REFERENCES

Links to the University Laboratory Safety Manual, Posters, SOPs, and Waste Request Form are available through the Academic Safety Resources webpage:

https://www.depts.ttu.edu/ehs/academicsafety/labsafety_resources.php

Biosafety and Microbiological and Biomedical Laboratories, 6th ed.

University Laboratory Safety Manual

Using EHS Biobarrels poster

EHS SOP 3.1: *Transporting Biological Materials*

EHS SOP 8.2: *Managing Biological Spills*

ACKNOWLEDGMENT OF PROFICIENCY

The individuals below have been trained and are competent in completing the above procedure.

Worker Name	Worker Signature	Date	Supervisor Initial	Date

Appendix BH

LINKS

Biosafety Homepage

<https://www.depts.ttu.edu/ehs/academicsafety/Biosafety/index.php>

Academic Safety Resources

Access to the LSM, tools & templates, Raider RAMP and more.

<https://www.depts.ttu.edu/ehs/academicsafety/resources.php>

IBC Committee Homepage

IBC Charge & Membership, links to application documents and information regarding review process

<https://www.depts.ttu.edu/ehs/academicsafety/icc/ibc.php>

IBC Toolbox

Guides for using Cayuse and creating protocols, researcher manuals, personnel forms and assurances.

https://www.depts.ttu.edu/ehs/forms/TTUIBC_ResearcherToolbox.php

Cayuse Homepage

<https://ttu.esirius.cayuse.com/>

Appendix CA

REFERENCE INFORMATION

Glossary of Terms

This section lists information pertinent to radiation safety and is considered to be a part of this manual. The definitions in this glossary will not cover every term associated with radiation but does cover a majority of the terms. If a term should be encountered in your work with radiation and is not in this glossary, consult your supervisor or call the TTU Department of Environmental Health and Safety.

Radiation Terms

ABSORBED DOSE: The amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material.

ABSORPTION: The phenomenon by which radiation imparts some or all of its energy to any material through which it passes.

ACTIVITY: The number of nuclear disintegrations occurring in a given quantity of material per unit time.

ADMINISTRATIVE PENALTIES: Means a monetary penalty assessed by the Bureau of Radiation Control for violations of the **TRCR (TAC)** and/or local policies and procedures, to deter future violations and to assure continued compliance.

AIRBORNE RADIOACTIVE MATERIAL: Means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases.

ALPHA PARTICLE: A strongly ionizing particle emitted from the nucleus during radioactive decay having a mass and charge equal in magnitude to a helium nucleus.

ALPHA RAY: A stream of fast moving helium nuclei (alpha particles), a strongly ionizing and weakly penetrating radiation.

ANALYTICAL X-RAY EQUIPMENT: Means x-ray equipment used for x-ray diffraction, florescence, or spectroscopy.

ANALYTICAL X-RAY SYSTEM: Means a group of local and remote components utilizing x-rays to determine the elemental composition or to examine the microstructure of materials. Local components include those that are struck by x-rays such as radiation source housing, port and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors, and shielding. Remote components include power supplies, transformers, amplifiers, readout devices, and control panels.

ANNIHILATION: An interaction between a positive and negative electron; their energy, including rest energy, being converted into electromagnetic radiation (annihilation radiation).

ANNUAL LIMIT ON INTAKE (ALI): Derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year.

ATOM: Smallest particle of an element which is capable of entering into a chemical reaction.

AUTORADIOGRAPH: Record of radiation from radioactive material in an object made by placing the object in close proximity to a photographic emulsion.

BACKGROUND RADIATION: Ionizing radiation arising from radioactive material other than the source directly under consideration.

BETA PARTICLE: Charged particle emitted from the nucleus of an atom, having a mass and charge equal in magnitude to an electron.

BETA RAY: A stream of high speed electrons or positrons of nuclear origin. Higher penetration but less ionization than alpha rays.

BRC: Means Bureau of Radiation Control a division of the Texas Department of Health.

BREMSSTRAHLUNG: Electromagnetic (x-ray) radiation associated with deceleration of charged particles passing through matter.

COMMITTED DOSE EQUIVALENT (HT,50): Dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

COMMITTED EFFECTIVE DOSE EQUIVALENT (HE, 50): Sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($HE, 50 = \sum W_T H_T, 50$).

CONTAMINATION, RADIOACTIVE: The deposit of radioactive material in any place where it is not desired, and particularly where its presence can cause harm.

CARRIER FREE: An adjective applied to one or more radionuclides in minute quantity, essentially undiluted with a stable carrier.

CFR: Means Code of Federal Regulations.

CRITICAL ORGAN: That organ or tissue, the irradiation of which will result in the greatest hazard to the health of the individual or his descendants.

DECAY, RADIOACTIVE: Disintegrations of the nucleus of an unstable isotope by the spontaneous emission of charged particles and/or photons.

DEEP DOSE EQUIVALENT (H_d): Applies to external whole body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm².) but internal organ(s) still considered to be irradiated.

DERIVED AIR CONCENTRATION (DAC): Concentration of a given radionuclide in air which, if breathed by the reference man for working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

DOSE: A general term denoting the quantity of radiation or energy absorbed in a specified mass. For special purposes it must be appropriately qualified, e.g. absorbed dose.

DOSE EQUIVALENT: A quantity used in radiation protection expressing all radiation on a common scale for calculating the effective absorbed dose. The unit for the dose equivalent is the rem, which is numerically equal to the absorbed dose in rads multiplied by a quality factor.

ELECTRON: Negatively charged elementary particle which is a constituent of every neutral atom.

ELECTRON VOLT: A unit of energy equivalent to the amount of energy gained by an electron in passing through a potential of 1 volt.

EXPOSURE: A measure of the ionizing that is produced in air by x or gamma rays. It is the sum of the electrical charges on all the ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in air, divided by the mass of air in the volume element.

Note: The unit for exposure is the roentgen.

FAIL SAFE CHARACTERISTICS: Means a design feature which causes beam port shutters to close, or otherwise prevents emergence of the primary beam, upon failure of a safety or warning device.

GAMMA RAY: Very penetrating electromagnetic radiation of nuclear origin. Except for origin, identical to x-rays.

GEIGER-MUELLER (G-M) COUNTER: Highly sensitive gas-filled detector and associated circuitry used for radiation detection and measurement.

GENETIC EFFECT OF RADIATION: Inheritable changes, chiefly mutations, produced by the absorption of ionizing radiation. On the basis of present knowledge these effects are purely additive, and there is no recovery.

HALF-LIFE BIOLOGICAL: The time required for the body to eliminate one-half of an administered dose of any substance by the regular processes of elimination. This time is approximately the same for the stable and radionuclides of a particular element.

HALF-LIFE EFFECTIVE: Time required for a radionuclide in a system to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

HALF-LIFE RADIOACTIVE: Time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has its own unique half-life.

HALF VALUE LAYER (half thickness): The thickness of any specified material necessary to reduce the intensity of an x-ray or gamma ray beam to one-half its original value.

INSPECTION: Means an examination and/or observation including but not limited to records, tests, surveys, safety check, and monitoring to determine compliance with state and local rules, regulations and requirements.

INVERSE SQUARE LAW: The intensity of radiation at any distance from a point source varies inversely as the square of the distance.

ION: Atomic particle, atom, or chemical radical bearing an electrical charge, either negative or positive.

IONIZATION: The process by which a neutral atom or molecule acquires either a positive or negative charge.

IONIZATION CHAMBER: An instrument designed to measure the quantity of ionizing radiation in terms of the charge of electricity associated with ions produced within a defined volume.

IONIZATION, SPECIFIC: The number of ion pairs per unit length of path of ionizing radiation in a medium.

IONIZING RADIATION: Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly in its passage through matter.

ISOTOPES: Nuclides having the same number of protons in their nuclei, and hence having the same atomic number but differing in the number of neutrons, and therefore in the mass number.

LABELED COMPOUND: A compound consisting, in part, of labeled molecules.

MAXIMUM PERMISSIBLE DOSE: Maximum dose of radiation which may be received by persons working with ionizing radiation, which will produce no detectable damage over the normal life span.

MILLIROENTGEN (mR): A submultiple of the roentgen equal of one-thousandth of a roentgen.

NEUTRON: Elementary particle with a mass approximately the same as that of a hydrogen atom and electrically neutral. It has a half-life in minutes and decays in free state into a proton and an electron.

NORMAL OPERATING PROCEDURES: Operating procedure for conditions suitable for analytical purposes with shielding and barriers in place. These do not include maintenance but do include routine alignment procedures. Routine and emergency radiation safety considerations are part of these procedures (reference **TRCR 32.2(d)**).

NUCLIDE: A species of atom characterized by its mass number, atomic number, and energy state of its nucleus, provided that the atom is capable for a measurable time.

OPEN BEAM CONFIGURATION: An analytical X-ray system in which an individual could accidentally place some part of his body into the primary beam path during normal operation.

PRIMARY BEAM: Ionizing radiation which passes through an aperture of the source housing by a direct path from the x-ray tube located in the radiation source housing.

RADIATION: 1. The emission and propagation of energy through space or through a material medium in the form of waves. 2. The energy propagated through a material medium as waves; for example, energy in the form of elastic waves. Such as Hertzian, infrared, visible (light), etc. 3. By extension, corpuscular emissions, such as alpha and beta radiation, or ray of mixed or unknown type, as cosmic radiation.

RADIOLOGICAL SURVEY: Evaluation of the radiation hazards incident to the production, use or existence of radioactive materials or other sources of radiation under a specific set of conditions. Such evaluation customarily includes a physical

survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes using or affecting these materials to predict hazards resulting from expected or possible change in materials or equipment.

RADIONUCLIDE: A nuclide with an unstable ratio of neutrons to protons placing the nucleus in a state of stress. In any attempt to reorganize to a more stable state, it may undergo various types of rearrangement that involve the release of radiation.

RADIOTOXICITY: Term referring to the potential of an isotope to cause damage to living tissue by absorption of energy from the disintegration of the radioactive material introduced into the body.

RAM: means radioactive material.

RELATIVE BIOLOGICAL EFFECTIVENESS: For a particular living organism, the ratio of absorbed dose of a reference radiation that produces a specified biological effect to the absorbed dose of the radiation of interest that produces the same biological effect.

REM: The special unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, distribution factor, and any other necessary modifying factors.

RSC: means Radiation Safety Committee.

ROENTGEN: The quantity of x or gamma radiation such that the associated corpuscular emission per 0.001293 grams of dry air produces, in air, ions carrying one electrostatic unit of quantity of electricity of either sign. The roentgen is the special unit of exposure.

RSO: means Radiation Safety Officer of TTU.

SHIELDING MATERIAL: Any material which is used to absorb radiation and thus effectively reduce the intensity of radiation, and in some cases eliminate it.

SMEAR (smear or swipe test): A procedure in which a swab, e.g., a circle of filter paper, is rubbed on a surface and its radioactivity measured to determine if the surface is contaminated with loose radioactive material.

SPECIFIC ACTIVITY: Total radioactivity of a given nuclide per gram of compound, element or radioactive nuclide.

TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE): Sum of the deep dose equivalent (for external exposures) and CEDE (for internal exposures).

TRACER, ISOTOPIC: The isotope or non-natural mixture of isotopes of an element which may be incorporated into a sample to make possible observation to the course of that element, alone or in combination, through a chemical, biological, or physical process. The observations may be made by measurement of radioactivity or of isotopic abundance.

THERMOLUMINESCENT DOSIMETER (TLD): A dosimeter made of certain crystalline material which is capable of both storing a fraction of absorbed ionizing radiation and releasing this energy in the form of visible photons when heated. The amount of light released can be used as a measure of radiation exposure to these crystals.

X-RAYS: Penetrating electromagnetic radiation having wavelength shorter than those of visible light they are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extranuclear part of the atom as x-rays.

INDEX OF ABBREVIATIONS AND ACRONYMS

ALARA	As Low As Reasonably Achievable
BRC	Bureau of Radiation Control
CFR	Code of Federal Regulations
DOH	Department of Health
DOT	US Department of Transportation
FDA	Federal Drug Administration
FRC	Federal Radiation Council
GC	Gas Chromatograph
ICRP	International Commission on Radiation Protection
MPD	Maximum Permissible Dose
NCRP	National Council on Radiation Protection and Measurements
NRC	Nuclear Regulatory Commission
OP	Operating Procedure
PO	Purchase Order
RAM	Radioactive Material
RIA	Radioimmunoassay
RPG	Radiation Protection Guide
RSC	Radiation Safety Committee
RSO	Radiation Safety Officer
TDH	Texas Department of Health
TLD	Thermoluminescent Dosimetry
TRCR	Texas Regulations for Control of Radiation
TTU	Texas Tech University

LIST OF SYMBOLS FOR RADIATION UNITS AND TERMS

Measurement and units

Ci	Curie
m	milli (one thousandth)
u	micron (one millionth)
k	kilo (thousand)
R	roentgen
rem	radiation equivalent man
dpm	disintegrations per minute
dps	disintegrations per second
cpm	counts per minute
MeV	Million electron volt
LET	Linear Energy Transfer
QF	Quality Factor

Appendix CB

TEXAS REGULATIONS FOR CONTROL OF RADIATION

The following section will briefly describe specific parts of the Texas Regulations for Control of Radiation (TRCR) and the Texas Regulations for Control of Laser Radiation Hazards (TRCLRH). TTU is subject to the rules of the TRCR, TRCLRH, and other state, federal, and local regulations when using radiation. These specific parts of the Texas Administration Code (TAC) have been extracted because of overall benefit to all radiation users at TTU. More specific information can be obtained from the Radiation Safety Office

1. **25 TAC §289.201 (TRCR Part 11) - General Provisions**, Texas Regulations for Control of Radiation: contains general information concerning recordkeeping, testing of sealed sources, violation information, and transport grouping of radionuclides.
2. **TRCR Part 13** contains rules and regulations pertaining to amending licenses, annulment of licenses, administrative penalties (i.e., fines), impoundment of sources of radiation, etc.
3. **25 TAC §289.202 (TRCR Part 21), Standards for Protection Against Radiation** - establishes standards for protection against ionizing radiation hazards. It is the purpose of the rules in this part to control the possession, use, and transfer of sources of radiation by any licensee so as to ensure that the dose to any individual does not exceed the standards established in this part. Areas covered include exposure limits, concentration of radioactive material in effluents, personnel monitoring, storage, disposal, records, limits of concentrations, etc.. This part is the basis for **ALARA**, "As Low As Reasonably Achievable", which means that each user should make every effort to keep exposures and releases as low as reasonably achievable.
4. **25 TAC §289.203 (TRCR Part 22), Notices, Instructions, and Reports to Workers; Inspections** - establishes requirements for notices, instructions, and reports by licensees or registrants to individual engaged in work under a license or registration, and options available to such individuals in connection with the State Bureau of Radiation Control (BRC) inspections regarding radiological conditions. Areas of particular interest are requirements for Posting of Notices, Instructions to Workers, Requests by Workers for Inspections, etc.
5. **TRCR Part 34, Radiation Safety Requirements for Analytical X-Ray Equipment** - This part provides special requirements for analytical X-ray equipment. Areas covered are equipment requirements, area requirements, operating requirements, and personnel requirements.
6. **PARTS 50, 60, & 70 - TEXAS REGULATIONS FOR THE CONTROL OF LASER RADIATION HAZARDS** - The objective of these regulations is to provide guidance for safe use of laser products and laser installations. Areas of particular interest include supervision, controls, safety requirements, regulations, and requirements for safe operation, signs, surveys, records, and registrations.

Appendix CC

INSTRUMENT CALIBRATION PROCEDURES

12/01/99

General Procedure for Calibration of Radiation Detection and Measurement Instruments

1. **Alpha Measuring Instruments:** will be calibrated annually by using a standard alpha source.
2. **Beta Measuring Instruments:** will be calibrated annually by using a standard beta source.
3. **Ionization Chamber Instruments:** will be calibrated annually by an authorized instrument service company or by the procedure in Part B.
4. **Well Counters:** will be calibrated annually by an authorized instrument service company.
5. **MCA's:** will be calibrated, using standard sources, each time they are turned on for operation and as necessary during analytical procedures.
6. **GM Radiation Survey Instruments:** will be calibrated annually using the procedure in Part B of this procedure or by an authorized instrument service company.

Periodic Calibration of Instruments

1. **Purpose:** This procedure will be used by TTU to perform its own annual radiation survey instrument calibrations for GM and, in some cases, ionization chamber instruments. *In the event that TTU cannot perform the calibration of a needed instrument, an authorized service company will be used.*
2. **Scope:** Each instrument will be calibrated to verify that it correctly measures the intensity of a radiation field (mR/hr). The procedure involves using a Ludlum Pulser to adjust the electronics of the instrument and then placing the instrument in a radiation field of known intensity and making necessary adjustments or calculations to verify the accuracy or determine correction factors.
3. **Objective:** To verify that each instrument is capable of measuring radiation levels over its multiple ranges to within plus or minus 20 percent of the true radiation level for the appropriate energies of the radiation.
4. **Method:** A known radiation field for the calibration procedure is provided through the use of a known source in a calibrator/shield. The beam calibrator is a manually operated device which incorporates a Cesium-137 source with an initial activity of 100 millicuries. The shield of the calibrator provides for full shielding in all directions at all times except when the unit is in the "ON" position. In the "ON" position, a radiation beam is emitted out of the port.

5. Applicability: This procedure applies only to GM and ionization chamber type instruments

6. Precautions and Safety:

a. Personnel Monitoring: The person(s) performing the calibration procedures MUST wear his/her assigned personnel monitoring device and pocket dosimeter.

b. Area Access: ONLY persons properly trained in instrument calibration procedures AND authorized by the RSO may conduct instrument calibrations.

c. Area Control: The area(s) where the calibrations are to be performed will be cleared of unauthorized/non-essential persons prior to initiating calibration procedures. "Caution - Radiation Area" signs will be posted at the entrance(s) to the area. Should any unauthorized/unmonitored person enter the area, the calibrator will immediately be turned to the OFF position.

d. Emergencies and Malfunctions:

(1) Calibrator Malfunction: if the ON/OFF shutter mechanism fails such that the beam cannot be shut off, immediately clear and secure the area and notify the RSO. DO NOT leave the area unattended!

(2) Improper Calibrator Operation: should the operation of the source rod become difficult, the calibrator shall be removed from service and returned to the manufacturer for repair.

7. Instrument Inspection: A thorough inspection of the instrument must be performed prior to the calibration procedure, as follows:

a. Visual Inspection: Visually check the outer meter face, adjustment knob, handle and meter case. Certain components, when damaged (such as the meter face, needle and adjustment knob), may affect the ability to calibrate.

b. Battery Condition Check: Inspect the batteries for damage and test for charge. Replace if necessary. Weak batteries can cause erratic behavior.

c. Electrical Inspection: Remove the case and visually inspect the electrical/electronic components. Inspect the internal probe, if present. If any component appears to be burned, broken, or loose, or there appears to be internal corrosion or moisture, do not proceed with calibration. Minor problems may be correctable, such as re-soldering a wire or removing corrosion or moisture. If repairs are satisfactorily performed, replace the cover and proceed with calibration. Otherwise, the instrument must be sent to an instrument repair service.

d. Electronics Test: Perform the electronics test using the Pulser as stated in the applicable Ludlum Instruction Manual.

e. Mechanical Inspection: Inspect and/or test all mechanical hardware, such as nuts, screws, etc., to ensure that they are secure. Check the retaining screw that

holds the selector knob on, the retaining screw for the handle, screws that hold the circuit board to the meter body, screws on the meter movement, etc. If necessary, all loose hardware must be tightened. Check the proper operation of switches to assure that they “lock in” on the selected positions.

- f. **Probe and Connecting Cable Inspection:** Inspect the cable and connectors for signs of damage or wear. Kinks in the cable may cause erratic behavior. The connectors must be of tight fit and the pins intact and firm. The connectors should attach to the instrument and probe connections firmly. Repair or replace the cable before proceeding with calibration.

8. Instrument Calibration (GM and ionization chamber instruments):

Note: Only persons authorized by the RSO shall be allowed to calibrate radiation survey instruments.

- a. **Prepare Calibration Record/Certificate:** Prepare a calibration record/certificate for each instrument to be calibrated.

- b. **Determine Calibration Points:**

- (1) Calculate and record the current source strength.
- (2) Determine the points (distances from calibrator) at which the instrument (probe) must be placed to produce the necessary radiation levels which allow calibration at two points on each range. Enter the field intensities on the calibration record(s) for each instrument.

- c. **Establish Calibration Range:** Mark the calibration range for the determined points (distances).

- d. **Calibrate at Each Point:**

- (1) Place the instrument at the desired point to checked
- (2) Unlock the device and expose the source.
- (3) Observe the reading on the instrument face at each predetermined point.
- (4) If the instrument reading does not agree with the field intensity (within plus or minus 20%), the calibration potentiometer for that range must be adjusted until the instrument indicates the correct response. Caution: a small amount of adjustment produces a relatively large change in the instrument reading.

Note: *For instruments that have only one calibration potentiometer, all ranges must be checked before adjusting the potentiometer. The potentiometer affects all ranges.*

- (5) Once the adjustments have been made, place the instrument back at the same location and verify the reading.
- (6) Repeat steps 6.d.1 through 6.d.5 for each point to be calibrated. It may be necessary to use attenuation blocks to obtain the lower range readings.

- e. **Turn Calibrator Off:** Return the source to the "OFF" position. Lock the calibrator.

9. Calibration Records:

- a. **Calibration Record and Certificate:** For each instrument calibrated, complete the following sections of the instrument calibration record (**Attachment E.2 – Certificate of Calibration, Form RS-32**):
 - (1) Sublicensee name and identifying information
 - (2) Instrument/detector manufacturer and information
 - (3) Calibration results
 - (4) Calibration method information
- b. **Certification:** The person performing the calibration must sign the "Calibrated by" space and enter the date of calibration. Indicate the next due date based on the calibration interval for the type of use of the instrument.
- c. **Calibration Sticker:** A "calibration sticker", should be placed on the instrument (obscure or remove previous ones) to indicate who calibrated the instrument; authorization (license number); date of calibration; next due date; instrument make, model and serial number; and the identity of the person performing the calibration.

10. Serviceability of Instruments:

- a. **Successful Calibration:** If the instrument was successfully calibrated, submit the completed "Survey Instrument Calibration Certificate" to the RSO for review and filing. Return the instrument to its proper storage location.
- b. **Unsuccessful Calibration:** If unable to calibrate an instrument, or the instrument requires repair, tag it as unusable and needing repair. Submit the instrument with notes of problem(s) to the RSO.

Sample: "SURVEY METER CALIBRATION LABELS" (stickers)

<u>TEXAS TECH UNIVERSITY</u>		
_____	_____	_____
MFG	Model	Ser.#
_____		_____
Cal.Date		Due Date
_____		_____
Cal.Source		High Voltage

	Tube I.D.	
Cal. By: _____		Texas Tech License L01536

CERTIFICATE OF CALIBRATION
State of Texas Broad License #L01536

Sublicensee _____ Dept. _____ Account # _____

Instrument Manufacturer _____ Model # _____ Serial # _____

Detector Manufacturer _____ Model # _____ Serial # _____

Last Calibration Date _____ Today's Calibration Date _____ Calibration Due Date _____

Battery Meter Zeroed F/S Response Zero Reset Audio Meter Face Number _____

Detector Tube Voltage _____ Volts HV "As Found" Reading _____ Volts Meter HV Adjusted Reading _____ Volts Input Sensitivity _____ mVolts

Maximum Reading Per Scale (mR/hr or CPM)	Calibration Point (mR/hr or CPM)	Meter Reading "As Found" (mR/hr or CPM)	Meter Reading "After Adjustment" (mR/hr or CPM)	% Error

Method of Calibration:

- Cs-137 Source Model 500 Pulser 0.1 1 10 100 1000 Ranges Calibrated Electronically
- Meter With in ± 10% With in ± 10 – 20% Tolerance
- Meter out of Tolerance > ± 20% Meter Requires Repair

Comments: _____

Calibrated by: _____ Date: _____

Appendix DA

FORMS

- Laser Application (LS-1)
- Laser Amendment (LS-2)
- Laser Amendment Attachment (LS-2A)
- Laser Standard Operating Procedure Outline (LS-7)
- Laser SOP Training Acknowledgement (LS-8)
- Laser Use Log (LS-11)
- Short Term Application (LS-17)

LASER EQUIPMENT SUBLICENSE APPLICATION

(UNDER TEXAS BUREAU OF RADIATION LASER LICENSE Z00130 ISSUED TO TEXAS TECH UNIVERSITY)
PLEASE PRINT OR TYPE. USE ADDITIONAL PAPER IF NECESSARY

APPLICANT'S FULL NAME

APPLICANT'S INITIALS

OFFICE DEPARTMENT & BUILDING

OFFICE NUMBER

PHONE NUMBER

APPLICANT'S E-MAIL ADDRESS

PLEASE COMPLETE SECTIONS I – III FOR ALL LASER EQUIPMENT UNDER YOUR CONTROL.

NOTE THAT SECTIONS E – L MUST BE COMPLETED FOR EACH LASER. USE ADDITIONAL FORMS IF NECESSARY

SECTION I

A. HAVE YOU EVER POSSESSED A LASER EQUIPMENT LICENSE UNDER YOUR NAME?
YES _____ NO _____

IF YES GIVE NUMBER AND ISSUING AGENCY: _____

WAS THE LICENSE OR SUBLICENSE EVER SUSPENDED? YES _____ NO _____

IF YES EXPLAIN: _____

B. HAVE YOU EVER HAD PRACTICAL EXPERIENCE WITH LASERS? YES _____ NO _____

C. HAVE YOU HAD FORMAL TRAINING IN THE SAFE USE OF LASERS FOR WHICH THIS APPLICATION APPLIES? YES _____ NO _____

IF YES EXPLAIN: _____

D. IF YOUR ANSWER TO PART B OR C WAS YES, DOCUMENT YOUR USE BY INCLUDING A COPY OF A PUBLISHED JOURNAL ARTICLE OR PROVIDE A CONFIRMATION LETTER FROM A LASER / RADIATION SAFETY OFFICER

E. COMPLETE FOR EACH LASER FOR WHICH YOU WILL BE LICENSED

Manufacturer	Model Number	Serial Number	Building	Room Number	Status (Active/Stored)
1.					
2.					
3.					
4.					
5.					

In, Sections F – L , the lasers will be referred to in the same order as they are listed in Section E

F. LIST INFORMATION FOR EACH LASER

Class (I,II,III,IV)	Laser Setup * Refer to Illustrations (A,B,C)	Emission Duration Range (seconds)	Emission Power Range (Watts or Joules)	Emission Wavelength Range
1.				
2.				
3.				
4.				
5.				

Laser Setups *

- A - Open Path (laser beam is accessible without defeating an interlock)
- B - Fully Enclosed (laser beam accessible via an “opened” interlock)
- C - Fiber Delivery (laser beam is delivered without an accessible beam path)
- D - Other (Explain)

G. STATE THE FOLLOWING FOR EACH LASER:

Person in Charge

Comments about Laser (s)

1. _____

2. _____

3. _____

4. _____

5. _____

H. LIST THE FOLLOWING PROPERTIES FOR EACH LASER

Laser	Type (dye, gas, solid state..)	Active Material (Ar,HeNe,GaAs,Nd Yag..)	Excitation Mechanism (optical,electrical,chemical..)	Time-Dependent Properties (cw, pulsed, rep. pulsed..)
1.				
2.				
3.				
4.				
5.				

I. DESCRIBE LASER APPLICATION (Research Development, Welding, Scribing, Cutting, etc..)

- 1. _____

- 2. _____

- 3. _____

- 4. _____

- 5. _____

J. ATTACH A COPY OF NORMAL OPERATING PROCEDURES FOR **EACH LASER**.

[25 TAC §289.301(v)(2)(B)] “Normal operating procedures” means operating procedures for conditions suitable for analytical purposes with shielding and barriers in place. These do not include maintenance but do include routine alignment procedure. Routine and emergency laser radiation considerations are part of these procedures.”

EXCEPTION: LSO MAY GRANT APPROVAL TO ACCEPT ONE COPY FOR SEVERAL LASERS WITHIN THE SAME CLASS AND SAME OPERATION SETTING, HOWEVER THE LSO MUST REVIEW EACH CASE, INDIVIDUALLY.

K. LIST ALL PERSONNEL WHO WILL USE THE LASER EQUIPMENT AND WHOSE NAMES SHOULD APPEAR ON THE SUBLICENSURE

	NAME	DATE TTU LASER TRAINING COMPLETED
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____

L. ATTACH A SEPARATE, PAGE-LENGTH DETAILED MAP OF THE PROPOSED WORK AREA FOR **EACH LASER**. INCLUDE LASER RADIATION AND NON-LASER RADIATION AREAS, EQUIPMENT LOCATION (I.E. SINKS, HOODS), AND DOORS. (THIS ALSO PERTAINS TO “MOBILE” LASERS. LSO WILL REVIEW AND DETERMINE EACH CASE INDIVIDUALLY)

M. **CLASS I – IIIA LASER APPLICANTS PROCEED TO SECTION III.**

N. **CLASS IIIB AND IV LASER APPLICANTS PROCEED TO SECTION II.**

SECTION II

TO BE COMPLETED BY CLASS IIIB AND IV LASER APPLICANTS ONLY

- A. DO YOU HAVE THE "STATE-REQUIRED" [25 TAC §289.301(t)(1)] PROTECTIVE EYEWEAR DESIGNED SPECIFICALLY FOR THE WAVELENGTH OF THE EMITTED LASER RADIATION?

YES _____ NO _____

IF YES, PROVIDE THE MANUFACTURER AND THE WAVELENGTH RANGE

- B. DO YOU ALREADY HAVE DOOR INTERLOCKS THAT PREVENT UNAUTHORIZED ACCESS TO THE DESIGNATED AREA (S) OF LASER USE, WHILE THE LASER(S) ARE OPERATING?

YES _____ NO _____

IF YES, PROVIDE THE MANUFACTURER IF NOT THE SAME AS THE LASER MANUFACTURER

IF YES, HAS THE TTU LSO APPROVED THE EXISTING INTERLOCK?

YES _____ NO _____

IF NO, DO YOU HAVE FUNDING FOR THE INSTALLATION OF **STATE-REQUIRED** DOOR INTERLOCKS FOR THE LASER AREA (S)? [25 TAC §289.301(r)(2)(B)] YES _____ NO _____

SECTION III

Acknowledgement Statement

I (THE APPLICANT) WILL COMPLY WITH THE STATE OF TEXAS LASER LICENSE REQUIREMENTS, REGULATIONS, AND ALL SPECIFIC CONDITIONS REQUIRED BY THE RADIATION LASER SAFETY COMMITTEE.

THE APPLICANT CERTIFIES THAT ALL PERSONNEL LISTED ON THIS SUBLICNESEE APPLICATION WILL COMPLY WILL THE STATE OF TEXAS LASER LICENSES REQUIREMENTS, REGULATIONS, AND ALL SPECIFIC CONDITIONS REQUIRED BY THE RADIATION SAFETY COMMITTTEE, AND THAT ALL OF THE INFORMATION CONTAINED HEREIN AND ATTACHED HERETO IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

DATE

SIGNATURE OF THE APPLICANT

SIGNATURE OF THE DEPARTMENT CHAIR

LASER APPLICATION FOR AMENDMENT OR RENEWAL OF A SUBLICENSE

SUBLICENSEE NAME	DEPARTMENT	PHONE NUMBER
SUBLICENSEE ID LETTERS	BUILDING & ROOM NUMBERS	SUBLICENSEE EXPIRATION DATE

A. CIRCLE ONE: **AMENDMENT** **RENEWAL** **AMENDMENT AND RENEWAL**

B. INDICATE ALL LASERS FOR WHICH YOU ARE CURRENTLY LICENSED.

	ACTIVE OR STORED	MANUFACTURER	MODEL #	SERIAL #	CLASS (I, II, IIIA, IIIB, IV)	
1.	_____	_____	_____	_____	_____	NC / A / D
2.	_____	_____	_____	_____	_____	NC / A / D
3.	_____	_____	_____	_____	_____	NC / A / D
4.	_____	_____	_____	_____	_____	NC / A / D

C. IF THIS AMENDMENT ADDS A NEW CLASS OF LASER, HAVE YOU HAD FORMAL TRAINING IN THE SAFE USE OF THIS LASER? (CIRCLE ONE) **YES** **NO** **NA**

IF YES, DOCUMENT YOUR USE FOR EACH NEW CLASS BY INCLUDING A COPY OF A PUBLISHED JOURNAL ARTICLE (ONE PER CATEGORY) OR PROVIDE A CONFIRMATION LETTER FROM A RADIATION/LASER SAFETY OFFICER.

D. LIST ANY NEW ROOMS OR AREAS (FOR WORK OR STORAGE) THAT WILL APPEAR ON THE AMENDED LICENSE. (INDICATE "NA" IF NOT APPLICABLE) _____

E. LIST ALL PERSONNEL WHOSE NAMES SHOULD BE **ADDED** TO OR **DELETED** FROM THE SUBLICENSE. INDICATE DATE THAT TTU TRAINING COURSE WAS COMPLETED. ANSWER THE QUESTIONS WHEN **DELETING** PERSONNEL. Question #1: Did person deleted act in a conscientious and safe manner while in your lab?
Question #2: Is retraining appropriate for this person?

FULL NAME	CIRCLE ONE	TRAINING DATE	ANSWER WHEN DELETING PERSONNEL	
			Question #1	Question #2
1. _____	A / D	_____	Y / N	Y / N
2. _____	A / D	_____	Y / N	Y / N
3. _____	A / D	_____	Y / N	Y / N
4. _____	A / D	_____	Y / N	Y / N

THE APPLICANT CERTIFIES THAT ALL PERSONNEL LISTED ON THIS SUBLICENSE APPLICATION WILL COMPLY WITH THE STATE OF TEXAS RAM LICENSE REQUIREMENTS, REGULATIONS, AND ALL SPECIFIC CONDITIONS REQUIRED BY THE RADIATION AND LASER SAFETY COMMITTEE, AND THAT ALL OF THE INFORMATION CONTAINED HEREIN AND ATTACHED HERETO IS COMPLETE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

SIGNATURE OF THE SUBLICENSEE	DATE
SIGNATURE OF THE DEPARTMENT CHAIR	DATE

ATTACHMENT FOR AMENDMENT OR RENEWAL OF A LASER SUBLICENSURE

E. LIST ALL PERSONNEL WHOSE NAMES SHOULD BE **ADDED** TO OR **DELETED** FROM THE SUBLICENSURE. INDICATE DATE THAT TTU TRAINING COURSE WAS COMPLETED. ANSWER THE QUESTIONS BELOW WHEN **DELETING** PERSONNEL.

Question #1: Did person deleted act in a conscientious and safe manner while in your lab?

Question #2: Is retraining appropriate for this person?

FULL NAME	CIRCLE ONE	TRAINING DATE	ANSWER WHEN DELETING PERSONNEL	
			Question #1	Question #2
5. _____	A / D	_____	Y / N	Y / N
6. _____	A / D	_____	Y / N	Y / N
7. _____	A / D	_____	Y / N	Y / N
8. _____	A / D	_____	Y / N	Y / N
9. _____	A / D	_____	Y / N	Y / N
10. _____	A / D	_____	Y / N	Y / N
11. _____	A / D	_____	Y / N	Y / N
12. _____	A / D	_____	Y / N	Y / N
13. _____	A / D	_____	Y / N	Y / N
14. _____	A / D	_____	Y / N	Y / N
15. _____	A / D	_____	Y / N	Y / N

THE APPLICANT CERTIFIES THAT ALL PERSONNEL LISTED ON THIS SUBLICENSURE APPLICATION WILL COMPLY WITH THE STATE OF TEXAS LASER LICENSE REQUIREMENTS, REGULATIONS, AND ALL SPECIFIC CONDITIONS REQUIRED BY THE RADIATION AND LASER SAFETY COMMITTEE, AND THAT ALL OF THE INFORMATION CONTAINED HEREIN AND ATTACHED HERETO IS COMPLETE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

SIGNATURE OF THE SUBLICENSUREE

DATE

SIGNATURE OF THE DEPARTMENT CHAIR

DATE

STANDARD OPERATION PROCEDURE OUTLINE

Each sublicensee will be responsible for creating SOP's for each laser which should include the following information.

System Information

- Description
- Location
- Classification

Hazard Summary

- Beam Information
- Non-beam Information

Control Measures

- Access Controls
- System Controls
- Personnel Controls

Procedural Information

- Adjustment and Alignment
- Maintenance and Servicing
- General Research
- Buddy Policy (if required)

Training Requirements

- Sublicensee
- SOP and PPE
- Environmental Health & Safety (if required)

Chain of Command

- Sublicensee
- Supervisory
- Research personnel

Emergency Instructions

- First Aid
- Evacuation
- Contacts: 9-911, sublicensee, LSO

NOTE: IF A LASER IS RE-ASSEMBLED OR MODIFIED, **LSO APPROVAL** IS REQUIRED BEFORE ITS USE

LASER SAFETY SHORT-TERM APPLICATION "SUPERVISED WORK WITH LASERS"

APPLICANT

1. FULL NAME: _____
2. TITLE: _____
3. INSTITUTION: _____
4. DEPARTMENT: _____

APPLICANT'S STATEMENT

I UNDERSTAND THAT THIS IS TEMPORARY APPROVAL ONLY FOR THE PERIOD SPECIFIED AND GRANTED DUE TO THE CIRCUMSTANCES STATED ABOVE WHICH IS AUTHORIZED BY THE TTU LASER SAFETY OFFICER (LSO) OR RADIATION LASER COMMITTEE CHAIRMAN. I RECOGNIZE THE HAZARDS OF LASERS AND UNDERSTAND THAT ALL STUDIES/WORK MUST BE DONE UNDER THE SUPERVISION OF THE SUBLICENSEE, SUBJECT TO SUBLICENSE CONDITIONS AS PRESCRIBED BY TTU LASER SAFETY POLICY.

APPLICANT'S SIGNATURE

DATE

LASER SAFETY USE ONLY

APPROVED BY

DATE

APPROVED PERIOD

Approval of this application does not include transfer of Laser Equipment

Appendix DB

REFERENCE INFORMATION

- Glossary of Terms
- Index of Abbreviations and Acronyms
- 25 Texas Administrative Code §289.301
- References

REFERENCE INFORMATION

GLOSSARY OF TERMS

This section lists information pertinent to laser safety and is considered to be a part of this manual. The definitions in this glossary will not cover every term associated with lasers but does cover a majority of the terms. If a term should be encountered in your work with lasers and is not in this glossary, consult your supervisor or call the TTU Department of Environmental Health and Safety.

ABSORPTION - means the transformation of radiant energy to a different form by interaction with matter.

ACCESS CONTROL - Entry must be restricted to only authorized laser personnel during the operation of laser equipment.

ACCESSIBLE EMISSION LEVEL (AEL) - means the maximum accessible emission level permitted within a particular class as set forth in TRCR Part 70 .

AGENCY - means the Texas State Radiation Control Agency, Texas Department of Health.

AVERAGE POWER - means the total energy imparted during exposure divided by the exposure time.

AVERSION RESPONSE - means the movement of the eyelid or the head to avoid an exposure to a noxious stimulant or bright light. It can occur within 0.25 seconds, including blink reflex time.

APERTURE - means any opening in the protective housing or other enclosure of a laser product through which laser radiation is emitted, thereby allowing human access to such laser radiation.

ATTENUATION - means the decrease in the radiant flux as it passes through an absorbing or scattering medium.

BEAM - means a collection of rays which may be parallel, divergent or convergent.

BEAM DIAMETER - means the distance between diametrically opposed points in the cross-section of a beam where the power per unit is 1/e times that of the peak power per unit area.

BEAM DIVERGENCE (O) - means the full angle of the beam spread between diametrically opposed 1/e irradiance points; usually measured in milliradians (one milliradian is approximately 3.4 minutes of arc).

BEAM EXPANDER - means any combination of optical elements which can increase the diameter of the laser beam. Laser beam expansion is always accompanied by a proportional decrease in laser beam divergence .

BEAM SPLITTER - means an optical device which uses controlled reflection to produce two beams from a single incident beam .

CLASS I - Any laser that does not permit access during the operation to levels of laser radiation in excess of the accessible emission limits contained in subsection (cc) (1) of this section.

CLASS II - Any laser that permits human access during operation to levels of visible laser radiation in excess of the accessible emission limits contained in subsection (cc) (1) of this section, but does not permit human access during operation to levels of laser radiation in excess of the accessible emission limits contained in subsection (cc) (2) of this section.

CLASS IIIa - Any laser that permits human access during operation to levels of visible laser radiation in excess of the accessible emission limits contained in subsection (cc) (2) of this section, but does not permit human access during operation to levels of laser radiation in excess of the accessible emission limits contained in subsection (cc) (3) of this section.

CLASS IIIb - Any laser that permits human access during operation to levels of laser radiation in excess of the accessible emission limits of subsection (cc) (3) of this section, but does not permit human access during operation to levels of laser radiation in excess of the accessible emission limits contained in subsection (cc) (4) of this section.

CLASS IV - Any laser that permits human access during operation to levels of laser radiation in excess of the accessible emission limits contained in subsection (cc) (4) of this section.

C0-2 LASER - wave-length 10.6 micrometers (for infrared, invisible).

COLLIMATED BEAM - a “parallel” beam of light with very low divergence or convergence.

CONTINUOUS WAVE (cw) - means the output of a laser which is operated in a continuous rather than pulse mode for a period greater than 0.25 seconds.

CONTROLLED AREA - means an area where the occupancy and activity of those within are subject to control and supervision for the purpose of protection from radiation hazards.

DIFFRACTION - means the deviation of a part of a radiation beam, determine by the wave nature of the radiation, and occurring when the radiation beam passes the edge of an opaque obstacle.

DIFFUSE REFLECTION - means the change of the spatial distribution of a beam of radiation when it is reflected in many directions by a surface or by a medium.

EMERGENT BEAM DIAMETER (a) - means the diameter of the laser beam at the exit aperture of the laser product. Measured in centimeters (cm).

ENERGY (Q) - means the capacity for doing work. Energy content is commonly used to characterize the output from pulsed laser products and is generally expressed in joules (Jo) .

ENERGY DENSITY - means the emittance (M) or irradiance (E) of electromagnetic radiation, energy per unit area, e.g., joules meter² or joules/centimeter² .

EXPOSURE - means the product of an irradiance (E) and its duration .

GAS LASER - means a type of laser where the laser action takes place in a gaseous medium .

HELIUM-NEON (HeNe) Laser - red aiming beam. Wave length 632.8 nanometers .

HERTZ (Hz) - means the unit which expresses the frequency of a periodic oscillation in cycles per second .

HUMAN ACCESS - means access at a particular point to laser or collateral radiation by any part of the human body or by an object. A laser product or installation shall be considered to permit human access if radiation in excess of an accessible emission limit is incident at a point that can be reached by a straight object 3.0 + 0.1 millimeters in diameter and 10.0 + 0.1 centimeters in useful length .

INCIDENT - means an unusual event or occurrence.

INDIVIDUAL - means a human being.

INFRARED RADIATION - the electromagnetic radiation with wavelengths that lie in the 0.7 micrometer to 1 millimeter range.

INSTALLATION - means any location where one or more products are used or operated.

INTENSITY - means the amount of energy or energy per unit time passing through a unit area perpendicular to the line of propagation at the point in question.

INTRABEAM VIEWING - means the viewing condition whereby the eye is exposed to all or part of a laser radiation beam.

IRRADIANCE (E) - means the quotient of the radiant power incident on an element of a surface by the area of what element, expressed in watts per square centimeter (W/cm²).

JOULE (J) - means a unit of energy, one J = 1 Watt/second .

LASER - Light Amplification by Stimulated Emission of Radiation. A device which generates or amplifies electromagnetic oscillations in the spectral region between the far infrared (submillimeter) and ultraviolet . The laser consists of an amplifying (active or Casing) medium and a regenerative of feedback device (resonant cavity). The amplifying medium can be gas, solid, or liquid. The feedback medium is generally

bounded by two end mirrors. The laser light produced is of high intensity, high monochromaticity, small beam divergency (collimated), and is phase coherent .

LASER CONTROLLED AREA - means any area which contains one or more lasers and in which the activity of personnel is subject to control and supervision for the purpose of protection from laser radiation hazards.

LASER PROTECTIVE DEVICE - means any device, the intended function of which is the control of laser radiation with the intent of reducing or eliminating the exposure of personnel to such radiation.

LASER RADIATION - means all electromagnetic radiation which is produced as a result of controlled stimulation emission.

LASER SAFETY OFFICER (LSO) - means any individual, qualified by training and experience in occupational and public health aspects of lasers, who is designated to evaluate the radiation hazard of and to establish, administer, and be responsible for, laser radiation protection .

LASER SYSTEM - means a laser in combination with an appropriate laser energy source with or without additional incorporated components.

LASING MEDIUM - means a material emitting coherent radiation by virtue of stimulated electronic or molecular transitions to lower energy levels.

LIMITING APERTURE - means the maximum circular area over which radiance or radiant exposure can be averaged.

MAINTENANCE - means the performance of those adjustments or procedures specified in user information provided by the manufacturer, with the laser or laser system, which are to be performed by the user to insure the intended performance of the product. It does not include "operation" or "service" as defined in this section.

MAXIMUM EMISSION DURATION - means the maximum duration of repeated, or continuous operation of which the laser product is capable, whichever is greater.

MAXIMUM OUTPUT - means that maximum magnitude of energy or power, at any time after manufacture, of total accessible laser radiation emitted by a laser product over the full range of operational capability .

MAXIMUM PERMISSIBLE EXPOSURE (MPE) - means that integrated radiance or irradiance which is specified for accessible emission limits of class I or collateral radiation of TRCR Table 70-3. Exposure duration for MPE shall be that of actual or potential personnel exposure, and not a product of classification emission duration.

MEDICAL LASER PRODUCTS - means any laser product designed or intended for purposes of in vivo diagnostic or therapeutic laser irradiance of any part of the human body .

NEODYMIUM:YTTTRIUM ALUMINUM GARNET (Nd:YAG) LASER - wavelength (λ) 1 06 nanometers .

NOMINAL HAZARD Z _ (NHZ) - means the space within which the level of the direct, reflected, or scattered radiation during normal operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the appropriate MPE level .

NOMINAL OCULAR HAZARD DISTANCE (NOHD) - means the distance along the axis of the unobstructed beam from the laser to the human eye beyond which the irradiance or radiant exposure during normal operation is not expected to exceed the appropriate MPE .

OPERABLE LASER - means a laser which can produce laser radiation.

OPERATION - means the performance of the laser or laser system over the full range of its intended functions (normal operation). It does not include "maintenance" or "service" as defined in this section.

OPTICAL DENSITY (D) - means the logarithm to the base ten of the reciprocal of the transmittance.

OUTPUT POWER and OUTPUT ENERGY - means the laser output power used primarily to rate CW lasers since the energy delivered per unit time remains constant (output measured in watts). In contrast, pulsed lasers deliver energy in pulses and their effects can be best categorized by energy output per pulse.

POWER (P) - means the time rate at which energy is emitted, transferred, or received; usually expressed in watts.

PROTECTIVE HOUSING - means those portions of a laser product which are designed to prevent human access to laser and collateral radiation in excess of the prescribed accessible emission limit under conditions specified in TRCR Part 70.

PULSE DURATION - means the time increment measured between the half-peaks-power points of the leading and trailing edges of the pulse.

PULSE REPETITION FREQUENCY (PRF) - means the number of laser pulses per unit time (usually expressed in seconds).

PULSED LASER - means a laser which delivers its energy in the form of a single pulse or a train of pulses, where the duration of a pulse is less than or equal to 0.25 seconds.

Q-SWITCH - means a device for producing very short (approximately 30 nanoseconds), intense laser pulses by enhancing the storage and dumping of electronic energy in and out of the basing medium, respectively.

Q-SWITCHED LASER - means a laser which emits short (approximately 30 nanoseconds), high-power pulses by utilizing a Q-switch.

RADIANCE (L) - means radiant power per unit area of radiation surface per unit solid angle of emission, expressed in watts per square centimeter per steradian ($\text{w/cm}^2/\text{Sr}$).

RADIANT ENERGY (Q) - means energy emitted, transferred or received in the form of radiation, expressed in joules (J).

RADIANT EXPOSURE (H) - means the quotient of radiant energy incident on an element of a surface by the area of that element, expressed in joules per square centimeter (J/cm^2).

RADIANT INTENSITY (I) (of a source in a given direction) - means the quotient of the radiant flux leaving the source, propagated in an element of solid angle containing the given direction, by the element of solid angle. Expressed in watts per steradian (w/Sr).

RADIANT POWER means power emitted, transferred or received in the form of radiation, expressed in watts (W).

REFLECTANCE, REFLECTIVITY (P) - means the ratio of total reflected radiant power to total incident power.

REFLECTION - means the deviation of radiation following incidence on a surface.

REMOTE CONTROL CONNECTOR - means a two-terminal connector which permits the connection of external controls placed apart from other components of the laser product to prevent human access to all laser and collateral radiation in excess of limits specified Safe Eye Exposure Distance (SEED) - means the distance from an operating laser such that the energy that might infringe upon the eye is less than the MPE.

SAFETY INTERLOCK - means a device associated with the protective housing or enclosure of a laser product to prevent human access to excessive radiation under conditions specified.

SERVICE - means the performance of those procedures or adjustments described in the manufacturer's service instructions which may affect any aspect of the performance of the laser or laser system. It does not include "maintenance" or "operation" as defined in this section.

SHALL - the word "shall" is understood to mean mandatory.

SHOULD - the word "should" is understood to mean that which is advisable.

SOURCE - means the term used to describe either a laser or laser-illuminated reflecting surface.

SPECULAR REFLECTION - means a mirror-like reflection.

TRANSMISSION - means the passage of radiation through a medium.

TRANSMITTANCE (T) - means the ratio of total transmitted radiant power to total incident radiant power.

ULTRAVIOLET RADIATION - means the electromagnetic radiation with wavelengths shorter than those for visible radiation (0.2 - 0.4 micrometers). This region is often broken down into three spectral bands by wavelength: UV-A (315 - 400 nanometers), UV-B (280 - 315 nanometers), and UV-C (200 - 280 nanometers).

UNRESTRICTED AREA - means any area to which access is not controlled for the purposes of protection of individuals from exposure to radiation .

VAPORIZATION - means the conversion of a solid or liquid into vapor.

VISIBLE RADIATION (Light) - means all electromagnetic radiation which can be detected by the human eye . It is commonly used to describe wavelengths which lie in the range between 0.4 micrometers and 0.7 micrometers .

WATT (W) - means a unit of power, or radiant flux .

WAVELENGTH - means only the propagation wavelength in air of electromagnetic radiation.

INDEX OF ABBREVIATION AND ACROMYMS

TAC	Texas
LSM	Laser Safety Manual
RLSC	Radiation Laser Safety Committee
LSO	Laser Safety Officer
SOP	Standard Operating Procedures
OD	Optical Density
PPE	Personal Protective Equipment
ANSI	American National Standards Institute
LIA	Laser Institute of America

REGULATIONS

The regulatory documents and licenses may be examined at Administration Support Center Room 122, in the department of Environmental Health & Safety. More specific information can be obtained from the Radiation Safety Office.

TEXAS DEPARTMENT OF HEALTH

The following section will briefly describe specific parts of the **Texas Regulations for Control of Radiation (TRCR) and the Texas Regulations for Control of Laser Radiation Hazards (TRCLRH)**. TTU is subject to the rules of the **TRCR, TRCLRH**, and other state, federal, and local regulations when using lasers

1. **25 TAC §289.301**- establishes requirements for the registration of who receive, posses, acquire, transfer, or use class IIIB and class IV lasers; requirements for protection against laser radiation hazards; and responsibilities of the registrant and the laser safety officer, laser hazard control methods, training requirements and notification of injuries.
2. **25 TAC §289.201- General Provisions**, contains general information concerning record keeping, testing of sealed sources, violation information, and transport grouping of radionuclides.
3. **25 TAC §289.203- Notices, Instructions, and Reports to Workers; Inspections** - establishes requirements for notices, instructions, and reports by licensees or registrants to individual engaged in work under a license or registration, and options available to such individuals in connection with the State Bureau of Radiation Control (BRC) inspections regarding radiological conditions. Areas of particular interest are requirements for Posting of Notices, Instructions to Workers, Requests by Workers for Inspections, etc.
4. **25 TAC §289.204- Fees for Certificates of Registration, Radioactive Material (s) Licenses, Emergency Planning and Implementation, and Other Regulatory Services**, establishes fees, schedules and provide for the payment of registrations, licenses emergency planning and implementation, and other regulatory services according to the various categories in the specified disciplines.
5. **25 TAC §289.205- Hearing and Enforcement Procedures**, governs the proceedings for the granting, denying, renewing, transferring, amending, suspending, revoking, or annulling of license or certificate of registration; determining compliance; assessing administrative penalties; and determining propriety of other agency orders.

TEXAS TECH UNIVERSITY LASER LICENSE

Texas Tech University currently holds a laser license issued by the Texas Department of Health Bureau of Radiation Control: **Certificate of Laser Registration Z00130**.

This license authorizes Texas Tech University to receive, possess, transfer or acquire laser devices and to use such devices for the purpose (s) and at the place (s) designated. Texas Tech University is subject to all applicable rules, regulations and orders of the Texas Department of Health, and the stated conditions.

REFERENCES

1. Laser Institute of America; 2000.
2. Rockwell Laser Industries; 1994.
3. Sliney, D.; and Wolbarsht, M. Safety with Lasers and Other Optical Sources. New York: Plenum Press; 1980.
4. Michel, R.; Michel, R.; Kerns, K.; and Zimmerman, T.; Managing a Sound Laser Safety Program, Operational Radiation Safety, Vol. 77, No 2. S2-S8. August 1999.
5. 25 Texas Administrative Code §289.301

Appendix EA

Field Activity Planning Checklist and Risk Assessment

Complete a separate assessment for each field site being visited. Mark NA in the left-hand column if the activity is not applicable to the field activities being conducted.

Risk Probability Breakdown

Risk is the combination of the severity of the harm that can be inflicted by a hazard and the likelihood of the harm happening.

Risk Level	Description / How to Determine Risk Level
A	Nuisance event, low hazard, incident can be managed by field participants, SCAN filed
B	Moderate event, work must stop to address incident, may required Field Trip Leader intervention, SCAN required
C	Potential emergency, immediate action required, medical attention may be required, Designated Contact notified, incident report filed
D	Emergency action required, medical attention sought, Designated Contact notified, incident report filed

Field Trip Leader(s): _____ Contact # _____

Field Trip Leader(s): _____ Contact # _____

Field Activity: _____

Field Site Name: _____

Estimated Dates at Site: _____

Planning and Preparation Check List				Comments
NA	Pre-Trip Planning and Training	Yes	No	
	<i>Has a specific field site been identified?</i>			
	<i>Is this a roving field experience?</i>			
	<i>Has the Field Safety Plan been completed?</i>			
	<i>Is the detailed Risk and Hazard Assessment complete?</i>			
	<i>Have you established Go/No criteria?</i>			
	<i>Do you have a Designated Contact?</i>			Person:
	<i>Has the Designated Contact been given a copy of the Field Safety Plan?</i>			
	<i>Do you have all insurance and permits necessary for field work?</i>			
	<i>Have you obtained emergency contact</i>			

Field Activity Planning Checklist and Risk Assessment

	<i>information for the facilities closest to the field site(s)?</i>					
	<i>Have you obtained Emergency Contact information for all field participants?</i>					
	<i>Have participants conducted pre-trip field safety briefing?</i>					
	<i>Have all participants read the Field Safety Plan?</i>					
	<i>Does the field safety plan include a list of equipment for field work?</i>					
	<i>Is all appropriate PPE available for all participants?</i>					
	<i>Are appropriate emergency communication devices available?</i>					
	<i>Has a list of required equipment been distributed to all participants?</i>					
	<i>Is appropriate first aid, field site kit, and emergency equipment checked for completeness and functionality?</i>					
	<i>Are at least two field participants trained in First Aid?</i>					Persons:
	<i>If vehicular travel is required to reach field site, can a TTU vehicle be used?</i>					Driver must be TTU approved
	Potential Hazard	Risk Probability				Comments & Mitigation
NA	Vehicles	A	B	C	D	
	<i>Vehicular storage buildings/garages</i>					
	<i>Are high volume fuel-storage facilities present?</i>					
	<i>Is secure storage for valuable/critical equipment available at the field site?</i>					
	<i>Are appropriate vehicles for field environment available?</i>					
	<i>Do vehicles have current service records?</i>					
	<i>Are vehicle oil and fluids at correct levels and tires at pressure?</i>					
	<i>Is there a flashlight, spare tire, jack & tire-lever and signage in case of breakdown?</i>					
	<i>Is a person with good driving record and mental state for driving available?</i>					
	Potential Hazard	Risk Probability				Comments & Mitigation
NA	Machinery & Equipment	A	B	C	D	
	<i>Will mechanical tools and instruments be used?</i>					SOP needed
	<i>Have tools and machinery been serviced and checked for operational readiness?</i>					
	<i>Is appropriate and safe (e.g., grounded, insulated) electrical power available?</i>					
	<i>Are tools and machines compliant with available power supplies?</i>					
	<i>Is appropriate PPE available for use with tools and machines?</i>					
	<i>Will tools and instruments need to be used in confined space?</i>					
	<i>Have participants been trained on equipment use?</i>					

Field Activity Planning Checklist and Risk Assessment

Potential Hazard		Risk Probability				Comments & Mitigation
NA	All-Terrain Vehicles (ATVs) and Related Vehicles	A	B	C	D	
	<i>Will ATVs or similar vehicle be used during fieldwork?</i>					
	<i>Are engine sizes greater than 90cc?</i>					
	<i>Is appropriate Snell ANSI approved riding gear available for use?</i>					
	<i>Is the terrain appropriate for ATV use?</i>					
	<i>Is the ATV road-approved and appropriately certified?</i>					
	<i>Will the ATV be used in proximity to normal highway traffic?</i>					
	<i>The ATV will not be required to carry loads or more than 1 person.</i>					
	<i>Have riders received training on vehicle in similar conditions as those anticipated in the field?</i>					
Potential Hazard		Risk Probability				Comments & Mitigation
NA	Roads and Railroads	A	B	C	D	
	<i>Is any of the fieldwork near roads and highways?</i>					
	<i>Is any of the fieldwork near railroad tracks?</i>					
	<i>Are appropriate high-visibility clothing and signage available?</i>					
	<i>Is any work to be conducted on or proximal to narrow, winding roads/highways with limited sight lines?</i>					
	<i>Will any work be on, under or close to bridges?</i>					
Potential Hazard		Risk Probability				Comments & Mitigation
NA	Water, Boats, and Watercraft	A	B	C	D	
	<i>Will the fieldwork include proximity to, or work upon a body of water?</i>					
	<i>Will the work require use of a watercraft?</i>					
	<i>Is there a team member with certificates and credentials for the watercraft?</i>					Bring copy
	<i>Does the fieldwork require the presence of a team member with technical water-safety certificates?</i>					Certificate:
	<i>Are appropriate safety devices available? (Buoyancy aids, life-vests, flares).</i>					
	<i>Are there appropriate mooring and anchoring facilities?</i>					

Field Activity Planning Checklist and Risk Assessment

	<i>insects, arachnoids and/or reptiles?</i>						
	<i>Is field clothing appropriate for deterring potentially hazardous fauna?</i>						
	<i>Is the first aid kit equipped with treatments for stings, bites, and potential fauna toxins?</i>						
	<i>Can field equipment and supplies be safely secured and made fauna-proof?</i>						

Field Activity Planning Checklist and Risk Assessment

	<i>Will reagents be intentionally introduced to the field locality?</i>					
	<i>Are appropriate licenses and permissions available/carried in the field?</i>					
	Potential Hazard	Risk Probability				Comments & Mitigation
NA	Private Property	A	B	C	D	
	<i>Will fieldwork be conducted on private property?</i>					
	<i>Have all private land/property owners been contacted?</i>					
	Potential Hazard	Risk Probability				Comments & Mitigation
NA	People – Strangers					
	<i>Is the fieldwork to be conducted in an area where other individuals may be encountered (e.g., national parks)?</i>					
	<i>Are there cultural considerations about the field site area to be noted?</i>					
	<i>Is international travel taking place?</i>					Consult with EHS for research material transport
NA	Personal Safety and Responsibilities					Comments & Mitigation
	<i>Have all field participants notified someone of where they are going and how long they will be gone?</i>					
	<i>Are team members that are driving vehicles or ATVs been properly licensed and/or trained?</i>					
	<i>If team members have a medical condition such as diabetes or allergies, do they have the proper items to treat themselves?</i>					
	<i>Have all team members provided emergency contact information?</i>					
	<i>Have all field participants undergone appropriate medical evaluation, treatment or vaccination?</i>					

Field Activity Planning Checklist and Risk Assessment

Potential Hazard Considerations

	Potential Hazard – Criteria, Limits, Critical Factors to consider	Comments Issues, Mitigators, Scenarios
	Natural Environment	
1	Foul Weather Considerations- wind, rain, snow, lightning, flash flood: <i>local, upstream</i>	<i>Before & During activity</i>
2	Temperature Extremes (Hot/Cold): <i>Temperatures (>30°C, <5°C), Wind, Humidity</i>	<i>Length of Exposure, Season/Day</i>
3	Strong Sunlight (Inc. sunburn): <i>Serious sunburn, “snow” blindness, contributing factor to fatigue</i>	<i>Exposure length, surface albedo</i>
4	Darkness/Low Light: <i>Contributing factor to other hazards that result in injury</i>	<i>Visibility, Fatigue, Weather</i>
5	Uneven/Slippery Walking Surfaces: <i>Slip, trip, or fall that results in injury</i>	<i>Cumulate Fatigue, Weather</i>
6	Sharp Objects- rocks, coral, vegetation: <i>Contact or fall results in penetration wound/scratched</i>	<i>Visibility, Fatigue, Weather</i>
7	Heights/Drop-offs (Inc. high elevation): <i>Fall that result in in free-fall drop of more than 2 m</i>	<i>Slope/softness of “landing” zone</i>
8	Falling Objects/Obstructions: <i>Spontaneous/Participate-caused, capable of causing serious injury</i>	<i>Time of year, freshness of outcrop</i>
9	Tight Spaces/Narrow Openings/Overhang: <i>Results in impact or crushing injury, or panic/distress</i>	<i>Visibility, crowding</i>
10	Toxic/Allergic Sources (Vegetation, pollen): <i>Causes acute reaction, contributing factor to other hazards</i>	<i>Time of year, EMS access</i>
11	Animals- insects, reptiles, mammals, other: <i>Causes trauma, envenomation, allergic reaction</i>	<i>Time of year, local experience</i>
12	Fire Hazard: <i>Hot vehicle exhaust system/discarded cigarette causes fire, traps group, endangers ecosystem</i>	<i>Access to site during burn bans</i>
13	Water/Current: <i>Fall results in submersion, Strenuous exertion in water triggers pre-existing medical condition</i>	<i>Time of day/year, Hypothermia</i>
14	Smoke/Dust/Fog: <i>Causes eye/throat/nose/ injury, contributing factor to other hazards</i>	<i>Time of year/date</i>
	Man-Made Environment (for Pedestrians)	
15	Vehicular Traffic: -roads, railroads: <i>Vehicle impacts participate, group activity causes traffic hazards</i>	<i>Time of Day/Year</i>
16	Road Shoulders- <i>space restrictions, visibility: vehicle impacts participation, group activity causes traffic hazard</i>	
17	Bridges: <i>Vehicle impacts participate, group activity causes traffic hazards</i>	<i>Sidewalk/ width of shoulder</i>
18	Fences & Gates: <i>if gate not available, crossing results in fall, impact, lacerations, penetrating wound</i>	<i>Property owner interactions</i>
19	Utility Lines: <i>Approach route or proportions of outcrop allow contact with power lines, resulting in injury</i>	<i>Alternate Routes</i>
20	Local Inhabitants (Inc. hunters): <i>Group provokes hazardous reaction from locals; distraction factor</i>	<i>Time of year/day</i>
	Transportation (Auto, Boat, Air)	
21	Vehicle Condition: <i>Primary or contributing factor to accident/collision</i>	<i>Rental company, local experience</i>
22	Driver Qualifications/Experience for Location: <i>Primary or contributing factor to accident/collision</i>	<i>Availability of local drivers</i>
23	Route Conditions- roughness (Inc. flat tires): <i>Rough enough to be contributing factor to accident/collision</i>	<i>Type of vehicle used, local drivers</i>
24	Route Condition- congestions: <i>Enough to be contributing factors to accident, esp. around airport and major cities</i>	<i>Time of day, Route selection</i>
25	Route Conditions- winding, limited sight: <i>Enough to be contributing factor to accident/collision</i>	<i>Time of day, Route selection</i>
26	Pedestrians: <i>Sufficiently numerous or common to be contributing factor to accident</i>	<i>Time of day, Route selection</i>

Field Activity Planning Checklist and Risk Assessment

27	Intersections/Railroad Crossing: <i>Hazardous/Unguarded/Confusing location contributes to accident</i>	Time of day, Route selection
Human Factors/Participant Activities		
28	Pre-Existing Physical/Medical Needs: <i>Contributing factor to accident, acute episode of illness</i>	Pre-trip participant information
29	Extended Immobility: <i>Enough to be contributing factor to accident, trigger pre-existing medical condition</i>	Agenda/Travel planning
30	Lack of Rest Stops/Facilities: <i>Contributing factor to fatigue, accident</i>	Pre-trip planning
31	Fatigue/Dehydration: <i>Enough to be contributing factor to accident, trigger pre-existing medical conditions</i>	Agenda, Time of year/day
32	Hiking/Walking: <i>Intensity, length, duration, cumulative exertion sufficient to trigger illness, contribute to injury</i>	Time of day/year, weather
33	Separation of Individuals from Group: <i>Contributing factor to accident</i>	Safety briefing, Read backs
34	Individual Behavior/Risk Acceptance: <i>Contributing factor to accident</i>	Management letter, briefings
35	Lifting/Carrying: <i>Improper technique/overloaded backpacks results in injury</i>	Gear selection, individual fitness
36	Climbing: <i>Requires use of both hands to ascend/descend more than 2 m vertical, exposure to fall & injury</i>	Weather, outcrop condition
37	Use of tools (e.g., chipping): <i>Improper technique/equipment causes injury to self or other participant</i>	Required PPE
38	Digging/Trenching: <i>Digging causes injury to self or other participant, trench collapse causes injury</i>	OSHA rules for deep trenches
39	Swimming/Snorkeling/SCUBA/Boating: <i>Improper technique/conditioning/equipment causes injury</i>	Pre-trip Screening, PDF Policy
40	Equipment Failure: <i>Sufficient critical and serious to be contributing factor to accident</i>	Pre-trip planning, inspections
41	Food Handling: <i>Improper technique/equipment contributes to food-borne illness</i>	Training, Sanitation facilities
42	Language/Culture Differences: <i>Contributing factor to accident</i>	Pre-trip participate information
Other Factors		
43	Limited/Remote Medical Services: <i>Consequences of injury/illness escalates due to remoteness</i>	Pre-trip, communication
44	Limited Communications: <i>Consequences of injury/illness escalates due to delayed access to EMS assistance</i>	Pre-trip planning, field checks

Appendix EB

Field Site Kit Checklist

Field researchers must assemble a field-site kit with materials appropriate to the location and nature of field activities. A list of items in the kit should be part of the Field Safety Plan, and the contents of the kit must be checked for completeness, functionality, and compliance prior to departure on every trip.

Required Items

- Copy of Field Safety Plan with emergency procedures and protocols and contact information
- Institutional insurance policy information
- Any required permits including TTU permits and/or permits from local enforcement agencies
- Appropriate communication equipment (e.g., radio, cell, or satellite phone)
- Appropriate PPE (safety glasses/goggles, gloves, hard hat, sturdy work boots, etc.)
- First aid kit of adequate size for the group and location of field site
- Drinking water or another hydration

Items for Consideration

- Insect repellent (DEET 30-50%)
- Sunscreen (at least SPF 30), sun hat (three to seven-inch brim), long sleeves, and/or other SPF blockers
- Spare clothes, including jackets, hats, gloves and blankets for cold climates.
- Flashlight or headlamp
- Map, compass, GPS
- Extra food/snacks
- Matches or fire starter
- Signal/mirror, whistle
- Knife or multi-tool; duct tape for basic repairs
- Extra batteries
- Other equipment specific to the educational and/or research mission of the trip

Appendix EC

Things you need to know:

- Heat illness can strike quickly—learn to recognize the symptoms.
- Workers with heat illness should stop working, get cool, and drink fluids.
- Altered mental state can be a sign of heat stroke and requires immediate attention.
- When treating severe heat illness, cooling is the first priority.

HEAT STRESS

First Aid for Heat Illness

Cooling is key. Know the symptoms and treatment of heat illness.

Signs and Symptoms

Symptoms can occur in any order. For example, a person will not always experience heat cramps before they suffer from heat exhaustion.

What to Do

Less Severe

Heat Rash/Prickly Heat

- Red cluster of pimples or small blisters, usually on neck, upper chest, groin, under breasts, and in elbow creases
- Extensive areas of skin that do not sweat on heat exposure, but present gooseflesh appearance that subsides with cool environments

- When possible, a cooler, less humid work environment is the best treatment
- Keep rash area dry
- Powder can be applied to increase comfort
- Do not use ointments or creams, as they may impair cooling—warm, moist skin can make the rash worse

Severe

Heat Cramps

- Muscle cramps, pain, or spasms in the abdomen, arms, or legs

- Drink fluids every 15 to 20 minutes and eat a snack or sports drink
- Avoid salt tablets
- Get medical help if the worker has heart problems, is on a low sodium diet, or if cramps do not subside within 1 hour

Heat Syncope (Fainting)

- Fainting, dizziness, or light-headedness after standing or suddenly rising from a sitting/lying position

- Sit or lie down in a cool place when beginning to feel faint or dizzy
- Slowly drink water or clear juice

Heat Exhaustion

- Headache
- Nausea
- Dizziness, weakness
- Irritability
- Thirst, heavy sweating
- Elevated body temperature
- Decreased urine output

- Call for medical help or take worker to a health facility for evaluation and treatment
- Stay with worker until help arrives
- Remove worker from hot area and give liquids to drink
- Remove unnecessary clothing, including shoes and socks
- Cool worker with water, cold compresses, an ice bath, or fans
- Encourage frequent sips of cool water

Heat Stroke

- Confusion, altered mental state, slurred speech, loss of consciousness
- Hot, dry skin or profuse sweating
- Seizures
- Very high body temperatures
- Fatal if treatment delayed

- This is an emergency! Call for emergency care immediately!
- Move worker to a cool area and remove outer clothing
- Cool worker with water, cold compresses, an ice bath, or fans
- Circulate air around worker to speed cooling
- Place cold, wet cloths or ice on head, neck, armpits, and groin
- Stay with worker until emergency medical services arrive

OFTEN FATAL

Case Study: Heat Stroke

A 44-year-old male worker died of heat stroke while working on a North Carolina farm. The man had been working in the fields for about a week. On August 1st, the heat index was between 100 °F and 110 °F. Around 3 p.m., the worker complained to the crew leader that he was feeling ill. He drank some water and was driven to the employee housing and left alone. He was found unconscious 45 minutes later. Emergency personnel took the worker to the hospital, where he was pronounced dead. His core body temperature was 108 °F.

Lessons Learned

- Feeling ill while working in the heat is a serious warning sign. Any employee who reports feeling unwell during work in hot conditions could have heat exhaustion, which can quickly progress to heat stroke if not treated.
- Proper first aid for someone with suspected heat exhaustion or heat stroke involves COOLING the body as quickly as possible—not simply drinking water.
- People with severe heat illness do not always recognize the risks they face. If a worker shows signs of heat exhaustion or heat stroke, do not leave him or her alone until he or she receives medical attention.



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Appendix ED

Protecting Workers from Cold Stress

Cold temperatures and increased wind speed (wind chill) cause heat to leave the body more quickly, putting workers at risk of cold stress. Anyone working in the cold may be at risk, e.g., workers in freezers, outdoor agriculture and construction.

Common Types of Cold Stress

Hypothermia

- Normal body temperature (98.6°F) drops to 95°F or less.
- **Mild Symptoms:** alert but shivering.
- **Moderate to Severe Symptoms:** shivering stops; confusion; slurred speech; heart rate/breathing slow; loss of consciousness; death.

Frostbite

- Body tissues freeze, e.g., hands and feet. Can occur at temperatures above freezing, due to wind chill. May result in amputation.
- **Symptoms:** numbness, reddened skin develops gray/white patches, feels firm/hard, and may blister.

Trench Foot (also known as Immersion Foot)

- Non-freezing injury to the foot, caused by lengthy exposure to wet and cold environment. Can occur at air temperature as high as 60°F, if feet are constantly wet.
- **Symptoms:** redness, swelling, numbness, and blisters.

Risk Factors

- Dressing improperly, wet clothing/skin, and exhaustion.

For Prevention, Your Employer Should:

- Train you on cold stress hazards and prevention.
- Provide engineering controls, e.g., radiant heaters.
- Gradually introduce workers to the cold; monitor workers; schedule breaks in warm areas.

For more information:



U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

How to Protect Yourself and Others

- Know the symptoms; monitor yourself and co-workers.
- Drink warm, sweetened fluids (no alcohol).
- Dress properly:
 - Layers of loose-fitting, insulating clothes
 - Insulated jacket, gloves, and a hat (waterproof, if necessary)
 - Insulated and waterproof boots

What to Do When a Worker Suffers from Cold Stress

For Hypothermia:

- Call 911 immediately in an emergency.
- To prevent further heat loss:
 - Move the worker to a warm place.
 - Change to dry clothes.
 - Cover the body (including the head and neck) with blankets, and with something to block the cold (e.g., tarp, garbage bag). Do **not** cover the face.
- If medical help is more than 30 minutes away:
 - Give warm, sweetened drinks if alert (no alcohol).
 - Apply heat packs to the armpits, sides of chest, neck, and groin. Call 911 for additional rewarming instructions.

For Frostbite:

- Follow the recommendations “**For Hypothermia**”.
- Do not rub the frostbitten area.
- Avoid walking on frostbitten feet.
- Do not apply snow/water. Do not break blisters.
- Loosely cover and protect the area from contact.
- Do not try to rewarm the area unless directed by medical personnel.

For Trench (Immersion) Foot:

- Remove wet shoes/socks; air dry (in warm area); keep affected feet elevated and avoid walking. Get medical attention.

For more information:



U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)