



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.

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# Chemical Hygiene Plan

(POLICIES AND PROCEDURES)

Updated May 2019

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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](#)

[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).

[Equipment Decontamination Form](#)

[Occupational Health Program Enrollment Form](#)

## RECENT CHANGES

### New Sections

- A23 Non-Compliance

### Section A3

- New abbreviations and definitions added

### Section A4 Policies

- Expansion of Section A4.3 PPE use, transport and cleaning
- Addition of Section A4.5 Work Area Investigation

### Section A5.5 PI/Supervisor Responsibilities

- Revision of research to be submitted to ILSC for review (i.e., only energetic materials require ILSC approval)
- Addition of requirement to notify EHS of non-TTU inspectors

### Section 8.4 Supervision of Minors

- Addition of requirement that PI is able to be immediately contact by minor or others while minor is in the laboratory

### Section 9 Facilities

- Addition of decontamination of vertical surface and floors
- Addition of requirement to keep eye wash covers in place and keep equipment accessories in good condition

### A10 Physical Hazards

- Addition of facility requirements for work areas with soldering stations
- Addition of requirement that EHS-approved recapping SOP be posted in the immediate work area where sharps are recapped
- Addition of statement that broken glass to be repaired must be stored in a labeled drawer or container
- Addition to Electrical section

### A11 Work Area Safety Plan

- Addition of requirement that WASP is reviewed biennially and revised to address new hazards, operations, equipment, etc. prior to introduction into work area

### A12 Standard Operating Proecdures

- Revision of A12.1.11 to broaden language to include all emergency procedures including spill response and personnel exposure

### A17 Chemical Handling

- Addition that Chemicals in storage Group 9 (Compatible Pyrophoric and Water Reactive Materials) that are flammable will have a red dot affixed to the EHS barcode. Such chemicals shall be stored in a desiccator inside of a flammable storage cabinet.
- Addition of requirements for chemicals on the floor to be stored in secondary containment and away from intense heat or light sources
- Addition of provisions for nanoparticles, pyrophoric materials, mercury and picric acid
- Revision to move toxins and nanoparticles to Section A17.4

- Addition of requirement that safety procedures for chemicals of special concern including carcinogens, teratogens and other highly toxic chemicals must be posted in the immediate work area
- Chemical handling changed to Section A17.5 and Spill Response changed to Section A17.6

#### A18 Respiratory Protection Program

- Voluntary use of respirators must meet all the OHP enrollment and screening criteria outlined in the section

#### A19 Waste Management & Disposal

- Sharps containers must be closed prior to EHS pick up
- Waste containers must be kept free of contamination (e.g., outside of liquid collection containers and inner portions of solid collection containers).

#### A20 Transport and Shipment of Chemicals

- Revision to A20.1.5: A TTU vehicle must be used when transporting DOT-regulated materials on public roadways. An appropriate spill kit must accompany the transport. Exemptions to this policy may be addressed through EHS.
- Addition of requirement for TTU personnel transporting DOT-regulated materials must take the DOT-driver training prior to transporting items. This training must be renewed every two years.
- Addition of requirement that chemicals being returned to the vendor must meet the requirements outlined in this section and guidance to contact EHS prior to returning items

## **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](#)<sup>d</sup> 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 – 806-742-3328

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

TTU Police (UPD)

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.

*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.

*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.

*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-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 area 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](mailto: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](#)<sup>d</sup> 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<sup>d</sup>, 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](#)<sup>d</sup>, [engineering controls](#)<sup>d</sup> 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<sup>d</sup> in the EHS Assistant inventory system by barcoding all incoming chemicals.

## **A4.3**

Proper Laboratory<sup>d</sup> Attire

### **A4.3.1**

Proper lab attire must be worn at all times in the laboratory<sup>d</sup>.

#### **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<sup>d</sup>. 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 \(PPE\)](#)<sup>d</sup> (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](#)<sup>d</sup>.

#### **A4.3.2.2**

In teaching laboratories<sup>d</sup>, the minimum PPE<sup>d</sup> 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<sup>d</sup>.

#### **A4.3.2.6**

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

### **A4.3.3**

Visitors are required to wear the PPE<sup>d</sup> determined for the work area while hazardous operations are being conducted and / or chemical / biological agents are not behind a physical barrier<sup>d</sup>. If visitors refuse to don PPE<sup>d</sup>, or if PPE<sup>d</sup> 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<sup>d</sup> required to enter the lab<sup>d</sup> while hazardous operations are being conducted and / or chemical / biological agents are not behind a physical barrier<sup>d</sup>.

#### **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<sup>d</sup>, PPE<sup>d</sup> can be removed.

#### **A4.3.4.2**

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

### **A4.3.5**

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

#### **A4.3.5.1**

Laboratory coats must be stored in the work area and not in offices or public areas<sup>d</sup>.

##### **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<sup>d</sup> shall not be used.

#### **A4.3.6.1**

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

#### **A4.3.6.2**

Soiled, reusable PPE<sup>d</sup> must be decontaminated; regular laundering of PPE<sup>d</sup> 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<sup>d</sup> shall not be laundered at home or at a public laundry mat.

### **A4.4**

General Laboratory<sup>d</sup> Practices

#### **A4.4.1**

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

#### **A4.4.2**

Storage of items identified in A4.4.1 and other personal hygiene products is not permitted in the laboratory<sup>d</sup>.

##### **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**

Work Area Investigation

#### **A4.5.1**

Work areas may be investigated when 1) an [incident](#)<sup>d</sup> 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.

##### **A4.5.1.1**

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

##### **A4.5.1.2**

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

##### **A4.5.1.2(a)**

A seven business day grace period will be granted to correct findings<sup>d</sup> 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](mailto: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 A4.5.1.2.

##### **A4.5.1.3**

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<sup>d</sup> inspection. Trainings may be in-person or online as dictated by the relevant [institutional compliance committee\(s\)](#)<sup>d</sup>.

##### **A4.5.1.3(a)**

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



#### **A4.5.2**

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](#)<sup>d</sup>, or other visitors in any capacity.

#### **A4.5.3**

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.

### **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](#)<sup>d</sup> (including faculty, employees, visiting researchers, students and [volunteers](#)<sup>d</sup>) 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<sup>d</sup> 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<sup>d</sup>;

##### **A5.2.3**

Maintain a [Safety Data Sheet \(SDS\)](#)<sup>d</sup> library;

##### **A5.2.4**

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

##### **A5.2.5**

Train [laboratory personnel](#)<sup>d</sup> on the principles of the CHP;

##### **A5.2.6**

Provide chemical [spill kits](#)<sup>d</sup> 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](#)<sup>d</sup> (CSA);

### **A5.2.10**

Maintain a list of all [Satellite Accumulation Areas](#)<sup>d</sup> (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](#)<sup>d</sup> 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](#)<sup>d</sup> or [Incident](#)<sup>d</sup> 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](#)<sup>d</sup> conducted with responses for each laboratory<sup>d</sup>; 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<sup>d</sup>;

#### **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](#)<sup>d</sup>;

##### **A5.3.13.1**

Deficiencies discovered upon survey<sup>d</sup> 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<sup>d</sup> will be conducted after the [correction period](#)<sup>d</sup>. 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**

In the event of damage to property an [incident](#)<sup>d</sup> report is to be filled out and submitted to the CHO within 24 hours after the incident.

##### **A5.4.2.1**

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

##### **A5.4.3**

Perform an initial evaluation of incidents<sup>d</sup> and look for possible overexposure;

##### **A5.4.4**

Assess the need for medical consultation / examination;

##### **A5.4.5**

Assess the need for employee medical monitoring;

##### **A5.4.6**

Assist in scheduling medical examinations for personnel;

#### **A5.4.7**

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

#### **A5.4.8**

Perform announced and / or unannounced chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment and document the findings:

##### **A5.4.8.1**

Department chair and PI / supervisor shall be informed of results of inspections and documentation shall be made available to the CHO upon request.

#### **A5.4.9**

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

#### **A5.4.10**

Maintain a list of laboratories<sup>d</sup> affected by the CHP and supply this list to the CHO when there are updates;

#### **A5.4.11**

Maintain a list of chemical fume hoods and supply this list to the CHO when there are updates.

### **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<sup>d</sup>;

#### **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](#)<sup>d</sup>, 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](#)<sup>d</sup> and [administrative](#)<sup>d</sup> and [engineering controls](#)<sup>d</sup> 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](#)<sup>d</sup>;

#### **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<sup>d</sup> to all individuals entering the work area(s) and ensure that the PPE<sup>d</sup> 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<sup>d</sup> 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\(s\)](#)<sup>d</sup> 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](#)<sup>d</sup> 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](mailto: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<sup>d</sup> 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](#)<sup>d</sup>

#### **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](#)<sup>d</sup> 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](#)<sup>d</sup> 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**<sup>d</sup>

### **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**<sup>d</sup>

#### **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<sup>d</sup> 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](#)<sup>d</sup>.

#### **A6.3**

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

#### **A6.4**

For [minors](#)<sup>d</sup> that are going to be in the laboratory<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup>](#) must be worn by all individuals while in the laboratory<sup>d</sup> when chemical, physical or biological hazards are not behind a physical barrier;<sup>d</sup>

### **A6.4.5**

Research operations must be suspended while the tour group is in the laboratory<sup>d</sup>; 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<sup>d</sup>](#)**

### **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<sup>d</sup>](#) IN [LABORATORIES<sup>d</sup>](#)**

### **A8.1**

Minors<sup>d</sup> Age 13 Years and Younger

#### **A8.1.1**

Minors<sup>d</sup> age 13 and younger are not eligible for laboratory<sup>d</sup> 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<sup>d</sup> (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<sup>d</sup> experiences involving minors<sup>d</sup> 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<sup>d</sup> is:

##### **A8.1.1.2(a)**

Under the direct supervision of the sponsoring investigator or senior [laboratory personnel](#)<sup>d</sup>, 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<sup>d</sup> 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<sup>d</sup> Age 14 and 15 Years

#### **A8.2.1**

Minors<sup>d</sup> of age 14 and 15 years may participate, if authorized in accordance with [Section A8.5](#) below, in laboratory<sup>d</sup> 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<sup>d</sup>, are wearing appropriate [PPE](#)<sup>d</sup> 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<sup>d</sup> Age 16 and 17 Years

#### **A8.3.1**

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

##### **A8.4.1**

Minors<sup>d</sup> shall be closely and directly supervised by the sponsoring investigator or senior member of the laboratory<sup>d</sup>.

##### **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<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup> while using biological agents will result in the immediate suspension of the PI's IBC protocols.

#### **A8.4.5**

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

#### **A8.4.6**

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

#### **A8.4.7**

Minors<sup>d</sup> shall be provided with adequate and appropriate personal protective equipment, including dosimeter badges when required.

#### **A8.4.8**

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

#### **A8.4.9**

Under no circumstances will minors<sup>d</sup> 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<sup>d</sup>

##### **A8.5.1**

A parent or guardian must give written consent for minors<sup>d</sup> to participate in laboratory<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup> may work in office space (not located in a laboratory<sup>d</sup>) 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<sup>d</sup>](#) present;

##### **A9.1.1.2**

[Laboratory<sup>d</sup>](#) doors shall remain shut at all times with the exception of rooms acting as distribution points for refilling of chemicals / supplies for laboratories<sup>d</sup>. 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<sup>d</sup> 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](#)<sup>d</sup> activities are being conducted in the laboratory<sup>d</sup> 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<sup>d</sup>; and

#### **A9.2.3.4**

Additional [PPE](#)<sup>d</sup>, [engineering controls](#)<sup>d</sup> and precautions must be used when entering the laboratory<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup> must have a sink for hand washing.

##### **A9.3.1.1**

Plumbed sinks are preferred, but if circumstances warrant, a [portable sink](#)<sup>d</sup> may be used. Contact the DSO and CHO if a portable sink<sup>d</sup> 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](#)<sup>d</sup>. 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<sup>d</sup> 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**

Laboratory<sup>d</sup> windows that open to the exterior must be fitted with screens. Contact the Physical Plant at 742-4677 for screen installation.

#### **A9.3.6**

First aid kits or supplies are recommended but not required for laboratory<sup>d</sup> 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](#)<sup>d</sup> 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<sup>d</sup>.

#### **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<sup>d</sup> 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](#)<sup>d</sup> (see Appendix AE).

##### **A9.6.5**

Devices containing mercury shall be secured in [secondary containment](#)<sup>d</sup> 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 receptable.

##### **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](#)<sup>d</sup> is not acceptable in the [laboratory](#)<sup>d</sup>.

### **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](#)<sup>d</sup>

#### **A10.3.1**

Avoid using sharps<sup>d</sup> whenever possible; use blunted needles and plastics when possible.

#### **A10.3.2**

Use disposable sharps<sup>d</sup> to avoid the hazards associated with decontaminating the items.

##### **A10.3.2.1**

Used sharps<sup>d</sup> must be discarded immediately after use into a puncture-resistant sharps container.

#### **A10.3.2.1(a)**

Do not overfill sharps<sup>d</sup> 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<sup>d</sup> containers must be easily accessible.

#### **A10.3.3**

Be prepared to use the device the moment the sharp<sup>d</sup> is exposed and secure or discard immediately after use.

#### **A10.3.4**

Do not bend, break or otherwise manipulate sharps<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup> 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<sup>d</sup>. 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](#)<sup>d</sup>.

#### **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](#)<sup>d</sup> 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](#)<sup>d</sup> 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](#)<sup>d</sup>, outlines laboratory group-specific policies and procedures, and gives guidance to [laboratory personnel](#)<sup>d</sup> in the event of an incident for all lab<sup>d</sup> locations. This document shall at minimum contain:

#### **A11.1.1**

The laboratory<sup>d</sup> location(s) that are covered in the plan;



### **A11.1.2**

Responsible party / parties for the laboratory<sup>d</sup> 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<sup>d</sup> locations, including the DSO's contact information;

### **A11.1.4**

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

### **A11.1.5**

Rules and policies of the laboratory<sup>d</sup> that are not less stringent than the University Laboratory Safety Manual;

### **A11.1.6**

Good laboratory<sup>d</sup> 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<sup>d</sup>, 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](#)<sup>d</sup>, [personal protective equipment \(PPE\)](#)<sup>d</sup>, 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](#)<sup>d</sup>;

### **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](#)<sup>d</sup>", 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<sup>d</sup> 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](#)<sup>d</sup>.

#### **A11.1.12.2**

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

#### **A11.1.13**

Current training records for all active laboratory personnel<sup>d</sup>, 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<sup>d</sup> 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](#)<sup>d</sup> 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<sup>d</sup>](#) 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](#)<sup>d</sup> 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<sup>d</sup> 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](#)<sup>d</sup>.

#### **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 TTU EHS (online). Refresher training is required biennially for all personnel.

##### **A14.2.2**

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

##### **A14.2.3**

Any [laboratory personnel](#)<sup>d</sup> – 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](#)<sup>d</sup> and visitors entering the [laboratory](#)<sup>d</sup> shall be notified of physical and health hazards that are presented by chemical and biological material in the laboratory<sup>d</sup> (see [Section A6](#)).

#### **A14.3.2**

TTU personnel and [volunteers](#)<sup>d</sup> shall be informed of the locations of the Work Area Safety Plan (WASP), University Laboratory Safety Manual, [SDSs](#)<sup>d</sup>, 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](#)<sup>d</sup>, 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<sup>d</sup>](#) 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<sup>d</sup>](#) 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<sup>d</sup>](#);

#### **A14.3.3.6**

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

#### **A14.3.3.7**

Detailed review of SDSs<sup>d</sup> 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](#)<sup>d</sup> 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](#)<sup>d</sup> 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](mailto: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](#)<sup>d</sup>, [administrative controls](#)<sup>d</sup> and [PPE](#)<sup>d</sup> 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](#)<sup>d</sup> 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](#)<sup>d</sup> 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](#)<sup>d</sup>.

### **A16.2.3**

Samples may be labeled to correspond with a lab notebook.

## **A16.3**

Chemical Substances Developed in a [Laboratory](#)<sup>d</sup>

### **A16.3.1**

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

### **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<sup>d</sup>, the supervisor shall comply with the OSHA Hazard Communication Standard ([29 CFR 1910.1200](#)) including the requirements for preparation of a [SDS](#)<sup>d</sup> and container labeling.

#### **A16.4**

##### **[Safety Data Sheets \(SDSs\)](#)**<sup>d</sup>

#### **A16.4.1**

SDSs<sup>d</sup> shall be obtained for all chemicals obtained.

#### **A16.4.2**

The responsibility for obtaining, evaluating and maintaining SDSs<sup>d</sup> is assigned to each individual laboratory<sup>d</sup>. Most SDSs<sup>d</sup> can be obtained through the [ChemWatch](#)<sup>d</sup> program on the EHS website.

##### **A16.4.2.1**

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

#### **A16.4.3**

SDSs<sup>d</sup> should be maintained in hard copy or electronic copy in the work area(s) in which the hazardous material(s) are used.

##### **A16.4.3.1**

SDSs<sup>d</sup> 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<sup>d</sup> for hazardous materials shall be readily accessible to employees during each work shift.

#### **A16.4.5**

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

#### **A16.4.6**

SDSs<sup>d</sup> 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](#)<sup>d</sup> 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) that are flammable will have a red dot affixed to the EHS barcode. Such chemicals shall be stored in a desiccator inside of a flammable storage cabinet.

##### **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<sup>d</sup> 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](#)<sup>d</sup> 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 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 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](#)<sup>d</sup> shall be counted in the total allowable amount of flammable liquids in the lab<sup>d</sup>.

**Table A1:** Maximum Allowable Storage of Flammable Liquids in Laboratories<sup>d</sup>

	Total Quantity* Outside of Safety Cabinets / Safety Cans		Total Quantity* Including Safety Cabinets / Safety Cans	
Class	Research Labs	Instructional or Teaching Labs	Research Labs	Instructional or Teaching Labs
I <sup>a</sup>	20 gal.	5 gal.	40 gal.	10 gal.
I <sup>a</sup> , II <sup>b</sup> , III <sup>c</sup> Total	40 gal.	10 gal.	80 gal.	20 gal.

\* Based on labs greater than 200 square feet. Labs less than 200 square feet shall be limited to half the quantities listed above. <sup>a</sup> Class I liquids have a flash point at or below 73°F. <sup>b</sup> Class II liquids have a flash point at or above 100°F. <sup>c</sup> Class III liquids have a flash point at or above 140°F. 1 gal. = 3.79 L.

### **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<sup>d</sup>](#), 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<sup>d</sup>](#) and [engineering controls<sup>d</sup>](#) 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<sup>d</sup>](#) (i.e., explosives, propellants, pyrotechnics)

#### **A17.4.5.1**

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

#### **A17.4.5.2**

WASP and SOPs (see [Section A12](#)) related to energetic materials<sup>d</sup> will be reviewed and approved by the Institutional Laboratory Safety Committee prior to acquisition of energetic materials<sup>d</sup>. 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](#)<sup>d</sup>.

##### **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<sup>d</sup> 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](#)<sup>d</sup>

##### **A17.4.7.1**

Pyrophoric materials<sup>d</sup> should be stored according to their respective [SDS](#)<sup>d</sup>.

#### **A17.4.7.2**

Flame-resistant lab coats must be worn while working with pyrophoric materials<sup>d</sup>.

#### **A17.4.7.3**

Researchers using energetic materials<sup>d</sup> 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](#)<sup>d</sup> unless actively being used.

##### **A17.4.8.2**

Additional PPE<sup>d</sup>, 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](#)<sup>d</sup> Handling

##### **A17.4.9.1**

Avoid handling dry forms of toxins<sup>d</sup> when possible.

##### **A17.4.9.2**

Clean room gloves are recommended for handling dry forms of toxins<sup>d</sup> that are electrostatic.

##### **A17.4.9.2**

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

##### **A17.4.9.2(a)**

Toxins<sup>d</sup> 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<sup>d</sup>, diluent / solvent and infectious material when selecting gloves and other [PPE](#)<sup>d</sup>.

#### **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<sup>d</sup> and be included in the Work Area Safety Plan (WASP) as outlined in [Section A11.1.8.5](#).

#### **A17.4.10**

##### **[Nanoparticles](#)**<sup>d</sup>

##### **A17.4.10.1**

Dry, powder nanomaterials<sup>d</sup> of unknown toxicity / reactivity or nanoparticles<sup>d</sup> 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](#)<sup>d</sup> and [engineering controls](#)<sup>d</sup> for the storage, use and disposal of nanomaterials<sup>d</sup> must be outlined in the WASP (see [Section A11](#)) and/or SOPs (see [Section A12](#)).

##### **A17.4.10.3**

A general [risk assessment](#)<sup>d</sup> must be performed for the nanomaterials<sup>d</sup> 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<sup>d</sup> 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](#)<sup>d</sup> 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](#)<sup>d</sup> 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<sup>d</sup>; 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](#)<sup>d</sup> must be appropriate for the chemicals used in the work area. Spill kits<sup>d</sup> 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<sup>d</sup> 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.

## **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](#)<sup>d</sup> or [administrative controls](#)<sup>d</sup> 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](#)<sup>d</sup> 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, a Waste label with container date, building and room number completed must be affixed to the waste container (see Section A19.3 for container guidance).

##### **A19.2.1.2(a)(i)**

Building – Building name;

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

Container Date – Date when waste is first added to the container.



#### **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](#)<sup>d</sup> containers used in chemical [laboratories](#)<sup>d</sup> 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**

Biological Waste Containers

#### **A19.3.2.1**

Biological waste should follow provisions described in Section B7.4 in the Biosafety chapter of the University Laboratory Safety Manual.

#### **A19.3.2.2**

Sharps<sup>d</sup> containers in BSL1 laboratories<sup>d</sup> must have the following features: 1) heavy-duty plastic (i.e. laundry detergent container), 2) stay upright during use, 3) able to close with a tight-fitting, puncture-resistant lid, 4) leak-resistant.

#### **A19.3.2.3**

Sharps<sup>d</sup> disposal in BSL2 and BSL3 laboratories<sup>d</sup> requires a red, FDA-cleared sharps container labeled as “Biohazard” and “Sharps” (see Section B7.4.1.1).

#### **A19.3.2.4**

When sharps containers are full, secure the lid prior to EHS pick up.

### **A19.3.3**

Radioactive Waste Containers

#### **A19.3.3.1**

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

#### **A19.3.4**

##### Glass Waste Containers

#### **A19.3.4.1**

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](#)<sup>d</sup> (SAAs)

#### **A19.4.1**

A waste determination shall be conducted for all waste generated.

#### **A19.4.1.1**

Incompatible wastes (e.g., halogenated and non-halogenated, acid and base, inorganic and organic, etc.) shall not be mixed.

#### **A19.4.1.2**

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](#)).

#### **A19.4.1.3**

Contact EHS if [mixed waste](#)<sup>d</sup> is to be generated.

#### **A19.4.1.4**

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](#)<sup>d</sup>, toxic gases, etc.).

#### **A19.4.2**

Waste containers may be used for 90 days after the container date.

#### **A19.4.3**

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

#### **A19.4.4**

No more than 40 gallons of hazardous waste and / or one quart of acutely hazardous waste ([40 CFR 262.34\(c\)\(1\)](#)) may be accumulated in SAAs<sup>d</sup>.

#### **A19.4.5**

Waste containers must be closed when waste is not actively being added or removed from the container.

#### **A19.4.6**

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

#### **A19.4.7**

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

#### **A19.4.8**

Waste containers not ready for EHS pick up shall be stored in their respective storage group (see Appendix AA) when waste is not actively being added or removed (i.e. flammable waste must be stored in flammable storage).

##### **A19.4.8.1**

Waste containers submitted for EHS pick up may be placed in a designated pick up area after the EHS Transaction Number is completed on the Waste label. The transaction number is obtained from the waste request confirmation email.

#### **A19.4.9**

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](#)<sup>d</sup> 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](#)<sup>d</sup> 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](#)<sup>d</sup> 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<sup>d</sup> 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](#)<sup>d</sup>); 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](#)<sup>d</sup> for the material must be provided to EHS if one is not found in [ChemWatch](#)<sup>d</sup>.

## **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**<sup>d</sup>

### **A21.1**

Procurement of Chemicals for [Laboratories](#)<sup>d</sup>

#### **A21.1.1**

Laboratory<sup>d</sup> and non-laboratory chemical purchases are approved by EHS.

#### **A21.1.2**

Laboratory<sup>d</sup> 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](#)<sup>d</sup>.

##### **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<sup>d</sup> 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](#)<sup>d</sup> (SDSs) for chemicals not previously purchased to ensure proper [administrative](#)<sup>d</sup> and [engineering controls](#)<sup>d</sup> 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<sup>d</sup>

### **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<sup>d</sup> 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) that are flammable will have a red dot affixed to the EHS barcode. Such chemicals shall be stored in a desiccator inside of a flammable storage cabinet.

#### **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.



#### **A21.2.5.1**

Work area personnel may be granted inventory access by completing the registration form under Chemical Inventory on the EHS website. The PI must email confirmation to [ehs.lab.safety@ttu.edu](mailto:ehs.lab.safety@ttu.edu) before access will be granted.

#### **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](mailto: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](#)<sup>d</sup> 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](#)<sup>d</sup> to test the chemical fume hood for proper operation.

### **A23**      **NON-COMPLIANCE**

#### **A23.1**

[Section A24](#), [laboratory](#)<sup>d</sup> closure, will be followed in situations where non-compliance resulted in conditions immediately dangerous to life and/or health or an [incident](#)<sup>d</sup> 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](#)<sup>d</sup> are not corrected upon follow-up [survey](#)<sup>d</sup> which will occur no less than 30-calendar days after the initial survey<sup>d</sup>.

##### **A23.1.1.2**

Work areas where the specific [finding\(s\)](#)<sup>d</sup> on four consecutive surveys<sup>d</sup> (e.g., two initial and two follow-up surveys<sup>d</sup>) are identical.

#### **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)<sup>d</sup> 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](#)<sup>d</sup> to be corrected and the consequences if findings are left unaddressed.

##### **A23.2.3**

Non-compliant work areas will be placed on a [quarterly](#)<sup>d</sup> inspection schedule. The duration of the quarterly<sup>d</sup> survey<sup>d</sup> 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<sup>d</sup> closure.

### **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](#)<sup>d</sup> 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<sup>d</sup> 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](#)<sup>d</sup> or [engineering control\(s\)](#)<sup>d</sup>, 4) a [correction period](#)<sup>d</sup> 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<sup>d</sup> to readdress the compliance issues, accept the appeal without closure, or continue with the original correction period<sup>d</sup>.

#### **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](#)<sup>d</sup> are responsible for packing and moving the laboratory<sup>d</sup>. 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<sup>d</sup> 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<sup>d</sup> 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, EHS will take over the area and complete decommissioning as time allows.

#### **A25.1.5**

Access will be returned to the department once the work area is decommissioned,

#### **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).

### **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<sup>d</sup> 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](#)<sup>d</sup> will be updated annually by the CHO as received by department heads.

### **A26.3**

The departmental representatives<sup>d</sup> 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)

November 2015

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## **B1**    **IMPORTANT CONTACT INFORMATION**

### **B1.1**    **EMERGENCY ASSISTANCE INFORMATION**

**IF YOU HAVE AN EMERGENCY AND REQUIRE FIRE & RESCUE, POLICE, OR  
EMERGENCY MEDICAL SERVICE CALL 9-1-1.**

### **B1.2**    **UNIVERSITY ASSISTANCE NUMBERS**

Environmental Health & Safety

- Emergency during University Operating Hours 806-742-3876
- Emergency during Non-Operating hours 806-742-3931

24-Hour Physical Plant Emergency Maintenance

- 806-742-3328

University Police Department

- Non-Emergency 742-3931
- Emergency 9-1-1

### **B1.3**    **UNIVERSITY DEPARTMENT AND COMMITTEE INFORMATION**

Environmental Health and Safety

- [safety@ttu.edu](mailto:safety@ttu.edu)
- <http://www.dept.ehs.ttu.edu/ehs/ehshome/>

Institutional Biosafety Committee

- [ibc.ehs@ttu.edu](mailto:ibc.ehs@ttu.edu)
- <http://www.dept.ehs.ttu.edu/ehs/ehshome/committee/ibcommittee>

Institutional Laboratory Safety Committee

- [ilsc.ehs@ttu.edu](mailto:ilsc.ehs@ttu.edu)
- <http://www.dept.ehs.ttu.edu/ehs/ehshome/committee/ilsccommittee>

Institutional Animal Care and Use Committee

- [iacuc@ttu.edu](mailto:iacuc@ttu.edu)
- <http://www.depts.ttu.edu/iacuc/>

Radiation and Laser Safety Committee

- <http://www.dept.ehs.ttu.edu/ehs/ehshome/committee/radcommittee>

Institutional Review Board

- <http://www.depts.ttu.edu/vpr/irb/>

## **B2** POLICY STATEMENT

### **B2.1** PURPOSE

This document serves as a statement of official Texas Tech University policy to establish the process for compliance with the following documents:

- [National Institutes of Health \(NIH\) Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules](#) (NIH Guidelines), November 2013.
- [Biosafety in Microbiological and Biomedical Laboratories](#) (BMBL), 5th 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

### **B2.2** 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 community. It is recognized that use of pathogenic microorganisms, organisms containing recombinant DNA, 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, recommendations, and regulations listed in section B2.1. Compliance with other applicable federal, state, and local regulations not specifically mentioned in this section is also required.

Furthermore, 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 and annually thereafter for all students working with biological materials and biennially for all faculty and staff working with biological materials.

## **B3** RESPONSIBILITIES

The Principal Investigator (PI) is directly and primarily responsible for the safe operation of the laboratory. His/her knowledge and judgment are critical in assessing risks and appropriately applying the principles in this manual; however, safety is a shared responsibility among all laboratory personnel.

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 5.5.19 of the Chemical Hygiene Plan. In addition to the help of laboratory personnel, many resources exist to assist the PI with these responsibilities, including the Department of Environmental Health and Safety (EHS), the Institutional Biosafety Committee (IBC), the Institutional Laboratory Safety Committee (ILSC), the Radiation and Laser Safety Committee (RLSC), the Institutional Animal Care and Use Committee (IACUC), the Institutional Review Board (IRB), and Departmental and/or College Safety Officers. Please see Section 5 of the Chemical Hygiene Plan a list of additional responsibilities.

**B3.1** Environmental Health and Safety (EHS) shall:

- B3.1.1** Prepare this Biosafety Manual, with revisions as necessary;
- B3.1.2** Provide online access to the Biosafety Manual and Chemical Hygiene Plan;
- B3.1.3** Investigate laboratory near-miss incidents and accidents;
- B3.1.4** Collect and dispose of biological waste;
- B3.1.5** Design, provide and coordinate safety trainings as requested;
- B3.1.6** Assist investigators with risk assessment as requested;
- B3.1.7** Monitor laboratories for compliance with all elements of the University's chemical hygiene program, biosafety program and applicable operating policies;
- B3.1.8** Assist faculty with submission of biohazard protocol applications to the IBC and maintain accepted protocol files;
- B3.1.9** Promote and assist in the University's vision of excellence in the laboratory by providing and stimulating awareness of issues that laboratories face in today's fast-paced and competitive research and teaching environments;
- B3.1.10** Search out new ways and ideas to meet the ever-changing regulatory requirements while promoting research and teaching in the safest environment possible; and
- B3.1.11** Coordinate the ILSC, IBC and RLSC and help develop and implement general laboratory and biological safety programs of these committees.

**B3.2** Principal Investigators (PI) shall:

- B3.2.1** Assess the risks of their experiments;
- B3.2.2** Ensure the safe and secure operation of their laboratory;
- B3.2.3** Coordinate the annual service and certification of Biological Safety Cabinets (BSCs);
- B3.2.4** Train laboratory personnel in safe work practices;
- B3.2.5** Complete the required biological safety training every two years and ensure all personnel and students complete the biological safety training as required per their position;
- B3.2.6** Properly manage and dispose of laboratory generated wastes;
- B3.2.7** Comply with this Manual, the University Chemical Hygiene Plan, the University Radiation Safety Manual, and all applicable University OP's relating to safety and health;
- B3.2.8** Comply with all applicable local, state and federal regulations and guidelines;

- B3.2.9** Register the following experiments with the applicable committee(s) as required:
- (a) Recombinant DNA (rDNA) activities; and/or
  - (b) Work with potentially infectious agents and biological toxins; and/or
  - (c) Experiments involving the use of potentially infectious human and/or non-human primate materials, such as unfixed tissues, cell lines, and body fluids/excretions/secretions.
- B3.2.10** Write and implement a laboratory-specific biosafety manual which covers all topics listed in section B8.2.4 of this manual; and
- B3.2.11** Notify EHS of all shipments of potentially hazardous materials and submit a copy of all shipping documents to EHS before the shipment departs.

**B3.3** The Institutional Biosafety Committee (IBC) shall:

- B3.3.1** Produce and update the Texas Tech University Biosafety Manual and oversee its implementation in the research laboratories and studios of Texas Tech University;
- B3.3.2** Develop policies and procedures relating to pathogenic microorganisms, biological toxins, rDNA and human and non-human primate materials and implement biological safety programs for Texas Tech University;
- B3.3.3** Review and recommend to EHS the need for general and specific training programs for research, studio and teaching activities involving biological agents, biological toxins, rDNA, and human and non-human primate materials and to review the appropriateness and effectiveness of such training programs;
- B3.3.4** Ensure rDNA research conducted at or sponsored by the University is compliant with the NIH Guidelines, approve those research projects that are found to conform to the NIH Guidelines and assess the safety of rDNA research experiments and any potential risk to public health or the environment;
- B3.3.5** Review research involving potentially infectious agents and biological toxins conducted at, or sponsored by the University for compliance with the guidelines in *Biosafety in Microbiological and Biomedical Laboratories (BMBL)* and approve those research projects that conform to the recommendations in the *BMBL*;
- B3.3.6** Certify PIs, their laboratories and their programs for work with potentially pathogenic microorganisms, biological toxins, rDNA and human tissues/fluids and notify the PI of the results of the IBC's review;
- B3.3.7** Report any significant problems with or violations of the NIH Guidelines and any significant research-related accidents or illness to the appropriate institutional official and to the NIH Office of Recombinant DNA Activities (ORDA) within 30 days; and
- B3.3.8** Follow the guidelines for membership defined by NIH, with the additional requirement of one representative from the Texas Tech University Animal Care and Use Committee.

**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.**



**B3.4** The Institutional Laboratory Safety Committee (ILSC) shall:

- B3.4.1** Improve the safety culture in research facilities, art studios, teaching facilities, and field research sites by establishing policies and procedures based on current best practice by a number of national professional groups;
- B3.4.2** Provide administrative advice regarding laboratory safety and reviewing and implementing the U.S. Chemical Safety Board recommendations and additional university recommendations;
- B3.4.3** Review and revise the Chemical Hygiene Plan, particularly with respect to the 2011, CSB recommendations and the recommendations imposed by the Texas Tech University President;
- B3.4.4** Specifically review and approve or disapprove all protocols, amendments, and renewals relating to the use of acutely hazardous chemicals as defined by the U.S. Environmental Protection Agency listing, particularly pyrophorics as identified in *Bretherick's Handbook of Reactive Chemical Hazards Vol. 2*, energetic materials, select carcinogens and particularly toxic chemicals. Any substance that meets one of the following criteria is considered to be a select carcinogen and a particularly toxic chemical if it:
- (a) is regulated by OSHA as a carcinogen; or
  - (b) is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program latest edition; or
  - (c) has been evaluated by the International Agency for Research on Cancer (IARC) and found to be either a group 1 carcinogen or a group 2a potential carcinogen;
- B3.4.5** Receive and review reports from the laboratory safety manager on surveys of laboratories using said materials, personnel exposure, and other issues pertaining to the chemical safety program and to physical hazards;
- B3.4.6** Develop appropriate benchmarks for laboratory safety compliance and laboratory safety awareness to report annually to the university President and the US Chemical Safety Board;
- B3.4.7** Conduct annual reviews of the laboratory safety program and recommend changes in policy as needed;
- B3.4.8** Review all TCEQ inspection reports; review reports concerning chemical incidents and recommend direction and corrective action concerning these incidents;
- make recommendations to the appropriate operating unit in regard to any corrective actions needed and serve as an avenue of appeal in cases of dispute and exception; and
- B3.4.9** Supervise the institutional educational programs on the use of chemicals.

**Texas Tech University policy requires that the ILSC review and approve protocols involving the laboratory use of acutely hazardous chemicals as defined by the U.S. Environmental Protection Agency listing, particularly pyrophorics as identified in *Bretherick's Handbook of Reactive Chemical Hazards Vol. 2*, energetic materials, select carcinogens and particularly toxic chemicals prior to work commencing.**

**B3.5** The Institutional Animal Care and Use Committee (IACUC) shall:

**B3.5.1** Develop and review all operating procedures relating to animal care and use at Texas Tech University.

**Texas Tech University policy requires that the use of all live vertebrate animals for research, instruction, demonstration, production, or maintenance purposes by TTU faculty, whether the animals are located in facilities at TTU or elsewhere, be approved by the IACUC in advance of their usage.**

**B3.6** The Institutional Review Board (IRB) shall:

**B3.6.1** Function in conjunction with the Human Research Protection Program to protect the rights and welfare of human subjects participating in research at Texas Tech, and

**B3.6.2** Reviews human-subjects research proposals, forms for proposal packets, and policies and procedures regarding use of human subjects.

**Texas Tech University policy requires compliance to the ethical principles of The Belmont Report and other federal regulations regarding human subjects; thus, all research involving human subjects requires proposal submission and review regardless of sponsorship prior to work commencing.**

**B3.7** The Radiation and Laser Safety Committee (RLSC) shall:

**B3.7.1** Formulate and recommend policy in the use of radioactive materials, radiation producing equipment and lasers;

**B3.7.2** Monitor the use of radioactive materials, radiation producing equipment and lasers in compliance with the Texas Department of State Health Service's regulations and Texas Tech University policy;

**B3.7.3** Certify investigators, their laboratories and their programs for work with radioactive materials, radiation producing equipment and lasers;

**B3.7.4** Review and recommend to EHS the need for general and specific training programs for research activities dealing with radiation and laser safety, and to review the appropriateness and effectiveness of such training programs;

**B3.7.5** Assure compliance with federal regulations; and

**B3.7.6** Set standards for radiation and laser safety.

**Texas Tech University policy requires compliance to federal regulations regarding the use of radioactive materials, radiation producing equipment and lasers; thus, all research involving such constituents requires proposal submission and review prior to work commencing.**

## **B4**    **BIOSAFETY CONTAINMENT LEVELS (BSL)**

Four levels of biosafety are defined in the BMBL. 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 defined additional protection measures. Each level consists of combinations of laboratory practices, safety equipment, and laboratory facilities which allow manipulation of biological agents of increasing danger to life and health (see Appendices BA-BC for more details).

**B4.1**    A brief description of each level from the BMBL is provided below:

BSL1 – BSL1 laboratory facilities and practices are suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans.

BSL2 – BSL2 laboratory facilities and practices are suitable for work involving agents that pose a moderate hazard to personnel and the environment. Treatment for disease is generally available; however, illness is sometimes fatal. Specific training and restricted access are required. The use of a biological safety cabinet may be required for certain procedures.

Unless risk group 3 or 4 agents are suspected (see section B5), initial processing of specimens and identification of isolates should be done at BSL2 unless permission for use of BSL1 containment procedures and practices has been granted by the IBC.

BSL3 – BSL3 laboratory facilities and practices are suitable for work with indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure. Treatment for exposure or vaccines may be available. Specific training, BSC use and special engineering and design features are required. Inspection and certification of a facility as BSL3 is indirectly conducted by the CDC as agents are largely part of the select agent program.

Most microbiological work at Texas Tech University is conducted at BSL1 or BSL2 containment. The University does have active BSL3 laboratory space.

TABLE 1. SUMMARY OF RECOMMENDED BIOSAFETY LEVELS

	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
<b>BSL1</b>	<ul style="list-style-type: none"> <li>• Not known to consistently cause disease in healthy adults</li> </ul>	<ul style="list-style-type: none"> <li>• Standard Microbiological Practices</li> </ul>	<ul style="list-style-type: none"> <li>• No additional safety equipment required.</li> <li>• PPE: lab coats and eye/face protection; gloves as needed.</li> </ul>	<ul style="list-style-type: none"> <li>• Open bench top sink required</li> </ul>
<b>BSL2</b>	<ul style="list-style-type: none"> <li>• Associated with human disease</li> <li>• Hazard: percutaneous injury, ingestion, mucous membrane exposure</li> <li>• Human materials and unknowns</li> </ul>	BSL-1 practice plus: <ul style="list-style-type: none"> <li>• Limited access</li> <li>• Biohazard warning signs</li> <li>• Laboratory-specific biosafety manual</li> <li>• Fever monitoring or other medical surveillance at the discretion of the PI</li> </ul>	<ul style="list-style-type: none"> <li>• BSC or other physical containment devices used for manipulations of agents that likely cause splashes or aerosols</li> <li>• PPE: laboratory coats; gloves; eye/face protection. Double gloving may be necessary.</li> </ul>	BSL-1 plus: <ul style="list-style-type: none"> <li>• Autoclave available</li> </ul>
<b>BSL3</b>	<ul style="list-style-type: none"> <li>• Agent may have serious or lethal consequences</li> <li>• Hazard: BSL2 and aerosol transmission</li> <li>• Human materials and unknowns likely to contain such agents.</li> </ul>	BSL-2 practice plus: <ul style="list-style-type: none"> <li>• Controlled access</li> <li>• Decontamination of all waste</li> <li>• Decontamination of lab clothing before laundering</li> <li>• Medical surveillance required</li> </ul>	<ul style="list-style-type: none"> <li>• BSC or other physical containment devices used for all open manipulations of agents</li> <li>• PPE: protective lab clothing; double gloves; eye/face protection; respiratory protection as needed</li> </ul>	BSL-2 plus: <ul style="list-style-type: none"> <li>• Physical separation from access corridors</li> <li>• Self-closing, double-door access</li> <li>• Exhausted air not recirculated</li> <li>• Negative airflow into laboratory</li> </ul>

## **B4.2** Animal Facilities

Four biosafety levels are also described in the BMBL for activities involving infectious disease work with experimental vertebrates. These four combinations of practices, safety equipment, and facilities are designated Animal Biosafety Levels 1, 2, 3, and 4, (ABSL1, ABSL2, ABSL3, ABSL4), and provide increasing levels of protection to personnel and the environment and parallel BSL 1-4. 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. (See Appendices BD & BE for more information).

Animal work can present unique hazards not found in standard biological laboratories. The co-application of BSL and ABSL are determined by protocol-specific risk assessment. All animal work must be approved by IACUC. Work involving animals in conjunction with BSL2 materials must be approved by both IACUC and the IBC; IBC approval should be sought first as it is required for submission to IACUC. Please see the IACUC website for additional details and protocol submission forms. A link to the IACUC webpage is provided in section B3.5.1.

TABLE 2. SUMMARY OF RECOMMENDED ANIMAL BIOSAFETY LEVELS FOR ACTIVITIES IN WHICH EXPERIMENTALLY OR NATURALLY INFECTED VERTEBRATE ANIMALS ARE USED

	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
<b>ABSL1</b>	<ul style="list-style-type: none"> <li>Agents not known to consistently cause diseases in healthy adult humans</li> </ul>	<ul style="list-style-type: none"> <li>Standard animal care and management practices, including appropriate medical surveillance programs</li> </ul>	<ul style="list-style-type: none"> <li>As required for normal care of each species</li> <li>PPE: laboratory coats and gloves; eye protection; /face protection, as needed</li> </ul>	Standard animal facility: <ul style="list-style-type: none"> <li>No recirculation of exhaust air</li> <li>Directional air flow recommended</li> <li>Hand washing sink is available</li> </ul>
<b>ABSL2</b>	<ul style="list-style-type: none"> <li>Agents associated with human disease</li> <li>Hazard: percutaneous injury, ingestion, mucous membrane exposure</li> </ul>	ABSL-1 practice plus: <ul style="list-style-type: none"> <li>Limited access</li> <li>Biohazard warning signs</li> <li>Laboratory-specific biosafety manual</li> <li>Decontamination of all infectious wastes and animal cages prior to washing</li> </ul>	ABSL-1 equipment plus: <ul style="list-style-type: none"> <li>Containment equipment appropriate for animals</li> <li>PPE: Laboratory coats; gloves; eye/face protection; respiratory protection, as needed</li> </ul>	ABSL-1 plus: <ul style="list-style-type: none"> <li>Autoclave available</li> <li>Hand washing sink available</li> <li>Mechanical cage washer recommended</li> <li>Negative airflow into animal and procedure rooms recommended</li> </ul>

## **B5 CLASSIFICATION OF AGENTS AND rDNA**

In section B4 the different categories of biological laboratory were discussed and tables indicating, in general, what nature of materials require what BSL are given. In this section, how materials are categorized according to the hazard they pose to personnel is discussed.

**Please note that investigators MUST register any project involving potentially disease-causing agent(s), rDNA, and/or human/non-human primate materials with the IBC and receive its approval BEFORE work is begun. See section B8.4 for details.**

The National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) publish guidelines for work with infectious microorganisms. The [BMBL](#) recommends that work be done using one of four levels of biosafety containment: BSL1, BSL2, BSL3 and BSL4 (see section B4) and does address certain biological agents. The [NIH Guidelines](#) further classify pathogenic agents into one of four risk groups (RG) according to specific criteria. Classification information for specific agents can be found in Appendix B of the NIH guidelines.

It is Texas Tech University policy that all laboratories adhere to these NIH/CDC guidelines. In some cases, the methods used in conjunction with a biological material may increase the normal BSL at which a material would be handled. If you are unsure how a biological agent/toxin or animal/human material should be classified, please contact EHS at 806-742-3876.

### **B5.1 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 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; in some cases what is being done with the agent may modify the BSL necessary for safe handling of the material. Additionally, 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. Appendix B of the NIH guidelines should not be considered an all-inclusive list; this list is reviewed and updated annually. Also, risk groups 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 a country/organization determines the RG of an agent:

- Pathogenicity
- Mode of transmission
- Host range
- Availability of effective vaccines and treatment

The NIH guidelines 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*. Please see section B8.2.2.1 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.

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 low community risk.

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 individual and high community risk.

The American Biological Safety Association has assimilated a risk group database <https://my.absa.org/tiki-index.php?page=Riskgroups>. This is a useful tool to determine an agent's risk group if you are uncertain; however it does not contain information regarding biological toxins. Be aware that only the NIH classification is applicable to work completed in the United States. In the event the NIH has not classified an organism please contact EHS. Certain specific groups of biological materials are discussed below for additional clarification.

## **B5.2** Genetically Engineered Organisms

All work with genetically engineered organisms is to be done in compliance with the NIH Guidelines. These guidelines classify recombinant DNA experiments into four risk groups as discussed in the previous section. Additionally, the USDA requires permits for field testing of genetically engineered plants. It is Texas Tech University policy that all laboratories follow these guidelines. A summary (current as of Fall 2015) is below; please refer to the [NIH Office of Biotechnology Activity website](#) for the most current guidelines.

### **B5.2.3** Experiments covered by the NIH Guidelines

All Experiments involving rDNA molecules require registration and approval by the IBC regardless of NIH exemption. Experiments that require IBC approval before initiation include those:

- (a) That use Risk Group 2, 3, 4, or Restricted Agents as host-vector systems;
- (b) In which DNA from Risk Group 2, 3, 4, or Restricted Agents is cloned into nonpathogenic, prokaryotic or lower eukaryotic host-vector systems;
- (c) That involve infectious virus, or defective virus in the presence of helper virus in tissue culture systems;
- (d) That involve whole plants or animals; and/or
- (e) That involve more than 10 liters of culture.

### **B5.2.4** Experiments that must be registered at the time of initiation include those:

- (a) Involving the formation of recombinant DNA molecules containing no more than 2/3 of the genome of any eukaryotic virus propagated in tissue culture;
- (b) Involving recombinant DNA-modified whole plants, and/or recombinant DNA-modified organisms associated with whole plants, except those that fall under Section III-A, III-B, III-C, or III-E of the Guidelines.

### **B5.2.5** Experiments exempt from the NIH Guidelines

Experiments exempt from the NIH Guidelines still require registration with the IBC, but may be initiated immediately. The Chair of the IBC will review the application form and confirm that the work is classified correctly according to the NIH Guidelines. A list of exemptions can be found in the NIH Guidelines, Appendix C. Exempt experiments are those that:

- (a) Use rDNA molecules that are not in organisms or viruses (*i.e.* synthetic) that cannot replicate inside a living cell, are not designed to integrate into DNA and do not produce a toxin;
- (b) Use molecules that are not in organisms, cells or viruses and that have not been modified/manipulated allowing them to penetrate cellular membranes;
- (c) Consist entirely of DNA segments from a single non-chromosomal or viral DNA source, though one or more of the segments may be a synthetic equivalent;
- (d) Consist entirely of DNA 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) Consist entirely of DNA 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) 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;

- (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) Do not present a significant risk to health or the environment as determined by the NIH Director, with the advice of the Recombinant DNA Advisory Committee (RAC), and following appropriate notice and opportunity for public comment;
- (i) Contain less than one-half of any eukaryotic viral genome propagated in cell culture;
- (j) Use the following host-vector systems: *E. coli* K12, *Saccharomyces cerevisiae*, *Saccharomyces uvarum*, *Bacillus subtilis*, *Bacillus licheniformis*, or *Kluyveromyces lactis*, unless genes from Risk Group 3 or 4 pathogens or restricted animal pathogens are cloned into these hosts;
- (k) Involve extrachromosomal elements of gram positive organisms; or
- (l) Involve purchase or transfer of transgenic rodents and the generation of certain BL1 Transgenic Rodents via Breeding.

### **B5.3** Human Materials

#### **B5.3.1** Regulation

On a federal level, 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 guidelines and University OP 60.24 regarding bloodborne pathogen protection to provide a safe working environment for TTU personnel.

#### **B5.3.2** Training Requirements, Medical Surveillance and IBC Review

In addition to the other trainings required by the University, both Biosafety and Bloodborne Pathogen training are required for faculty and personnel who oversee or work in environments where human and/or non-human primate material is handled.

Documented offering of the Hepatitis B vaccine is required in these laboratories, the cost of which is presently to be covered by the PI responsible for the exposed personnel. This documentation must be maintained by the PI or laboratory supervisor. The extent of laboratory medical surveillance is at the discretion of the PI. Consult EHS if you have questions regarding vaccination or medical surveillance.

In accordance with the BMBL, all human and/or non-human primate material should be presumed infectious and handled using BSL2 work practices. This concept is called Universal Precautions. Work with human and/or non-human primate materials requires a certified BSL2 laboratory space and IBC protocol review. Please see section B8.4 for more information and contact EHS with additional questions at 806-742-3876.



### **B5.3.3** Description of Materials

Human and non-human primate material includes the following:

- a) All fluids and excretions (blood, blood components, urine, saliva, semen, vaginal secretions, cerebrospinal fluid, excrement, synovial fluid, sweat, etc.),
- b) Unfixed tissues,
- c) Cells (including established cell lines for cell culture), and
- d) Any other material of human or non-human primate origin (with the exception of hair and nails).

All human material is considered potentially infected with bloodborne pathogens such as hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Please contact EHS at 806-742-3876 if you have questions regarding a specific material or project.

## **B6** EMERGENCY PROCEDURES

### **B6.1** Biological Spills

Spills involving biohazards require immediate and proper response. Such spills are potentially hazardous to the party directly involved and to others in the lab. The nature of the biohazard, 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 by using these parameters will help determine if and to what degree EHS assistance is needed.

- (a) Nature of the Biohazard
  - RG1/RG2
  - Composition (liquid, solid, sample, etc.)
  - Risk of aerosolization
- (b) Quantity
  - Volume
  - Concentration of biohazard
- (c) Location
  - Contained vs uncontained

#### **B6.1.1** Biological Spill Kit

A biological spill kit shall be kept in each laboratory where work with microorganisms is conducted; the kit supplied by EHS does not fulfill this requirement. It is the responsibility of the laboratory to gather and compile the supplies for the kit according to their individual needs. The kit(s) should be kept in an accessible location where spills are most likely.

While not listed below as an element for the kit, fresh disinfectant should always be available in the laboratory. If you have access to an autoclave, you should select a

container which is autoclavable for the broken glass so that it can be autoclaved immediately after collection.

Basic equipment includes:

- paper towels, pig pads, dams for large spills and/or absorbent powder for biological materials
- household rubber gloves
- forceps, tongs or other tool(s) to pick up and collect broken glass
- rigid container without holes to collect broken glass

## **B6.2** 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. Below are guidelines for developing such procedures for managing biological spills in the laboratory. Do not hesitate to contact EHS if you are not comfortable addressing a spill.

- (a) Alert others working in the area of the spill to prevent spreading. Post a sign if needed.
- (b) If your lab coat and gloves were contaminated in the spill promptly remove them (coat then gloves) turning the exposed surface to the inside, place in a biohazard bag and thoroughly wash the affected area(s) with soap and water.
- (c) Evacuate the immediate area (10 foot radius) of the spill for a minimum of 20 minutes. In some laboratories this may be the entire laboratory space.
- (d) Don clean PPE before addressing the spill. Wear at least gloves, safety glasses and a lab coat.
- (e) Cover spilled material with paper towels. For large spills, use pig pads and/or absorbent dams. 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.
- (f) Starting at the perimeter, cover absorbent material with fresh disinfectant in sufficient quantity to ensure effective microbial inactivation. Be sure to use an appropriate disinfectant for the spilled material.
- (g) Allow 20 minutes of contact time for disinfection unless a longer contact time is required by the manufacturer. Leave the immediate area while waiting for contact time to pass. Safely remove PPE and wash hands before leaving the laboratory.
- (h) Don fresh gloves. The same lab coat may be worn if not contaminated in the previous step. Dispose of absorbent materials in biohazard waste container to be autoclaved unless bleach is used.
- (i) Disinfect spill area again with diluted disinfectant and allow adequate contact time. Do not neglect vertical surfaces. It is prudent to mop the lab floor.
- (j) Remove lab coat. Autoclave lab coats or soak in bleach to disinfect. Remove gloves and place in biowaste.
- (k) Wash hands with soap and water when finished. Don clean PPE before continuing work.

- (l) Submit a SCAN report using the Quick Link on the WH&S website:  
<http://www.dept.ehs.ttu.edu/ehs/ehshome/>.

**B6.2.1** Spill Involving Broken Glass

If broken glass is involved in a spill, remove visible pieces prior to covering the spill. Always handle glass indirectly using forceps, tongs or other device. Place glass in rigid container and decontaminate by autoclaving or chemical disinfection.

Once disinfected, transfer glass to broken glass box – again, do not handle glass with your hands. See section B7.4.9 for specific glass disposal details.

**B6.2.2** Spill of Human Fluids:

In laboratories in which human materials are handled, a daily preparation of 20% bleach solution or EPA-registered “hospital-grade” disinfectant is required for decontamination. Use a volume of disinfect equal to the spill to ensure adequate decontamination. Follow the guidelines above to address the spill. **If bleach is used, do not autoclave clean up materials; fatal chlorine gas can be produced.**

Notify the PI and submit a SCAN report regarding the incident. If the spill caused direct exposure of personnel to human materials then an incident report needs to be filled and the individual may need to be evaluated by a physician. Samples of the material should be collected in the event testing is requested by the physician.

**B6.2.3** Spill of a BSL3 material:

Follow the protocol in the laboratory-specific safety manual.

**B6.2.4** Spill in a Biological Safety Cabinet:

Leave the cabinet turned on and sash at a working height during clean up.

Remove outer gloves. Remove any contaminated PPE and wash effected areas with soap and water before proceeding.

Don clean PPE. Remove any glass as described in B6.2.1. For small spills start at letter ‘d’ in section B6.2 above and proceed accordingly. For larger spills it may be necessary to flood the work surface, as well as drain pans and catch basins below the work surface, with disinfectant – not ethanol/isopropanol as it will evaporate. Allow 20 minutes contact time. Disinfect all interior walls and all materials within the hood with disinfectant during your wait.

Soak up the disinfectant and spill with paper towels or other absorbent material, and drain catch basin into a container. Lift front exhaust grille and tray, and wipe all surfaces. Ensure that no paper towels or solid debris are blown into area below the grille.

Discard all clean-up materials into biohazard waste container. Wash hands and exposed skin areas with soap and water.

If the spill overflows into the interior of the cabinet, more extensive decontamination (e.g., fumigation by a third party) may be necessary.

#### **B6.2.5** Spills in a Centrifuge

Close centrifuge lid and let sit for 20 minutes to allow aerosols within the centrifuge to settle. 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 if bleach was used.

Open the centrifuge and carefully remove any pieces of debris from the centrifuge interior using forceps and place in a biowaste bag. Remove rotor and set aside for disinfection. It would be prudent to disinfect the rotor in a BSC.

Absorb / cover spill with paper towels. Squirt disinfectant on towels and remaining interior of centrifuge using a laboratory soak bottle or pour disinfectant. Let disinfectant sit for 20 minutes. Do not use a spray bottle as this can aerosolize contaminants.

Follow with DI-water if bleach was used, then 70% ethanol or isopropanol. Dispose of all waste as biohazardous waste.

#### **B6.2.6** 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.**

Wash hands and exposed skin areas with soap and water, and monitor personnel and spill area for residual radioactive contamination. If skin contamination is detected, repeat decontamination procedures under the direction of the Radiation Safety Officer. If spill area has residual activity, determine if it is fixed or removable and handle it accordingly.

Submit a SCAN report regarding the incident at the EHS website:  
<http://www.dept.ehs.ttu.edu/ehs/ehshome>.

#### **B6.3** Illness or Injury Involving Biological Materials

**B6.3.1** **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 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. This form is available on the EHS website at: <http://www.dept.ehs.ttu.edu/ehs/ehshome/labsafety> under the lab documents tab and in Appendix BJ. 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.dept.ehs.ttu.edu/ehs/ehshome>.

**B6.3.2**     **Splash to the Eye:** Use the emergency eyewash to immediately flush the eye with a gentle stream of clean, temperate water for 15 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.

An incident report will need to be filed immediately so that the individual is eligible for workers compensation. This form is available on the EHS website at: <http://www.dept.ehs.ttu.edu/ehs/ehshome/labsafety> under the lab documents tab and in Appendix BJ.

**B6.3.3**     **Contamination to the Body:** Immediately remove contaminated clothing and drench skin with water. Wash with soap and water, and flush the area for 15 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. This form is available on the EHS website at: <http://www.dept.ehs.ttu.edu/ehs/ehshome/labsafety> under the lab documents tab and in Appendix BJ.

## **B6.4**     Fires

- (a) Without placing yourself in danger, secure biological materials by placing them in an incubator, fridge or freezer.
- (b) Activate the building fire alarm (if the fire is in your location) and leave the building at once according to building evacuation procedures.
- (c) Meet the fire department outside and tell them of the fire location.
- (d) You are not required to use a fire extinguisher. Only use an extinguisher if you:
  - Are knowledgeable on how to properly operate a fire extinguisher
  - Are confident and comfortable operating a fire extinguisher, and
  - Using the fire extinguisher does not put you in danger.

## **B7**     **DECONTAMINATION AND DISPOSAL**

### **B7.1**     Definitions

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 further difficulties with disinfection and sterilization.

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

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. Sanitation, disinfection, antisepsis and sterilization, are all forms of decontamination.

Sanitation – the reduction of microbial load on an inanimate object/surface to an acceptable level.

Disinfection – the use of (liquid/chemical) antimicrobial agents on inanimate objects to destroy or irreversibly inactivate all infectious fungi and bacteria but not their spores. Disinfectants can be “general” or “hospital” grade, the latter being shown effective against *S. aureus*, *S. cholerae* and *P. aeruginosa*. Additionally, it may be effective against *M. tuberculosis*, pathogenic fungi and specifically named viruses; some are sporicidal and considered sterilants/sterilizers.

Chemical disinfectants are used to render a contaminated material safe for further handling, whether it is a material to be disposed of as waste or a laboratory bench on which a spill has occurred. It is important to choose a disinfectant that has been proven effective against the material(s) or agent(s) being used and at the appropriate concentration. Use RO/DI water for dilution. **With the exception of ethanol and isopropanol, only use chemical disinfectants that are registered by the EPA.** Lists are available at <http://www.epa.gov/oppad001/chemregindex.htm>.

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.

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.

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

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

-static – repression of growth or multiplication of an agent in its presence. (e.g., bacteriostatic, fungistatic, etc.)

## **B7.2** Chemical Disinfectants Commonly Used in the Laboratory

Multiple factors contribute to the destruction/inactivation of biological organisms and agents. Such factors include the following:

### (a) Biological factors

- Microbial load (number and variety of organisms present)
- Organism life cycle (sporeformer?)
- Innate resistance of these organisms
- Presence of biofilms

(b) Physical and chemical factors

- Temperature and pH→ can increase/decrease efficacy of a chemical disinfectant
- Presence of organic and inorganic materials.
  - Organic matter can create physical barriers reducing contact and bind antimicrobial agents decreasing overall concentration of the effective agent in a solution. Inorganic matter can create a physical barrier in the formation of salt crystals.
- Disinfectant concentration
- Duration of exposure or “contact time”.

There is no such thing as a perfect disinfectant; there are pros and cons to each chemical disinfectant type. Common disinfectant types are discussed below and in Appendix BF. Please note that this is not an exhaustive list of disinfectants.

**Texas law states that only EPA-registered disinfectants or properly diluted bleach shall be used for chemical decontamination of biological wastes; furthermore, all label instructions for dilution and contact time on EPA-registered disinfectants are to 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).**

All stock solutions of chemical disinfectants should be stored according to the label and CHP guidelines for chemical segregation. 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.

**B7.2.1** Iodophors

Use:

- Recommended dilution is 75-5,000 mg/L (ppm), or approximately 0.5% concentration
- Effective against vegetative bacteria, fungi, and viruses
- Some are antiseptics (e.g., betadyne, scrubodyne)
- Some are surface disinfectants (e.g., Wescodyne™ Steris Corporation)

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

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

### **B7.2.2** Sodium Hypochlorite (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 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 1:10 dilution of bleach 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*.
- Available free chlorine is maximized when the solution is pH 5-7.
- Store prepared solutions in brown plastic bottles to protect from light.
- Recipe for large quantity ~1% solution with 800 ppm available chlorine:
  - 1:64 dilution of Clorox in water (2oz in 1 gallon of water)
  - 2oz of 5% distilled white vinegar (cooking vinegar)
  - Make daily! (Microbe 6:257, June 2006)

Pros:

- (a) Broad spectrum effectiveness
- (b) Readily available and inexpensive
- (c) High concentrations can kill spores and remove biofilms
- (d) Fast acting

Cons:

- (a) Very corrosive, especially to stainless steel
- (b) Must be prepared daily for effective available ppm chlorine concentration
- (c) Rapidly inactivated by organic matter, light, and some metals



(d) **WARNING!!!!** Bleach in combination with other cleaners can produce deadly, toxic compounds

- Bleach + 4% phosphoric acid cleaner = chlorine gas
- Bleach + Ammonia containing cleaner = chloramine vapors and potentially hydrazine

### **B7.2.3** 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  $C_1 * V_1 = C_2 * V_2$  formula to calculate the concentration you wish to make

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

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) Attacks acrylic, polypropylene, PVC and polycarbonate plastics and rubber overtime or with prolonged or repeated use
- (f) Can coagulate proteins and attach them to surfaces
- (g) Can compromise latex and vinyl gloves with extended exposure (1 hour)
- (h) Dissolves adhesives in instruments (such as microscopes)
- (i) Cannot penetrate protein-rich materials (e.g., dried blood/plasma)

### **B7.2.3** Quaternary ammonium salts/Amines (quats)

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
- 4<sup>th</sup> generation QUATs maintain effectiveness in the presence of organic material and hard water

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

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

### **B7.2.4** Phenolics

Use:

- Dilute according to manufacturer instructions
- Effective against bacteria, fungi and enveloped viruses

Pros:

- (a) Tuberculocidal
- (b) Maintain good activity in the presence of organic material and hard water
- (c) Residue has some residual activity after drying

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

**B7.2.5** Hydrogen Peroxide (3-8%) or Vapor-phase Hydrogen Peroxide (VHP)

Use:

- Surface sterilant
- Broad-spectrum effectiveness
- Requires specialized equipment
- Aqueous H<sub>2</sub>O<sub>2</sub> 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.

Pros:

- (a) Environmentally safe by-products (H<sub>2</sub>O, O<sub>2</sub>)
- (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

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

**B7.3** Autoclaving (Steam Sterilization)

Autoclaves use pressurized steam (moist heat) to destroy microorganisms and are the most widely used and dependable system available for the decontamination of laboratory waste and the sterilization of laboratory equipment, glassware, media and reagents. Autoclaving should be used whenever possible as the choice means of decontamination of laboratory waste. There are 4 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.

Certain wastes require decontamination prior to disposal by the Texas Commission on Environmental Quality (TCEQ). Thus, to ensure consistency of sterilization practices, EHS has instituted a program for autoclave use and monitoring; however 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 (See B3.2.6 and Appendix BK). Mechanical, chemical and biological monitors should be used to evaluate unit performance in accordance with the program.

### **B7.3.1** Regulations

The following is taken directly from the Texas Administration Code (TAC); please refer to 30 TAC §330.3 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.

According to the TAC "medical waste" requires treatment prior to disposal. Generally speaking, medical waste consists of waste associated with BSL2 activities. Briefly, medical waste 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, Chapter 3, §3.296(f)).

Generators (*i.e.* each laboratory) of medical waste are regulated based on the amount (in lbs.) of waste they produce in a month. If waste is treated on-site by a lab, they must adhere to the regulations below.

#### **B7.3.1.1** Required Record of Autoclaved Waste

**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 waste treated;
- (c) Method/conditions of treatment;
- (d) The name (printed) and initials of the person(s) performing treatment; and
- (e) A written procedure for the operation and testing of any equipment used and a written procedure for the preparation of any chemicals used in treatment.

#### **B7.3.1.2** Required Frequency of Biological Testing

**The laboratory in conjunction with EHS shall:**

- (a) Demonstrate a minimum four log ten reduction ( $10^4$ log) (as defined in 25 TAC §1.132 (relating to Definitions)) on routine performance testing using appropriate *Bacillus* species biological indicators (as defined in 25 TAC §1.132).

- (b) Conduct testing on autoclaves which process BSL1 material on an annual basis.
- (c) Conduct testing on autoclaves which process BSL2 material at least monthly or at the following applicable interval:
  - For generators 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 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.

### **B7.3.2** Monitoring Autoclave Performance

As indicated above, autoclaves used to decontaminate laboratory waste must be tested periodically to assure effectiveness in order to protect human health and the environment.

Mechanical monitors include thermometers, pressure gages and displays on the autoclave. Correct readings do not ensure sterilization; but incorrect readings could be an indication of problems. EHS recommends the printer for autoclaves as a regular means to monitor and log autoclave performance.

A cycle print out is available on some campus units; printers on these units should be maintained with ink and paper.

Autoclave performance shall be evaluated with chemical and biological tests. Indicators shall be placed in autoclave locations that are the slowest to heat. Please see the Appendix BK 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.

Two types of tests are frequently used to evaluate autoclave efficacy:

- 1) Chemical indicators
- 2) Biological indicators

#### **B7.3.2.1** Chemical Indicators

Chemical indicators use temperature-, pressure- and/or vapor- sensitive chemicals to assess physical conditions during autoclaving and are generally inexpensive and easy to use. Heat-sensitive indicator tape is a chemical indicator and should be used on all materials within every autoclave load. Multi-parameter and single-parameter chemical indicators are available for autoclaves. Refer to the manufacture for placement of chemical indicators within the load.

Chemical indicators should be used in conjunction with biological indicators, not replace them, as they only assess that the physical parameters of sterilization were met; biological indicators are the only means to prove sterilization has been achieved.

#### **B7.3.2.2** Biological Indicators

Biological indicators contain heat-resistant spores (commonly *Geobacillus stearothermophilus*) that are destroyed when an autoclave is functioning properly. Biological indicators are the most accepted and widely used means of monitoring the sterilization process.

As indicated in B7.3.1.2, EHS will test all University autoclaves with biological indicators at least annually. Autoclaves which process BSL2 level materials will be tested at least monthly by the laboratory with or without the assistance of EHS. Indicators for testing, procedure and record sheets will be provided by EHS. The procedure and record sheets can be found in Appendix BK.

Biological indicators **shall** be used when:

- (a) The autoclave has been repaired
- (b) New waste cycle parameters are set
- (c) Autoclave waste loading procedures or materials have changed

Biological indicators **should** also be used when:

- (a) A new type of packaging material or tray is used
- (b) New personnel is trained
  - NOTE: These evaluations would be at the laboratory's expense.

#### **B7.3.2.3** Failed Indicators

If an autoclave fails a biological test post an "out of service" sign on the unit and contact the appropriate party to initiate a service call. Do not use the autoclave until it has been inspected, repaired and successfully challenged with a biological indicator in 3 consecutive "dummy" or non-hazardous loads with control tests for each. Record and report all results to EHS. Please see the procedure in Appendix BK and contact EHS with further questions.

### **B7.3.3** Autoclave Bag and Container Selection

#### **B7.3.3.1** Polypropylene Bags

Commonly called biohazard or autoclave bags, these bags are tear resistant but can be punctured or burst in the autoclave. Therefore, place bags in a rigid container during autoclaving. Bags are available in a variety of sizes and thicknesses. Purchase bags with a printed indicator that changes color when processed. **Polypropylene bags are impermeable to steam and for this reason, should not be twisted and/or taped shut. Gather bags loosely at the top and secured with a large rubber band, twist tie or autoclave tape. This will create an opening through which steam can penetrate.**

#### **B7.3.3.2** 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.**

#### **B7.3.3.3** 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.

#### **B7.3.4** 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.

##### **B7.3.4.1** 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. See section B7.3.3.

##### **B7.3.4.2** Packets and Bags

- (a) Always put bags of biological waste into an autoclavable secondary container to catch spills. See section B7.3.3.
- (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. Do not overfill bags or twist/knot the tops of bags. This prevents adequate steam entry into the bag and can result in incomplete sterilization. Use indicator tape or twist ties to loosely secure the top of the bag.
- (d) In the case of a vial, insert a needle.
- (e) Place a strip of indicator tape on bag if not used to secure the top of the bag.
- (f) 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.

#### **B7.3.4.3** Loading

Loading procedures must allow adequate steam circulation and will vary with items to be loaded and unit configuration. Wear lab coat, eye protection, heat insulating gloves, and solid shoes. Carry, do not wear, your PPE with you if you must travel in public corridors to the autoclave.

- (a) Select containers with the lowest sides and widest diameter possible for the autoclave.
- (b) Remove container lid if present.
- (c) Leave space around each item.
- (d) Use perforated trays and/or wire baskets for items that will not generate spills.

#### **B7.3.5** Cycle Selection Guidance:

- (a) Use liquid cycle (slow exhaust) when autoclaving liquids, to prevent contents from boiling over.
- (b) Select fast exhaust cycle for glassware.
- (c) Use fast exhaust and dry cycle for wrapped items.

#### **B7.3.6** Time Selection Guidance:

- (a) Take into account 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 extend time to achieve sterilization.
- (c) All biological waste should be autoclaved for a minimum of 50 minutes at 121°C and 15 psi.

#### **B7.3.7** Removing the Load:

Wear lab coat, eye protection, heat insulating gloves, and solid shoes. Carry, do not wear, your PPE with you if you must travel in public corridors to the autoclave.

- (a) Check that the chamber pressure is zero.
- (b) Standing behind the door while you open it, slowly crack open door to vent steam. Beware of this rush of steam.
- (c) If liquids were processed, open autoclave door and allow liquids to cool for 20 minutes before removing.



## **B7.4** Management of Biologically Contaminated Materials and Waste

### **B7.4.1** Disposal Containers

Each laboratory is responsible for purchasing containers for the disposal of biological waste unless the research being conducted warrants waste management by EHS (see section B7.4.3.3).

#### **B7.4.1.1** Sharps Containers

Disposal of sharps requires a special container by law. In BSL2 and BSL3 laboratories, a FDA-cleared sharps container is required. They are available in various sizes and have the following features:

- (a) Puncture-resistant rigid plastic
- (b) Red
- (c) Labeled as containing a "Biohazard" and "Sharps"
- (d) Lid design traps items so they cannot be retrieved, is puncture/leak resistant and locks tightly
- (e) Have a line that indicates when the container should be considered full.

These containers may be purchased from local sources, including the Physical Plant Central Warehouse and medical supply stores, as well as from laboratory product distributors.

An alternative to FDA-approved sharps disposal containers appropriate for use in chemical and BSL1 laboratories is a heavy duty household container such as a liquid laundry detergent container; milk jugs are not rigid enough to be used for sharps. Any container used must have the following features:

- (a) Heavy-duty plastic (not a milk jug);
- (b) Must stay upright during use;
- (c) Able to close with a tight-fitting, puncture resistant lid which doesn't allow sharps to come out; and
- (d) Leak-resistant.

Do not purchase or use "needle-cutter" devices; use of such devices can generate aerosols.

#### **B7.4.1.2** Biohazard Autoclave Bags and Holders

Autoclave bags should be made of polypropylene and can be purchased from laboratory product distributors in a variety of sizes and thicknesses; also see section B7.3.3.1. Bags should be purchased in red, orange, and clear. Regardless of the color used, the bag must have a biohazard symbol.

There are a wide variety of biohazard bag holders and bins. With the exception of bench-top pipette tip collection bags, bags should be placed inside a rigid container with lid while waste is being collected. If a normal trash bin is used to hold a biohazard bag the trash bin must be labeled with a biohazard symbol, never used for non-biohazardous waste, and have inner and outer surfaces that are able to be disinfected.

### **B7.4.2** Biological Waste Regulations

All biological wastes require treatment prior to disposal. Thus, to ensure consistency of decontamination and sterilization practices, EHS has instituted a waste program that includes autoclave use and monitoring (see section B7.3). Waste types and proper treatment are discussed below.

Biological wastes are regulated by TCEQ. This means that laboratories which generate biological waste must segregate biological waste from other hazardous wastes and general, non-hazardous wastes.

### **B7.4.3** Biological Waste Treatment and Disposal

By law, biological waste is to be treated in accordance with 25 TAC 1.136. Brief guidelines are below. Please contact EHS if you have questions as to how to manage your biological waste.

#### **B7.4.3.1** Solids

- (a) Collect disposable, solid materials contaminated by a biological agent, *excluding* sharps, into an autoclave bag within a sturdy container.
- (b) When half to three-quarters full, prepare bag as described in B7.3.3.2 and autoclave the bag as described in section B7.3.
- (c) Allow bag to cool, affix a “treated” sticker to the bag and place autoclave bags in black trash bags.
- (d) Bags may now be disposed of in the building's dumpster by laboratory staff.

**DO NOT THROW TREATED OR UNTREATED RED BAGS DIRECTLY INTO A DUMPSTER.**

#### **B7.4.3.2** Liquids

Liquid biological waste can be disposed of in two ways:

- (a) Autoclaving – see section B7.3, or
- (b) Chemical disinfection – see section B7.2; contact EHS if bleach is not to be used.
  - Sodium hypochlorite is an inexpensive disinfectant that can be used to disinfect most liquids without a heavy organic load.
  - Different materials require different concentrations and contact times. Should you choose to decontaminate liquids by chemical disinfection, a *validated* standard operating procedure for the specific liquid matrix must be followed.

For *most* liquids:

- 1) Add an equivalent volume of 20% bleach solution (Clorox - %5.25 household bleach) to the container with the liquid. This yields a final dilution of 10% bleach.
- 2) Allow 20 minutes of contact time.
- 3) Dispose of solution by pouring down the sink.

**DO NOT AUTOCLAVE LIQUID.**

- 4) Wash container as usual and rinse well before autoclaving.

**B7.4.3.3** Biological Waste Pick-up by EHS

Biological waste barrels with liners are provided by EHS to laboratories for biological waste collection and disposal in certain cases. Laboratories that may need barrels might include those which:

- (a) Lack access to an autoclave;
- (b) Perform research which generate large amounts of waste that are not manageable in available autoclave(s);
- (c) Perform research utilizing high hazard pathogenic agents which effect plants, animals and/or people;
- (d) Perform research utilizing human materials; and/or
- (e) Perform research which includes live animals, whole carcasses of unpreserved animals, whole cuts of meat or other dense items which are at risk of not autoclaving properly.

**B7.4.3.3.1** Guidelines for Biological Barrel Use

- (a) Call EHS and request the required number of barrels for biological waste no less than 1 week in advance.
- (b) Submit waste pick-up request online through the EHS website: <http://www.dept.ehs.ttu.edu/ehs/ehshome>. Additional barrels can be requested in the comment section of the waste request.
- (c) Barrels cannot weigh more than 40lbs.
- (d) Liners must be knotted – sides pulled up and tied together – and lids secured.

**B7.4.4** Human Materials

All human materials should be handled using universal precautions. Discard disposable items contaminated with human materials (excluding sharps and glassware) into the biowaste barrels available from EHS. Follow guidelines for barrel use in section B7.4.3.3.1.

**B7.4.5** Disposal of Animal Tissues, Carcasses and Bedding

- (a) Disposal of non-farm animal tissues, unpreserved carcasses and bedding is to be coordinated with EHS and IACUC. Freeze / refrigerate tissues and carcasses until pick-up to prevent odor.
- (b) Preserved carcasses can be disposed as general waste. Collect all liquid preservative and dispose of as hazardous waste. Place carcasses in black trash bag and dispose of in building's dumpster.

If you have questions please call EHS at 806-742-3876.

**B7.4.6** Multi-hazard or Mixed Waste

Avoid generating mixed waste; if unavoidable, keep volume of mixed waste to a minimum. Do not autoclave mixed waste.

- (a) When discarding waste containing a biological agent and radioactive material, inactivate the biological agent first, and then dispose of as radioactive waste. **DO NOT USE BLEACH SOLUTIONS ON IODINATED MATERIALS: RADIOIODINE GAS MAY BE RELEASED.** Seek advice from the Radiation Safety Officer at 806-742-3876 before beginning inactivation procedures.
- (b) When discarding waste containing a biological agent and a hazardous chemical, inactivate the biological agent first and then dispose of as chemical waste. Seek advice before beginning inactivation procedures.

**B7.4.7** Disposal of Sharps

Sharps are considered to be any metal object/device used to puncture or cut. While broken glass can puncture or cut, it is not considered as "sharps" waste and is handled separately. Examples of sharps include any type of injection device and whatever is attached to it, razors, X-Acto knives, pointed scissors, scalpels, etc. Such items require special disposal as outlined below.

Guidelines for disposal:

- (a) Puncture-proof, securable containers 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.
- (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) Sharps that have contacted chemicals can be rinsed or flushed once (collect rinse as hazardous waste) and disposed of in a sharps container. When full, dispose of the sharps container through EHS waste pickup as "Biological" waste.

- (h) 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.

Dispose of ALL sharps containers through EHS waste disposal. "Biological" is the indicated waste type unless radioactive materials are present.

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 to EHS within 24hrs of the injury. Call EHS if you have any questions at 806-742-3876.

#### **B7.4.8** 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:

- (a) Autoclave items that have been collected in autoclavable container. See section B7.3 for guidelines.
- (b) Chemically disinfect items by soaking in sodium hypochlorite solution for a minimum of 20 minutes before washing. For heavily soiled items, a scrub then and second soak in fresh sodium hypochlorite solution may be necessary. Follow disinfectant step(s) with a thorough water rinse. The rinse is especially important for items vulnerable to corrosion and those which will be autoclaved.

#### **B7.4.9** Glassware

Any sturdy, puncture-resistant, closable box may be used for glass disposal. Specific glass disposal boxes can be purchased from various laboratory product distributors and come in multiple sizes.

Do not handle broken glass with your hands. Use forceps, tongs or some other tool to collect and handle broken glass.

##### **B7.4.9.1** Uncontaminated Glass

Uncontaminated Pasteur pipettes and broken or unbroken glassware are discarded into containers specifically designated for broken glass disposal as described in B7.4.9 above. When boxes are full, tape closed and place in the building's dumpster in accordance with University Operating Procedure 60.10.

##### **B7.4.9.2** Contaminated Glassware

Biologically contaminated Pasteur pipettes and broken or unbroken glassware may be treated in one of two ways:

- (a) Autoclave in a puncture-proof, autoclavable container, or
- (b) Place in a wire sieve then soak in sodium hypochlorite solution or other applicable chemical disinfectant solution for the appropriate contact time.

Autoclaving is the recommended decontamination method. There are benchtop autoclavable 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).

Once glass has been decontaminated, discard into designated glass disposal box as described in B7.4.9.1 above.

Do not handle broken, contaminated glass with your hands. Use forceps, tongs or some other tool to collect and handle broken glass. Call EHS at 806-742-3876 if you have questions.

#### **B7.4.9.3** Additional Considerations Regarding Contaminated Glass

Glass contaminated with chemicals can be triple rinsed and disposed of in the regular glass disposal box. The rinse water shall be collected and disposed of as chemical waste. See the Radiation Safety Manual for details regarding the handling of glass contaminated with radioactive materials.

## **B8** BIOLOGICAL LABORATORY OPERATION

Biosafety is an inexact science based on agent(s) present and procedures being used. The U.S. Department of Health and Human services defines laboratory biosafety as “the application of combinations of laboratory practices and procedures, laboratory facilities, safety equipment, and appropriate occupational health programs to mitigate the risks associated with handling potentially infectious microorganisms and other biological hazards.” More helpful definitions are below.

### **B8.1** Definitions

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

Biosafety – Laboratory biosafety is 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.

Biosecurity – Laboratory biosecurity is 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.

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

Primary containment – consists of techniques (good microbiological practices, hand washing, proper pipetting, proper donning and doffing of personal protective equipment) and equipment that when used properly, prevent the release of biological material. Such items include laboratory equipment (centrifuges with sealed rotors or safety cups, biological safety cabinets), splash shields, keyboard covers; and personal protective equipment (gloves, lab coats, gowns, face shields, shoe covers, goggles, safety glasses, respirators, etc.)

Secondary containment – consists of facility design and construction that functions to protect workers, the public and the environment. Laboratory features may include advanced features such as directional air flow (negative pressure in lab spaces); air treatment systems; or air locks at lab entrances, or may be as simple as restricted access in lab corridors, impervious lab furniture and benches; and locking doors.

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

Personal Protective Equipment (PPE) – All clothing and other work accessories designed to serve of be worn as a barrier against workplace hazards.

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 Management – The process of identifying and evaluating hazards and developing strategies and controls that minimize risks posed by identified hazards.

Risk Assessment – The analysis of risks associated with an event, procedure or process.

## **B8.2** Risk Management

There are certain inherent risks associated with biohazardous work which is why worker training and competency are paramount for laboratory and environmental safety. These risks must be acknowledged and addressed prior to beginning laboratory work and repeated when any changes are made to the agent, procedure, practice, employee or facility.

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. The primary hazards to consider are those associated with the agent and those associated with the laboratory procedure applied to the agent. 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 (when 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.

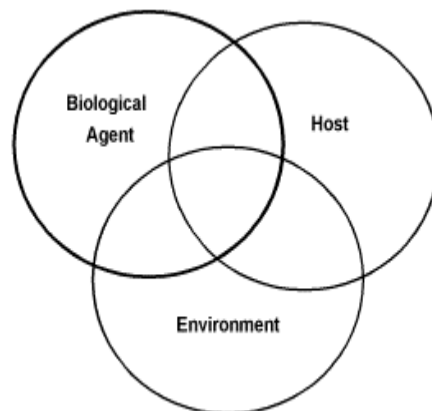
### **B8.2.1** Identification of Hazards

First, you identify the agent(s), if they are known; samples of unknowns should be handled with universal precautions at BSL2 unless permission has been granted otherwise by the IBC. Second, identify all lab procedures which will be applied to the agent. Third, identify who will be performing the work and where it will be done.

Identification of the above will help you to properly evaluate the three central components of a RA (agent, host and environment) which need to be addressed when considering biological risks.

Several factors about each component and their relationship to each other are evaluated in the next step, risk assessment.

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>.

### **B8.2.2** Risk Assessment (RA)

Biological risk assessment is generally not as direct as a risk assessment for a chemical or physical hazard as it does not evaluate objects that behave in a predictable, documented manner but involves living organisms that exist in a state of natural variation.

#### **B8.2.2.1** The Host

The human immune system can be affected by multiple factors that can modify the host response to an exposure; such factors may include:

- (a) Genetic predisposition
- (b) Pregnancy
- (c) Stress and fatigue
- (d) Medications
- (e) Chronic conditions (*i.e.* diabetes, HIV, allergies, autoimmune disease, etc.)
- (f) Acute conditions (common cold, open wound/laceration)
- (g) Treatment sensitivities
- (h) Vaccination status
- (i) Composition of natural flora

Furthermore, some medications may alter your state of mind leaving you less coordinated, alert and capable in the laboratory.



For these reasons, you may choose to alert your PI or laboratory supervisor if you have a health condition that can affect your safety in the lab so that duties can properly be assigned to you.

**In all cases, EHS strongly encourages you to inform your personal physician of all hazardous material you handle.**

Behavioral factors that can affect worker safety in the laboratory include:

- (a) Age
- (b) Education
- (c) Lack of training or recurrent training
- (d) Failure to use PPE or use it properly and other bad habits
- (e) Complacency
- (f) Distractions

#### **B8.2.2.2** Biological Agent(s)

Given the ubiquitous nature of 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 renders it impossible to calculate infectious dose; however relative estimates can be made in regard to the risk an agent poses when the following elements of an agent are considered:

- (a) Pathogenicity and resilience
- (b) Mode(s) of transmission
- (c) Route of infection
- (d) Host range
- (e) Vectors
- (f) Availability of treatment/prevention measures

See Section B5.1 regarding risk groups. Risk groups serve as 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.

#### **B8.2.2.2.1** Additional Factors to Consider Concerning Biological Agents

- (a) The concentration to be used
- (b) Volume of agent to be used
- (c) Risk of aerosolization and procedures to be used

These factors may increase/decrease the biosafety level required for an agent regardless of the risk group.

#### **B8.2.2.2.2** Risk Matrix

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 matrix below can help direct prioritization.

The agent risk groups are listed across the top (risk group 4 is not mentioned as the university does not have the facilities to hand RG4 agents). 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 high-risk.

TABLE 3. Risk Matrix

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 4<sup>th</sup> Ed., Fleming and Hunt, ASM Press 2006.

#### **B8.2.2.3** The Environment

Environmental factors to be considered in a RA address primarily address agent containment. Environmental factors may include:

- (a) ventilation and laboratory design
- (b) laboratory procedures and training
- (c) containment equipment
- (d) established and updated operating procedures
- (e) Personal Protective Equipment availability and usage
- (f) laboratory sanitation and waste management
- (g) use of animals

#### **B8.2.3** Risk Control

Once hazards are identified and the risk they pose assessed, control measures (what means of containment are to be utilized etc.) can be implemented. Hazard controls may be on an administrative, facility or laboratory level and can range from personal protective equipment (PPE) and methodology to facility design and biological safety cabinets.

**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.**

In addition to PPE, an additional key element in risk control is the biosafety manual. **This document is required for BSL2 work** and serves as the basic foundation for risk control measures 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. This document may either be an amendment to an existing laboratory safety manual or a stand-alone document in addition to your laboratory safety manual.

#### **B8.2.4** Laboratory Biosafety Manual

The Laboratory Biosafety Manual should cover the following list of items and be specifically tailored to the needs of the individual laboratory space. It shall be reviewed annually and updated as new biohazardous materials or methods are introduced. Please contact EHS at 806-742-3876 if you have questions about manual content or for a review of your manual. Please address the following in your Biosafety Manual:

##### **(a) General lab operations –**

Laboratory access and guidelines for workers/non-workers; training and certification; proper entry/exit procedures; procedures for identifying, reporting and correcting problems; facility and equipment decontamination procedures; pest management; general laboratory safety guidelines; etc.

##### **(b) Safety equipment and personal protective equipment –**

PPE requirements; proper donning and doffing procedures for PPE; maintenance and decontamination of equipment (BSC, autoclaves, eyewash, showers, centrifuges, water baths, incubators, etc.); laundering of laboratory coats; etc.

##### **(c) Practices and procedures –**

Safe handling and storage of biological materials; equipment usage; 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.

Standard operation procedures (SOPs) are important for all laboratory functions. Use of images, pictures and flowcharts in SOPs is helpful. Written procedures should include the following sections:

1. Identifying name with action words;
2. Creator name, date of creation and PI approval;
3. Purpose which explains the objective, scope, conditions, safety considerations and needed definitions, associated SOPs or other pertinent information to understand and complete the SOP;
4. List of PPE or other safety equipment needed for the task(s);
5. List of materials and equipment needed to fully complete the task;
6. Sequence of each task in detail;
7. Expected results of procedure or interpretation of outcomes.

**(d) Health and medical monitoring –**

Define what constitutes exposure for all materials; signs/symptoms of exposure for all materials; fever monitoring; vaccination requirements and or titer testing if required; etc.

**(e) 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 work day, locking freezers, inventory and material management procedures, adequate documentation, etc.); measures to assess personnel are at the discretion of the PI

**(f) Emergency procedures –**

Accidents: spill, release, exposure, fire, etc.; documentation and reporting requirements; terrorist threat; etc.

Incidents that may result in exposure to potential infectious materials must be immediately evaluated and reported to the PI and laboratory supervisor and documented. A SCAN report should be submitted to EHS for near misses <https://www.dept.ehs.ttu.edu/ehs/EHSHome/scan/Create> and an Incident Report shall be filed with EHS if harm was done to property or person. A pdf of the incident report form is available online on the EHS website at <http://www.dept.ehs.ttu.edu/ehs/ehshome/labsafety/IncidentReport>.

**(g) Training –**

Documented understanding of the biosafety manual; notification of the risks associated with the materials workers may be exposed to; frequency of in-lab proficiency testing and other trainings/assessments; etc.

**B8.2.5 Personal Protective Equipment**

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.

Given its purpose, PPE should be dedicated to a specific laboratory space and not moved among laboratories. Carry your PPE if you need it in another location, such as when removing a load from a shared autoclave.

**(a) Selection of PPE is made based on the hazard assessment and may vary with procedure to be performed.**

**(b) Defective, soiled or damaged PPE shall not be used.**

**(c) PPE shall not be worn outside the laboratory (e.g., in public corridors, outside buildings, etc.).**

#### **B8.2.5.1** Gloves

Disposable gloves are commonly used in laboratories and are required for working with chemicals and BSL2 level biological materials and recommended for BSL1 activities. Double gloving is recommended with certain materials. It is recommended that both nitrile and latex gloves are available. Nitrile gloves are recommended for working with chemicals; most glove manufacturers have done performance tests for common chemicals.

- (a) Glove cuffs should be worn OVER lab coat cuffs.
- (b) Avoid touching your face, eyewear, personal items or other environmental surfaces with your gloves.
- (c) Gloves should be removed in such a way as to not contaminate the wearer or aerosolize material on the gloves.
- (d) Used disposable gloves shall be discarded immediately after removal and not reused.
- (e) Gloves should be changed frequently. Gloves shall be changed when they are visibly contaminated, between procedures, or when integrity has been compromised.
- (f) Wash hands prior to donning gloves to remove lotions which may compromise glove integrity.
- (g) Wash hands anytime gloves are removed. Hands must be washed before leaving a laboratory.

You are encouraged to research the protection offered by your glove selection. Kimberly-Clark and Ansellpro offer glove selection tools to help you in selecting the proper gloves to suit your needs. Please find the links below.

<http://www.kcproductselector.com/Gloves.aspx>

<http://www.ansellpro.com/specware/>

Specialty gloves (natural rubber, cryogenic, neoprene, thermal, PVC, etc) may be needed for certain procedures. Such PPE must be available, in good condition and specified in the written procedure.

#### **B8.2.5.2** Eye and Face Protection

As with glove use, the type of eye and face protection needed for a certain laboratory may vary with procedure. **Regular prescription glasses are not a substitute for safety glasses.** Over the glasses safety glasses should be available on hand for workers. Contact lens may or may not be worn at the PIs discretion. 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; provide protection from impact and dust, not necessarily splashes and spays; only chemical splash goggles protect against splashes.

Laser safety goggles – Provide protection from laser light, make sure your eye protection addresses your laser type.

Face shields – Headgear providing a transparent sheet of plastic covering the entire face. They protect against nuisance dusts and potential splashes or sprays of hazardous liquids but do not provide adequate protection against impact hazards and should be worn with safety glasses.

#### **B8.2.5.3** Coats, Gowns, and Aprons

Different types of coats provide different types of protection based on the design and material composition. Some may be waterproof, flame resistant or chemical resistant.

- (a) Regardless of the design or material, lab coats should be knee-length to minimize exposure to hazards.
- (b) The lab coat selected shall address the hazards in the laboratory. For example, a barrier coat is recommended in BSL2 laboratories; this coat has knit cuffs and snaps up to the neck to prevent exposure to potentially infectious materials.
- (c) Laboratory coats should be comfortable and well-fitting; an improper fit may endanger the user.
- (d) Laboratory coats should be frequently laundered 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 coats prior to laundering is prudent.

### **B8.3** Working with Biological Materials

Federal and state regulations and guidelines govern laboratory safety to protect laboratory workers, 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 withdraw of funds from the University.

#### **B8.3.1** Registration Document and IBC Approval

The principal investigator is responsible for the preparation and submission of the Biohazard Application Form for any project involving the following with the IBC; approval is required before work is begun.

- (a) potentially infectious agents (infectious to humans, other animals, and plants)
- (b) rDNA (including those exempt from the NIH Guidelines),
- (c) biological toxins and/or
- (d) human materials

The Biohazard application form is available online at <http://www.dept.ehs.ttu.edu/ehs/ehshome/biologicalsafety>. EHS is available to assist in completing the form and any other pertinent documentation prior to IBC review. Send the completed registration document, any supporting documents, signature sheet and the current EHS training records of personnel listed on the protocol to EHS at [ibc.ehs@ttu.edu](mailto:ibc.ehs@ttu.edu) to initiate the review process.

Prior to IBC review of the registration document, the laboratory spaces where the work will be conducted must be surveyed by EHS to determine that they meet the BSL2 containment requirements if the lab is not already certified as BSL2. Once the lab meets the requirements, the IBC will review the application form and contact the PI after review with any needed corrections / clarifications and/or approval/disapproval.

### **B8.3.2** Licensing of a Lab Space

The Department of Environmental Health and Safety can guide you in meeting the requirements for a BSL2 laboratory space. Please contact us at 806-742-3876 if you have any questions.

The following is required in addition to general laboratory requirements outlined in the Chemical Hygiene Plan for a laboratory to be licensed as BSL2 space and maintain that laboratory designation:

- (a) A copy of a laboratory specific biosafety manual must be available and accessible in the laboratory.
- (b) Documentation is required indicating worker understanding of the biosafety manual and that they have been informed and understand the hazards associated with their work.
- (c) A copy of the most current edition of the CDC document *Biosafety in Microbiological and Biomedical Laboratories* must be accessible.
- (d) A copy of the most current edition of the NIH document *Guidelines for Research Involving Recombinant DNA Molecules* must be accessible.
- (e) Biological Safety training is required.
- (f) Specific in-laboratory training must be given and proficiency levels or workers must be checked. This must be documented.
- (g) Training records or a sign indicating the location of training records must be in the laboratory.
- (h) Use of human materials requires Bloodborne Pathogen training in addition to Biological Safety training. Hepatitis B vaccine must be offered.
- (i) Emergency numbers shall be easily accessible.
- (j) Lockable door which remains closed at all times.
- (k) Authorized access to the lab only. 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 B8.5 for more details.
- (l) Appropriate PPE must be worn at all times.

- (m) Gloves must be worn when working with biological materials or agents or may come in contact with contaminated surfaces or equipment.
- (n) Hand washing must occur before leaving the laboratory.
- (o) Laboratory work is secured and the lab is decontaminated at the end of the work day.
- (p) Medical surveillance programs and immunization requirements shall be put in place, as appropriate, depending on materials or agents to be used.
- (q) Lab equipment that contacts biological agents/materials must have proper biohazard signage.
- (r) Routine decontamination of laboratory equipment is required and a log is to be kept.
- (s) Decontamination of the general laboratory area (including floor) is required weekly.
- (t) Decontamination must occur after all splashes and spills. A biological specific spill kit and fresh disinfectant must be readily available at all times.
- (u) Labeled biological waste containers must be readily available.
- (v) Waste segregation procedures and disposal plans must be in place for general waste, liquid biological waste, solid biological waste, sharps, etc.
- (w) Biological safety cabinet (BSC) shall be located away from doors, room ventilation, heavily traveled areas, and other disruptive equipment so as to maintain undisturbed airflow.
- (x) All aerosol-generating procedures involving the manipulation of potential infectious materials should be conducted in a biological safety cabinet or other physical containment device. In instances that at BSC is not feasible, upgraded PPE shall be used.
- (y) Biological safety cabinet certification must be current (within the past 12 months) or a sign must be posted indicating the cabinet must not be used.
- (z) Autoclaves must be tested monthly. Autoclaves solely used for BSL1 level work shall be tested annually. All testing shall be logged.
- (aa) Biological materials/agents must be placed in a durable, leak-proof container during collection, handling, processing, storage or transport within the laboratory.

At 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.

### **B8.3.3** Special Concerns for BSL2 Laboratories

As described in section B8.3.2, only authorized personnel are allowed in BSL2 laboratory spaces.

#### **B8.3.3.1** Occasions of entry by Custodial Personnel

Once a laboratory is designated as BSL2 the PI or laboratory manager must notify custodial services that they are not to enter the laboratory. General



laboratory wastes (non-contaminated waste) shall be placed outside the laboratory for custodial pick up. Custodial Services can be reached during university business hours at 806-742-9777. A red dot shall be placed on the door by custodial staff as a signal not to enter the laboratory space.

Laboratory mopping with an appropriate disinfectant is required weekly and must be performed by laboratory personnel. Arrangements can be made with custodial for semiannual/annual floor waxing.

The laboratory must be properly disinfected prior to custodial entry and custodial staff shall be accompanied by laboratory personnel while in the laboratory. Custodial workers shall wear necessary PPE and wash their hands prior to leaving the laboratory.

#### **B8.3.3.2** Occasions of entry by Maintenance Personnel

If maintenance workers must enter a laboratory space, they first must notify the PI or designated emergency contact. While in the laboratory, maintenance personnel must be escorted by laboratory personnel at all times and clean PPE must be made available to them upon entry into the laboratory. Experiments in progress should be secured and suspended if possible. Maintenance workers shall wash their hands prior to leaving the laboratory.

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. It is for this reason that all agents and materials must be secured and the lab surfaces decontaminated prior to leaving at the close of the working day. They still must be escorted if possible, don appropriate PPE and wash hands prior to leaving the space.

#### **B8.3.3.3** Occasions of entry by Others

Those who are visiting a laboratory must be escorted at all times. They shall be notified of the hazards present in the laboratory and wear the same PPE as workers are required to. If PPE is refused or clean PPE is unavailable then entry into the laboratory shall be denied. Hands must be washed after PPE is removed, just prior to leaving the laboratory.

Minors under the age of 13 are not permitted in laboratory spaces under any circumstances. Minors age 13 may enter laboratories but may only observe. Minors age 14-17 may participate in laboratory work in accordance with the specifications of section 8 of the Chemical Hygiene Plan unless the building or laboratory-specific manual is more restrictive.

#### **B8.3.4** Basics to Aseptic Technique

Proper aseptic practices are an essential tool in a BSL2 laboratory. Aseptic technique can be defined as a set of practices that serve to minimize or prevent contamination to the worker, the work area and the items being manipulated.

Given that use of aseptic techniques will vary by laboratory and task, only general concepts are addressed here. In all cases, good hygienic practices greatly minimize contamination.

Basic aseptic technique guidelines are listed below.

- (a) Perform sensitive tasks *that do not involve biological materials* in a laminar flow hood.
- (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.
- (d) Keep work surfaces uncluttered and free of non-essential materials.
- (e) Arrange work flow 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) Frequently wash hands and change gloves. 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. A proper flame has a bright, inner pale blue cone surrounded by a more translucent outer cone.
- (l) Place caps/covers face down on work surface.
- (m) Use tools (forceps, tube openers, etc.) to open and close tubes containing biological material.
- (n) Clean up spills immediately.

#### **B8.3.5** Proper Use of Sharps

Sharps are considered to be any metal object/device used to puncture or cut. Examples of sharps include any type of injection device and whatever is attached to it, razors, X-Acto knives, pointed scissors, scalpels, etc. and require special disposal. See section B7.4.7. Some safety guidelines for proper use of sharps are outlined below.

- (a) Avoid using sharps whenever possible; use blunted needles and plastics instead.
- (b) Use devices with safety features to isolate sharps.
- (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) Do not bend, break, or otherwise manipulate needles by hand.
- (f) Do not remove needles. Discard needle and syringe as an intact unit immediately after use into puncture resistant sharps container.
- (g) Do not recap needles or other sharps by hand. 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 documented demonstration of proficiency must be recorded.
- (h) Use care and caution when cleaning up after procedures that require the use of sharps.
- (i) 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.
- (j) Sharps containers shall be easily accessible. Locate sharps containers in areas in which needles are commonly used.
- (k) Do not hand-pass exposed sharps. Place sharps in a predetermined neutral zone to pass objects to others.
- (l) Do not overfill sharps containers. Remove from service when 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: Notify the PI and seek treatment, if needed. An incident report must be filed with EHS within 24 hours of the event.

A pdf of the incident report form is available online on the EHS website at <http://www.dept.ehs.ttu.edu/ehs/ehshome/labsafety/IncidentReport>.

Near misses should be reported to EHS by submitting a SCAN form on the EHS website <https://www.dept.ehs.ttu.edu/ehs/EHSHome/scan/Create>.

## **B9 COMMON LABORATORY EQUIPMENT USEAGE**

### **B9.1 Biological Safety Cabinets**

The biological safety cabinet (BSC) is designed to provide protection to the product, the user, and the environment when appropriate practices and procedures are followed. The three types of BSCs (Class I, II, III) are described in Appendix BJ. The common element to all classes of biological safety cabinets is the high efficiency particulate air (HEPA) filter. This filter removes particulates of 0.3 microns or larger with an efficiency of 99.97%; however, particles both larger and smaller than 0.3 microns are efficiently retained within the filter.

### **B9.1.1** Chemical and Radioactive Materials in the BSC

While the HEPA filter can protect the worker from most biological hazards when used properly, it does not remove hazardous chemicals, vapors or gases. Work with particular chemicals or radioactive materials may require special measures or such work may be prohibited within the BSC based on the unit's design. 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 work you plan to do can be done safely within your BSC, please contact EHS at 806-742-3876.

- (a) **Flammable or otherwise volatile chemicals shall not be used in a Class II, Type A BSC. Limit the use of ethanol to decontamination of gloves and surface decontamination of materials within the BSC. Do not use ethanol to decontaminate the BSC.** This cabinet generally exhausts HEPA filtered air back into the work space and recirculates the remainder; furthermore, 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.
- (b) **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.
- (c) **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 should be used for procedures using volatile, toxic or carcinogenic chemicals.**

### **B9.1.2** Biological Materials

Certain biological materials and procedures may require the use of a BSC. A list of guidelines is below – it 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.

A biological safety cabinet should be used to protect you and the environment (and your work if a Class II or III cabinet is used) in the following conditions:

- (a) **When performing procedures with a high potential for creating aerosols** or those that might cause splashing, spraying or splattering of droplets of biological materials.
  - 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.

- (b) **When large quantities or high concentrations of organisms are used.**
- (c) **For processing of human materials where disease status is unknown.**
- (d) **Handling and manipulation of BSL3 agents** is ALWAYS performed in a BSC. Additional PPE, including respiratory protection, may also be required.

### **B9.1.3** Installation, Maintenance and Certification

- (a) The ideal location for a BSC is away from the lab entry in an area with restricted foot traffic and little equipment which create air movement that may disrupt the air curtain created by the hood. 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.
- (b) Biosafety cabinets are highly customizable; however, certain features are prohibited or not recommended. Sinks are generally not allowed in BSCs but may be deemed necessary in some cases (e.g., necropsy of infected mice). In this case, call EHS for cabinet selection and installation guidance.
- (c) Ultraviolet (UV) lamps are not recommended in BSCs. If installed, check manufacturer guidelines for maintenance and frequency of replacement. Laminar hood and BSC UV lamps must be properly maintained and never used as the sole source of hood decontamination. General maintenance includes:
  - 1. Cleaning bulb weekly to remove dust and debris which may lessen effectiveness of UV light.
  - 2. Checking bulb regularly with a UV meter to ensure a germicidal intensity of UV light is being emitted.
  - 3. Closing sash when lamp is on and turning off lamp when room is occupied.
- (d) Biosafety cabinets require regular maintenance and certification by a professional technician to assure that it protects you, your experiments, and the environment.
  - 1. Each cabinet must be certified when it is installed and annually after installation.
  - 2. 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.
  - 3. If a cabinet need repairs to ducted parts of the unit, it must be fumigated by a third party prior to repairs.
  - 4. Switches and repairs of that nature can be completed in-house by qualified lab personnel, a third party or the physical plant.
- (e) Laminar hoods do not require annual certification; however, EHS recommends they be certified annually to protect the integrity of your work.
- (f) Annual BSC certification is the PI's responsibility and completed by a third party; please call EHS if you need a list of vendors.

#### **B9.1.4** Guidelines for Operation of a Class II Biological Safety Cabinets

These guidelines can be applied to fume hoods and laminar flow hoods as well.

The operator's manual for your equipment will have specific instructions and recommendations for your unit. **A lab specific operating procedure should be created to address individual lab needs** from these guidelines.

**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 cuff when handling sensitive materials or BSL2 agents. Additional PPE requirements are necessary for handling and manipulation of BSL3 agents.

##### **B9.1.4.1** Preparation

- (a) Check certification date on BSC. Certification must be within the past 12 months. If certification has expired, DO NOT USE THE BSC.
- (b) Turn on fluorescent light and turn off the UV light if in use.
- (c) 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.
- (d) 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.
- (e) Check gages/monitors to ensure the unit is functioning properly. Do not work in a BSC while a warning light or alarm is signaling.
- (f) Disinfect the cabinet work surface, interior walls and the interior surface of the window with a disinfectant determined by the PI to address the particular agent.
  - 1. Do not raise sash beyond operable height.
  - 2. Ethanol is not to be used as a disinfectant for the interior surfaces of the BSC while the blower is running as it evaporates too quickly to effectively decontaminate the interior surfaces. Ethanol shall not be used inside Class II – type A hoods.
  - 3. Bleach should not be used to disinfect BSCs. If bleach is used, an ethanol or water rinse is required to avoid corrosion of the stainless steel surfaces. Use sterilized water to avoid introducing contamination into the BSC.
- (g) 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 and aerosol generation 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.

- (h) 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 work should be placed in the BSC. Preparation of a materials checklist will minimize arm movements in and out of the BSC which disrupt the delicate protective air curtain.
1. Keep the front and rear grilles clear.
  2. 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.
  3. Bulky items should be placed to the rear and to one side of the work surface.
  4. Place supplies, especially aerosol-generating equipment such as vortexes, as far back as possible in the cabinet.
  5. Workflow should be clean to dirty.
  6. Locate the container for disposal of items inside 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 also unnecessarily introduces contamination to the environment outside the BSC. Only horizontal pipette discard trays should be used. A shallow pan filled with disinfectant (no ethanol) is a good option. Contact EHS if you have questions.
  7. Include disinfectant and paper towels in your supply list to manage spills quickly if they occur.
- (i) Use a surface-decontaminated tub to move material into and out of the BSC to minimize disruptions to the air curtain.
- (j) 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.
- (k) Make sure the sash is at the proper height for operation. Keep head out of the hood; adjust stool so that your face is above the sash opening. The BSC is now ready for biological materials.

#### **B9.1.4.2** Working in the BSC

- (a) Once arms are in the BSC, delay work 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.
1. Work at least 6 inches beyond the front grille.

2. Move smoothly and deliberately in and out of the BSC, perpendicular to the unit – avoid side-to-side, sweeping movements.
  3. Do not rest arms on front grille
- (c) Always use good aseptic and microbial technique when working in a BSC.
1. Use mechanical pipetting aids.
  2. Keeping clean materials away from aerosol-generating activities will minimize cross contamination.
  3. Keep open tubes/bottles in a vertical position and do not place lids on work surface.
  4. Hold the lid above the sterile surface of petri or tissue culture dishes
  5. Recap or recover items as soon as possible.
- (d) Decontaminate gloves before entry into and removal from the BSC.
- (e) Open flames shall not be used inside a BSC or laminar flow hood. 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.
- (f) Disposable sterile loops should be used in place of metal to avoid incinerator use if possible.
- (g) Follow emergency spill protocols in the event of a spill (see section B6.3.4). 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.
- (h) When work is completed with the BSC still running, decontaminate the surfaces of supplies and equipment and remove them from the cabinet. Wipe-down the work area, interior walls and the interior surface of the window with a disinfectant determined by the PI which meets the requirements of the particular agent. Close sash if desired and turned off BSC unless laboratory protocol states the BSC is to be kept running.
- (i) If an UV light is used in the hood it may be turned on at this point if others are not working nearby. Due to its limited penetrating ability, surfaces must be dust-free and the UV light bulb should be wiped frequently to remove dust. UV radiation shall not take the place of chemical disinfection in the cabinet interior.

## **B9.2** 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 preparation or most



DNA work. **Laminar hoods should never be used as a substitute for a BSC or with the following materials:**

- (a) with cells for cell/tissue culture,
- (b) with human, animal or plant pathogens,
- (c) with rDNA work if the host-vector system is classified as BSL-2, is self-replicating, or has the capability to insert itself into DNA, and/or
- (d) with any other *potentially* infectious materials.

### **B9.3** Centrifuge Containment and Safety

- (a) Examine centrifuge tubes and bottles for cracks or stress marks before using them.
- (b) Use the proper size of rotor or bucket for your tubes/bottles/plates.
- (c) Never overfill centrifuge tubes since leakage may occur when tubes are filled to capacity. Fill centrifuge tubes no more than 3/4 full.
- (d) Use a tube/plate/bottle with an equivalent amount of water as a balance when odd numbers of items are centrifuged.
- (e) Centrifuge safety buckets and sealed rotors protect against the release of aerosols. Do not use without lids in place. When working with pathogens that are easily aerosolized delay the opening of the centrifuge 5 minutes or open safety buckets/rotor within a BSC.

### **B9.4** Vacuum Lines

All vacuum lines used to aspirate supernatants, tissue culture media and other liquids that may contain microorganisms should be protected from contamination by the use of a collection flask and overflow flask containing a disinfectant. In addition, when working with agents classified as BSL2 and BSL3, a hydrophobic vacuum line filter shall be used.

#### **B9.4.1** 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.

If a glass flask is used at floor level, place it in a sturdy leak-proof container to prevent breakage by accidental kicking. In BSL2 or BSL3 laboratories, the use of Nalgene flasks is recommended to reduce the risk of breakage.

#### **B9.4.2** 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 DECONTAMINATION AND DECOMMISSIONING OF LABORATORY EQUIPMENT**

### **B10.1 General Information**

It is the laboratory's responsibility to ensure that equipment is thoroughly decontaminated on a regular basis. BSL-2 laboratories are required to keep of log of equipment decontamination.

Equipment in need of repairs, maintenance or removal from areas where recombinant DNA and/or potentially infectious materials are stored and/or manipulated must be autoclaved or thoroughly chemically decontaminated and subsequently cleared by EHS prior to repairs, maintenance or removal. 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 located in Appendix BI of this manual.

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.

### **B10.2 Hazard assessment**

Additional hazards may be associated with the equipment (i.e. chemical and/or radioactive). If other hazards are present, it is generally necessary to address the biological hazard first.

#### **B10.2.1 Biological Hazard**

Disinfect all surfaces with an appropriate chemical agent. If possible, autoclave parts or equipment that can withstand autoclave conditions using a bio-waste setting (121°C, 15psi, 50 minutes). Do not autoclave equipment if other hazards are present.

#### **B10.2.2 Additional Chemical Hazard**

If flammable/combustible, corrosive, reactive or toxic chemicals were used with a piece of equipment, decontaminate the equipment with an appropriate non-reactive disinfectant. Decontaminate the equipment as required for chemical hazard, handle waste accordingly, and defer waste to appropriate waste stream for EHS pick up.

Warm soapy water is a good option for the initial cleaning. Collect water as chemical waste. Follow soap and water with a more stringent disinfectant like a quaternary ammonia product.

#### **B10.2.3 Additional Radioactive Hazard**

Radioactivity can be determined with survey equipment. If present, chemically disinfect the equipment to mitigate the biological hazard. Dispose of cleaning materials as radioactive waste and proceed with radioactive decontamination procedures in accordance with the Radiation Safety Manual. Collect all waste as radioactive waste.

### **B10.3 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. It is the responsibility of the PI to contact the manufacture to address additional considerations. Should further questions regarding decontamination exist, please contact EHS.

**Be sure to decontaminate ALL interior and exterior surfaces of the equipment – do not neglect tubing and other accessories or components.**

**Biological contamination is addressed here.** If an item was used for chemical or radioactive storage and/or manipulation, decontaminate the equipment as required, handle waste accordingly, and defer waste to appropriate waste stream for EHS pick up.

**Personnel shall always wear appropriate PPE** while performing decontamination; at minimum, gloves, lab coat, and protective eye wear should be worn. **Autoclave items when possible and allow allotted contact time for disinfect** used during the decontamination process.

#### **B10.3.1** 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.

#### **B10.3.2** Incubators

Remove thermometers. Properly secure any mercury thermometers. Drain and collect water from water-jacketed incubators for disinfection. 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 drain. If water was visibly contaminated, fill water jacket with disinfectant. After allotted contact time, drain and flush with copious amounts of DI/RO water.

Some incubators have a sterilization cycle. Disinfect all interior surfaces then run the sterilization cycle. Follow with 70% ethanol if a different disinfectant was used to remove any residue.

For incubators without a sterilization cycle, autoclave removable parts able to withstand autoclave conditions using biowaste settings unless otherwise specified by the manufacturer. Chemically decontaminate remaining surfaces.

NOTE: Some disinfectants can leave residues that can be absorbed by media and be cytotoxic. Follow with 70% ethanol to remove any undesired residue.

#### **B10.3.3** Biosafety Cabinets

Biological safety cabinets require decontamination by a third party before the cabinet is removed from a lab or repaired. Decontamination is generally by 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.

#### **B10.3.4** Laminar Flow Hood

Laminar flow hoods should not need fumigation to disinfect as only non-hazardous items should have been handled in them. Decontaminate all surfaces with 70% ethanol or other desired disinfectant.

#### **B10.3.5** Centrifuges

Remove tube adaptors and the rotor if possible. Soak snap-on lids, adaptors and rotors in a manufacturer-approved disinfectant appropriate for agent(s) for at least 20 minutes. Rinse with DI/RO water, dry, and follow with 70% ethanol or isopropanol. Disinfect the exterior of the centrifuge in the same manner. Dispose of all waste as biohazardous waste.

#### **B10.3.6** Water baths

Disinfect water chemically by adding enough bleach to achieve a 10% solution. Allow bleach solution to sit in water bath for 20 minutes. Scrub inside of water bath to release any biofilms/mold/algae and allow to sit for 20 more minutes. Dispose of water in drain and chemically disinfect the lid and outside of the bath.

#### **B10.3.7** Balances/Scales

Remove parts that can be removed. Disinfect with appropriate disinfectant, follow with 70% ethanol or water if needed. Wipe with warm soapy water to remove chemical residue if biological residue is not an issue.

#### **B10.3.8** 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 chemically disinfect collected liquid by adding enough bleach to achieve a 10% solution.

Flush system with a 10% bleach solution; follow with a copious amount of DI or RO water. After the water rinse, flush system with 70% ethanol and thoroughly flush system with sterile DI or RO water; be sure to capture ethanol waste separately for EHS disposal.

#### **B10.3.9** 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.

### **B10.4** EHS Clearance of Decontaminated Equipment

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 inspect the equipment. Equipment shall not be removed from the laboratory for repairs, surplus, disposal, etc. until EHS has cleared the equipment.

## **B11** DECOMMISSIONING OF A LABORATORY SPACE

### **B11.1** General Information

This requirement is designed to assist PIs who are preparing to relocate to another laboratory at Texas Tech University or 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 expedite laboratory assignment to new occupants.

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, EHS will take over laboratory and complete decommissioning as time allows.

Once the lab is decommissioned laboratory access will be returned to the department. Please see Appendix BI for the Lab Decommissioning Checklist.

### **B11.2** Decontamination

The entire laboratory shall be decontaminated 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.

Refer to sections B6 and B10 for more information on disinfectants and decommissioning of laboratory equipment, respectively.

- a) All laboratory benches, equipment, glassware, storage areas, shelves, fixtures and furniture must be decontaminated with an appropriate cleaner for agents present in laboratory.
- b) Leave hazard labels in place on equipment.
- c) Fume hoods, glove boxes, BSCs and laminar flow hoods must be decontaminated. BSCs require a third party for decontamination.
- d) Areas in which radioactive materials have been stored or used shall follow the Radiation Safety Manual for proper decontamination/ decommissioning procedures.

### **B11.3** Packing and Moving

- a) Laboratory personnel are responsible for moving the laboratory. Labels with the PI's name, a content description, and any hazard information shall be affixed to all boxes. Please contact EHS regarding the transportation of any hazardous materials. Chemical and biological material transportation is regulated and requires training. Assume all chemicals and gases are regulated; a list of regulated biological agents is provided in Appendix BH; you may also choose to reference 49 CFR Subchapter C.

Regulated biological materials include:

- all cultures and stocks of biological agents (includes recombinant DNA materials),
- all human, plant and animal pathogens,
- all human tissue, fluids and blood components,
- all human and animal cell cultures,
- all infected animals and animal tissues, and all biological toxins.

Please contact EHS with any questions.

- b) A PI can give biological materials to an existing PI. The PI receiving the materials is responsible for attaining an IBC protocol for the received materials if required. See section B3.2.8 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.

- c) Any biological agents left in a laboratory by a PI become the property of EHS upon the PIs departure and will be destroyed.
- d) If a PI is departing the University, opened and unopened chemicals may be transferred to a different PI. Contact EHS to transfer the chemicals so that the chemical inventory of both PIs reflects the transfer.
- e) Any opened chemicals left in the laboratory after departure of the existing PI will be disposed of as hazardous waste by EHS. Unopened chemicals will become the property of EHS until they are assigned to new laboratories.
- f) 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.
- g) Thermometers and other loose items shall be removed from equipment and packaged separately. Mercury thermometers shall be disposed of as hazardous waste if the PI is departing the university.
- h) Oil and water shall be drained from pumps, baths and other equipment and disposed of in the appropriate waste stream.
- i) Furniture and fixtures are to be left in the laboratory unless an item is essential to a piece of equipment that is eligible to be moved. All items are to be decontaminated regardless of final destination.

#### **B11.4** Waste Disposal

All chemical, biological, and radioactive waste must be disposed of in their respective waste streams.

##### **B11.4.1** Biological Waste

All biological agents must be appropriately destroyed, transferred to a new PI or moved/shipped to their new location. Contact EHS regarding the transportation of biological material.

Prior to the PI departing the laboratory, all sharps and other biohazardous waste shall be disposed of in accordance with the section 7 of the Biosafety Manual.

##### **B11.4.2** Chemical Waste

Prior to the PI departing the laboratory, all chemical waste shall be labeled with EHS hazardous waste labels and a pick up scheduled with EHS.

Compressed gas tanks shall be capped and secured. Empty compressed gas tanks are to be returned to the distributor. Contact EHS for disposal of non-returnable tanks.

##### **B11.4.3** Radioactive Waste

Radioactive waste shall be disposed of in accordance with the Radiation Safety Manual prior to the PI departing the laboratory.

##### **B11.4.4** General Waste

Any waste (boxes, trash, broken glass, etc.) shall be properly disposed of prior to the PI departing the laboratory.

### **B11.5** Radiation Laboratories

Laboratories 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 once decommissioning is complete.

### **B11.6** EHS Clearance of Decommissioned Laboratory Spaces

The laboratory will be inspected by EHS prior to PI departure to ensure that all hazards are addressed and verify the laboratory space has been properly decontaminated at which point the area will be cleared of laboratory-related hazards.

If a PI departs before the laboratory decommissioning is complete, EHS will take over laboratory access and complete decommissioning of the space. EHS will return control of the laboratory to the department after decommissioning is complete.

## **B12** TRANSPORT AND SHIPMENT OF BIOLOGICAL MATERIALS

### **B12.1** 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. University vehicles can be used for this purpose. The use of personal vehicles is discouraged and done at the owner's risk.

#### **B12.1.1** Conditions

- (a) Do not take biological materials to non-lab areas or leave items unattended when transporting materials between campus laboratories.
- (b) The destination lab must be the same biosafety level as the materials being transported.
- (c) Materials must be properly packaged as outlined in B12.1.2.
- (d) The package is not to be opened in transport between laboratories for any reason.
- (e) If traveling to campus, have a biological spill kit with you in case of a spill.
- (f) In the event of a spill between laboratories on campus, notify EHS immediately at 806-742-3876.

#### **B12.1.2** Packaging

**For RG1/BSL1 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 rigid secondary, leak-proof container with a locking lid.

**For RG2/BSL2 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.

**B12.2** 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. The law requires that any person shipping hazardous goods (chemical or biological) to take Hazardous Shipper Training. Even with training, EHS recommends that the shipper check with applicable regulatory agencies prior to shipping potentially hazardous materials.

**The Department of Environmental Health & Safety is to be notified of all shipments of potentially hazardous materials. A copy of all shipping documents must be submitted to EHS 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.

**B12.3** Permits and Documentation

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 still maybe subject to special packaging requirements. The required Hazardous Shipper Training covers this information for those who wish to ship items.

**B12.3.1** CDC Permit

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. More information regarding CDC permits can be found at:  
<http://www.cdc.gov/od/eaipp/>.



**B12.3.1.1** The information below was taken directly from the CDC website. The following materials require a CDC Import Permit:

- (a) Infectious biological agent - A microorganism (including, but not limited to, bacteria (including *Rickettsiae*), viruses, fungi, or protozoa) or prion, whether naturally occurring, bioengineered, or artificial, or a component of such microorganism or prion that is capable of causing communicable disease in a human.
- (b) Infectious substance - Any material that is known or reasonably expected to contain an infectious biological agent.
- (c) Vector - Any animals (vertebrate or invertebrate) including arthropods or any noninfectious self-replicating system (e.g., plasmids or other molecular vector) or animal products (e.g., a mount, rug, or other display item composed of the hide, hair, skull, teeth, bones, or claws of an animal) that are known to transfer or are capable of transferring an infectious biological agent to a human.
- (d) Animals – Any member of the animal kingdom except a human including an animal product (e.g., a mount, rug, or other display item composed of the hide, hair, skull, teeth, bones, or claws).
- (e) Arthropods – Any living insect including crustaceans, spiders, scorpions, etc. capable of being a host or vector of human disease.
- (f) Snails – Any freshwater snails (phylum Mollusca, class Gastropoda) capable of transmitting schistosomiasis.
- (g) Bats – All live bats. Bats may also require a permit from the U.S. Department of Interior, Fish and Wildlife Service. For additional information, see <http://www.fws.gov/permits/importexport/importexport.shtml>
- (h) Non-human primate material – all non-human primate material (e.g., blood, plasma, tissue, urine, feces) requires an import permit.

**Please note that the above described material may require an additional permit from the United States Department of Agriculture (USDA)/Animal and Plant Health Inspection Service (APHIS) or be prohibited from importation under the USDA regulations.**

**B12.3.1.2** The information below was taken directly from the CDC website. The following materials do not require a CDC Import Permit:

- (a) Select agents listed in 42 CFR Part 73 and its importation has been authorized in accordance with 42 CFR 73.16 or 9 CFR 121.16.
- (b) Diagnostic specimen not known by the importer to contain, or suspected by the importer of containing, an infectious biological agent and is accompanied by an importer certification statement confirming that the material is not known to contain or suspected of containing an infectious biological agent, or has been rendered noninfectious.

- (c) Animal or animal product being imported for educational, exhibition, or scientific purposes and is accompanied by documentation confirming that the animal or animal product is not known to contain (or suspected of containing) an infectious biological agent or has been rendered noninfectious.
- (d) Nucleic acids that cannot produce infectious forms of any infectious biological agent and the specimen is accompanied by an importer certification statement confirming that the material is not known to contain or suspected of containing an infectious biological agent.
- (e) Animal or animal product listed in 42 CFR Part 71 and its importation has been authorized in accordance with 42 CFR §§ 71.52, 71.53, or 71.56.
- (f) Product that is cleared, approved, licensed, or otherwise authorized under any of the following laws:
  1. The Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), or
  2. Section 351 of the Public Health Service Act pertaining to biological products (42 U.S.C. 262), or
  3. The Virus-Serum-Toxin Act (21 U.S.C. 151-159).

**Please note that the above described material may require a permit from USDA/APHIS or be prohibited from importation under the USDA regulations.**

**B12.3.2** APHIS issues permits for import to, 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. The information below describing the above listed materials is taken directly from the USDA/APHIS website. Further information and application forms may be obtained on the USDA/APHIS website at:  
<http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/importexport>

- (a) 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.
  1. U.S. Fish and Wildlife Service permits are required for certain live animals, including bats. Please call 1-800-344-WILD or go to [www.fws.gov/](http://www.fws.gov/) for further information.
- (b) Veterinary Biologics - Includes vaccines, bacterins, antisera, diagnostic kits, and other products of biological origin.
- (c) Biotechnology products - Includes genetically engineered organisms considered to be regulated articles.

(d) Plants, Organisms and Soil - Includes nursery stock, small lots of seed, fruits and vegetables, timber, cotton, cut flowers, and protected, threatened and endangered plants; arthropods and mollusks (insects and snails); fungi, bacteria, nematodes, mycoplasma, viroids and viruses, biological control agents, bees, Plant Pest Diagnostic Laboratories, federal noxious weeds, and parasitic plants.

**B12.3.3** Importation of select agents or biological toxins requires the intended recipient to be registered with the Select Agent Program and submit an APHIS/CDC Form 2 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 in Appendix BE. Please contact EHS at 806-742-3876 if your work includes any of the agents listed in Appendix BE. More information regarding select agents and toxins is available at: [www.selectagents.gov](http://www.selectagents.gov).

**B12.3.4** A validated license is required by the Department of Commerce for export of certain microorganisms, biological toxins and other hazardous materials. Whether or not authorization is required to export is determined by the Export Control Classification Number (ECCN) found on the Commercial Control List (CCL). A list of controlled items is presented in Appendix BF. This list was current as of April 2015. For more information, please see the Dept. of Commerce website: <http://www.bis.doc.gov/index.php/licensing/commerce-control-list-classification>

Other agencies such as the FDA or DEA may regulate the goods your wish to transport. Please consult 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 agency export control requirements.

**B12.3.5** Additional Documentation

Additional documentation is often needed in the transfer of scientific materials to and from the University. 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. 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/vpr/ors/preaward/forms-boilerplates.php>.

#### **B12.4** Packaging

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 infectious substances and other hazardous materials.

As previously mentioned, these regulations are frequently updated. Current training is therefore mandatory for shipping of hazardous materials. Once training is complete, 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.

Exclusion from materials which require a permit, does not exclude an item from special packaging and labeling requirements. Details regarding this information are presented in the shipping training. Call EHS at 806-742-3876 if you have questions about a shipment and/or to schedule your training prior to your shipment.

# Radiation Safety Manual

(POLICIES AND PROCEDURES)

December 1, 1999

[Chemical / Laboratory Safety](#)

[Biosafety](#)

[Laser 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

1. Agency: means the Bureau of Radiation Control, Texas Department of Health.
2. ALARA: means “as low as reasonably achievable”.
3. BRC: means the Bureau of Radiation Control, Texas Department of Health.
4. License: means Texas Radioactive Material License No. L01536, issued by the Agency.
5. Registration: means Texas Registration of Radiation Producing Machines No. R00574.
6. RSC: means the Radiation Safety Committee of Texas Tech University.
7. RSM: means TTU’s Radiation Safety Manual.
8. RSO: means the Radiation Safety Officer
9. RSS: means the Radiation Safety Specialist.
10. RST: means the Radiation Safety Technician
11. TAC: means the Texas Administrative Code.
12. TRCR: means the Texas Regulations for Control of Radiation.
13. US NRC: means the United States Nuclear Regulatory Commission.
14. US DOT: means the United States Department of Transportation

#### B. Radiation Protection Program

1. 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].
2. 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.
3. Date of Implementation: December 1, 1999, upon approval by the RSC.

4. Review: This program will be reviewed no later than the anniversary month of its inception, each year.
5. Program Elements:
  - 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.
  - b. Radiation surveys: Radiation surveys are discussed in II.H.6. of the RSM.
  - 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.
  - d. Respiratory Protection: Addressed in II.J. of the RSM.
  - 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.
  - f. Posting of Areas and Rooms: II.H.1. of the RSM provides for posting of warning signs.
  - g. Labeling of Containers: II.H.1. of the RSM provides procedures for labeling of containers.
  - h. Receipt of Packages Containing Radioactive Material: Radioactive material receipt procedures are specified in II.H.3.b. of the RSM.
  - 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.
  - j. Management of Required Records: Records management procedures are addressed in II.H.2. of the RSM.
  - 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

1. 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.
2. 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).
3. 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).
4. 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:**

1. **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.
2. **Duties (RSC Charge) - The RSC will:**
  - a. establish policies and procedures, as well as provide administrative advice regarding radiation and laser safety;
  - b. approve or disapprove all applications, amendments, and renewals relating to the use of radioactive materials, lasers, or radiation producing equipment;
  - c. receive and review reports from the RSO on monitoring, surveillance, and personnel exposure;
  - d. monitor procurement, use, and disposal procedures;
  - e. take appropriate corrective action on radiation/laser incidents, including administrative guidance and license suspension or revocation;
  - f. provide a representative to the University Safety and Health Committee; and
  - g. serve as an avenue of appeal in cases of dispute and exception to actions by the RSO.
3. **Radiation Safety Committee Membership** – The committee shall be composed of:
  - a. Three faculty members who regularly uses radioactive materials;
  - b. Two faculty members who regularly uses lasers;
  - c. At least one faculty member who regularly uses radiation producing equipment;
  - d. At least two faculty/staff members who are non-users of radioactive materials, lasers, or radiation producing equipment;
  - e. Vice Provost for Research or designated representative;
  - f. RSO (Ex-Officio); and
  - g. Associate Vice President for Operations, (Ex-Officio)
4. **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.

**5. Radiation Safety Committee Operating Procedures:**

- 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.
- 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.
- c. Sub or ad hoc committees may be appointed by the Chairperson as needed.
- 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.
- 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.

**6. Radiation Safety Committee Responsibilities - The RSC shall:**

- a. Establish policies regarding radiation and laser safety;
- b. Provide administrative advice to the RSO on matters regarding radiation and laser safety;
- c. Receive, review, and act on all applications for the use of radiation sources in any areas used by TTU personnel;
- d. Receive and review periodic reports from the RSO on monitoring, contamination, and personnel exposure;
- e. Periodically review the overall use of radiation and laser sources at TTU from the standpoint of operational hazards;
- f. Receive and review all reports from the RSO concerning radiation and laser incidents at TTU;
- g. Conduct necessary investigations, hearings, and/or appropriate corrective action on any radiation or laser over-exposure or spill occurrence at TTU;
- h. Meet at least monthly during the academic year.
- i. Perform an annual audit of the Radiation Safety Program.
- j. Upon committee action, issue sublicenses which will be duly signed and approved by the Chairperson of the RSC.

**F. Radiation Safety Officer**

1. 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.

**2. RSO Duties - The duties of the RSO include:**

- 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;
- b. Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection, including instruction of radiation safety classes;
- 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;
- d. Receiving, delivering, and shipping all radioactive materials coming to or leaving TTU property;
- e. Monitoring all accelerators and other machines capable of producing penetrating radiation;
- 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;
- 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;
- 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;
- i. Instructing personnel in proper procedures for the use of radioactive materials;
- j. Supervising and coordinating the waste disposal program, including keeping of waste storage and disposal records;
- k. Storing of all licensed radioactive materials not on sub-licenses;
- l. Ensuring the proper storing, labeling, transport, and use of sources of radiation, storage, and/or transport containers;
- m. Performing and/or supervising all in-house sealed source leak tests;
- n. Maintaining an inventory of all radioactive materials, radiation producing equipment, and lasers on TTU property;
- o. Supervising decontamination of radioactive material accidents;
- p. Maintaining a continuous program of environmental radiation hazard evaluation through routine lab inspections and hazard elimination;
- q. Maintaining radiation safety program records in the Radiation Safety Office;

- r. Reporting regularly to the RSC;
- s. Maintaining a thorough knowledge of management policies and administrative procedures of TTU;
- t. Prohibiting and preventing, by immediate suspension or termination if necessary, any unsafe or illegal use of radioactive material, radiation producing equipment, or lasers.
- 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
- v. Performing other tasks requested by the RSC.

**G. Radiation Safety Office** – conducts operations and services to support TTU's radiation safety program.

1. 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.
2. The Radiation Safety Technician will support the RSO and the RSC by performing assigned routine safety functions which include, but are not limited to:
  - a. Performing and documenting radiation surveys of radiation levels in TTU facilities;
  - b. Performing and documenting radiation surveys of contaminated, or potentially contaminated, surfaces and areas in TTU facilities;
  - 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;
  - d. Controlling movement and storage of packages and containers of radioactive materials and wastes;
  - e. Performing and documenting leak tests of sealed sources;
  - f. Inspecting radiation survey instruments to assure current calibration;
  - g. Testing fume hoods to assure proper operation;
  - h. Performing calibration of radiation survey instruments according to the procedures listed in Appendix C of this manual; and
  - i. Other duties as assigned by the RSO or RSC or directed by the TTU Administration.
3. 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:
  - a. Processing and approving orders of radioactive materials;
  - b. Receiving and delivering all incoming radioactive materials;
  - c. Maintaining the inventory of all radioactive materials;
  - d. Performing inspections, surveys, and audits;

- e. Ordering, delivering, and retrieving dosimetry badges and maintaining the dosimetry program;
  - f. Assisting with the radioactive waste program;
  - g. Maintaining records for the above functions; and
  - h. Other duties as assigned by the RSO or RSC or directed by the TTU Administration.
4. 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.

1. 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).
2. 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.
3. 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.
4. Personnel Monitoring Procedures:
  - a. Requests for Dosimetry:
    - (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.

- (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".
- (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.

**b. Termination of Service:** The following rules should be followed for dosimetry service termination:

- (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.
- (2) Individual user will return badge to sub-licensee or RSO upon completion of work with ionizing radiation or before leaving Texas Tech.
- (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.

**c. Procedures for Wearing of Badges:** Rules regarding the wearing and use of personnel monitoring devices:

- (1) Attach the badge holder to the area of your garment most likely to be exposed to the radiation.
- (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.
- (3) NEVER wear another person's badge.
- (4) Report the loss of a badge or holder to the RSO immediately.
- (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.
- (6) THE BADGE ISSUED TO YOU IS YOUR RESPONSIBILITY.
- (7) Take care not to send your badge to the laundry with your lab coat.

- (8) NEVER puncture, remove, or alter in anyway the badge holder or its contents.
- (9) REMEMBER - A rule cannot be written to cover every possible situation, use COMMON SENSE when no rule is available
- (10) Reports of exposure to ionizing radiation are kept by the Radiation Safety Office. Any individual may request (in writing ) to review his/her exposure reports at any time. However, the request should indicate the report(s) needed for review.

## I. Bioassay Procedures

1. 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.
2. Urinalyses:
  - 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.
  - 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.
3. Thyroid counts - Thyroid scans will be conducted on any individual that handles, in open form, volatile Iodine-125 in amounts greater than:
  - 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
  - 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.

4. Additional Requirements:

- 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.
- 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.

5. 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:

1. 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.
2. Sub-license – an authorization issued by the RSC to use radiation sources.
3. 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

1. Qualifications for Sub-License
  - a. 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.
  - 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.
  - 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.
  - d. The RSC will authorize issuance of the sub-license if it determines that all requirements have been met.
  - 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.
  - f. Requirements for Individuals Working Under an Applicant's Sub-license:
    - (1). Workers (technicians, students, graduate assistants, post doctorals, etc.) must attend the local Radiation Safety Shortcourse.
    - (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.

- (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.
- (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.

## 2. Procedures for Obtaining a Sub-license

- a. The RSO will first review all applications.
- 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.
- c. Final approval of all applications is required by the TTU RSC at its regular monthly meeting.
- 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.
- 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.

## 3. Sub-license Renewal and/or Amendment

- a. Term of Sub-license - Texas Tech University sub-licenses remain in effect for two years from date of issue.
- 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.
- c. Actions or activities requiring an amendment to a sub-license:
  - (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.);
  - (2) If an increase in maximum allowable activity is expected or needed;
  - (3) If a different isotope is needed;
  - (4) If isotope(s) on sub-license are no longer needed;
  - (5) If there is a change in equipment (X-ray or Laser inventory);
  - (6) If there is a significant change in submitted Operating Procedures.
  - (7) If significant changes occur in the normal operation of sub-license procedures, for example, the use of animals, increased waste disposal, etc.
  - (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:

1. Suspend or terminate the use of radionuclides or radiation producing equipment.

2. 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.
  3. 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-license to act for the absent sub-licensee.
  4. A sub-licensee leaving the campus for a visiting professorship at another institution:
    - a. May transfer the radioactive material to that institution pending notification of approval by the Radiation Safety Offices of both institutions;
    - b. Transfer the radioactive material to another TTU sub-licensee pending approval of the RSO;
    - c. Placed the radioactive material in storage with the RSO; or
    - d. Dispose of the radioactive material.
- D. 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.**
1. A letter of intent to terminate the sub-license will be submitted to the RSO. This letter will include:
    - a. The date of termination.
    - 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.
    - 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.
    - 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.
    - e. Upon receipt of the letter of intent, the RSO will conduct a close-out survey of the affected areas and equipment.
    - 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.

- 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.
- h. ON TERMINATION, FURTHER USE OF RADIOACTIVE MATERIAL BY THE SUB-LICENSEE AND INDIVIDUAL WORKERS OF THAT SUB-LICENSE IS STRICTLY PROHIBITED.
- 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.
- 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- The following procedures outline the TTU inspection/monitoring program conducted for evaluation of programs operated under sub-licenses.

- 1. 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.
  - a. The entire program at TTU is periodically evaluated by the TTU-RSC and by the Texas BRC for compliance.
  - b. This system of "checks and balances" assures TTU and the general public that the radiation program at TTU operates safely and efficiently.
- 2. Frequency of Inspections -
  - a. The RSO shall make inspections of radioactive material sub-licensees on a quarterly basis.
  - b. The RSO shall make inspections of radiation producing equipment sub-licensees on an annual basis.
  - c. Sub-licensees who have had their area deactivated do not have to be inspected.
- 3. Inspection Policy/Responsibilities
  - a. The RSO shall inspect facilities for compliance with all applicable regulations - state, federal, and local.

- b. The RSO shall make a record of each inspection and keep those on file in the Radiation Safety office.
- 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.
- 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.
- e. The RSO will report all major deficiencies as well as any instance of non-compliance for a sub-license, applicable rules, or statutes, to the RSC.
- f. The RSO shall make follow-up inspections of all sub-licensees having deficiencies deemed serious by the RSC within 60 days of report.
- g. All inspection statistics should be evaluated by the RSC.
- 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.
- 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.
- j. The RSC may terminate a sub-license if serious deficiencies are continued.

## **F. Sub-License Programs and Procedures**

### **1. Sub-Licensee/Authorized User Responsibilities**

- a. Each authorized user has the following obligations:
  - (1). Ensuring that the individual user responsibilities are discharged by those under their control and supervising their work;
  - (2). Working within the limits of the User's sub-license;
  - (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;
  - (4). Furnishing the RSO with information concerning individuals and activities in their areas;
  - (5). Ensuring that all surveys and safety checks required for their particular area of interest are carried out and recorded properly;
  - (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;
  - (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;
  - (8). Keeping stocks of stored radioactive material to a minimum;



- (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;
  - (10). Complying with the proper procedures for handling radiation incidents;
  - (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.
- 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**

1. 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":
2. 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:
  - a. The annual occupational dose shall not exceed the more limiting of:
    - (1) the total effective dose equivalent being equal to 5 rems (0.05 sievert); or
    - (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).
  - b. The annual occupational dose to the lens of the eye, to the skin, and to extremities will not exceed:
    - (1) an eye dose equivalent of 15 rems (0.15 sievert), and
    - (2) a shallow dose equivalent of 50 rems (0.5 sievert) to the skin or to any extremity.
  - 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)].

- 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).
- 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.

**1. Facilities**

- a. Work areas(s) (benches, hoods, trays, etc.) will have a non-absorbent surface.
- b. Laboratories will have wall coverings of a washable, hard, heat-chemical resistant paint (i.e. epoxy).
- 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)
- 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)
- e. Storage areas (cabinets, refrigerators, freezers, fume hoods, laboratories, etc.) will be secured to prevent unauthorized removal of radioactive material.
- 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.
- 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.
- h. All signage (sub-license, Notice to Employees, emergency numbers, etc.) shall be posted in prominent view.
- 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.
- 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.

- k. 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.
- l. 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.

- (1) Fume hoods shall be labeled if radioactive materials are to be used or stored in the hoods.
- (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.
- (3) The gas, water, and electrical appliance should be operable from the outside of the fume hood.
- (4) The fume hood shall have a counter-balanced sash made of tempered safety glass.
- (5) The fume hood should have a layer of absorbent paper with water-proof backing covering the entire work surface.
- (6) The inspections shall be conducted by the Department of Environmental Health and Safety.

## 2. Record Keeping

- 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.
- 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".
- 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.

- d. Inventory - all sub-licensees will keep a copy of the most recent semi-annual radioactive material inventory.
- e. Inspection Reports - All sub-licensees should keep their semi-annual inspection reports (Form RS-24).
- f. Amendment/renewals - All sub-licensees should keep a copy of their amendments and renewals.
- 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.
- 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.

### 3. Control of Radioactive Material

#### a. Ordering Radioactive Material – General Procedure

- (1) Requestor calls the Radiation Safety Office

Phone: 742-3876

- (2) The requestor shall have the following information for Radiation Safety:

- (a) Sub-licensee
- (b) Isotope
- (c) Activity (in millicuries ONLY)
- (d) Chemical form
- (e) Requestors phone number
- (f) Local point of contact
- (g) Vendor
- (h) Account Number
- (i) Total dollar amount

- (3) The Radiation Safety Office will;

- (a) check the sub-licensee's current inventory to verify that the isotope and requested activity does not exceed the sub-licensee's limit.
- (b) check the TTU Broad License to verify that the isotope and requested activity do not exceed the TTU Broad License Limit.
- (c) 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.

- (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.
- (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.
- (6) ALL radioactive material shipments must be shipped to the following address:

ATTN: Radiation Safety Officer  
Administrative Support Center  
2903 4<sup>th</sup> Street, Room 122  
Texas Tech University  
Lubbock, Texas 79409

- (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.

**b. Receipt and Accountability of Radioactive Material**

**(1) Receipt**

- (a) 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.
- (b) Upon receipt, the package(s) will be monitored in accordance with TAC §289.202(ee).

**(2) Accountability**

- (a) A "Radioactive Material Use Form" (Form RS-14) will be prepared and issued to sub-licensee upon his/her receiving the shipment.
- (b) 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.

- (c) 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.
  - (d) 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.
- (3) 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.

#### 4. Transfer and Shipping of Radioactive Material

- 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.
- b. Shipping -
  - (1) If radioactive material is to be shipped from TTU, the shipper must notify the Radiation Safety Office.
  - (2) 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.

#### 5. Storage of Radioactive Material

- a. Radioactive material shall be stored only in approved areas.
- 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.
- c. Storage of radioactive material, animal containing radioactive material and parts thereof shall be such as to prevent unauthorized removal.
- 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.

#### 6. Radiation Surveys

- 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.
- b. These surveys shall be performed in direct proportion to isotope use. Surveys shall be continual, even during periods of inactivity.
  - (1) Using filter paper (Whatman 1-4.25cm or equivalent), wipe an area of 100 cm<sup>2</sup>.

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.).

- (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.
- (3) Results of the smear surveys should be corrected for efficiency and reported in units of activity (i.e., dpm, Bq, etc.).
- (4) The following shall be maintained in the survey log book:
  - (a) survey date and name of surveyor
  - (b) counts per minute
  - (c) results in units of activity
  - (d) map of laboratory
  - (e) swipe locations
  - (f) efficiency of counter
- (5) All results shall be recorded whether positive or negative.
- (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

- (7) Equipment in a radiation laboratory shall not be removed from that laboratory until demonstrated by the RSO to be free of radioactive contamination.
- (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.

- (9) Routine surveys by the Radiation Safety Office in no way release a sub-licensee from his/her obligation to their surveys.
  - (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-license.
  - (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.
7. 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:
- a. A letter of intent to deactivate an authorized radiation use area will be submitted to the RSO. This letter will include:
    - (1) The room number(s) and diagram of the laboratory(s) to be deactivated.
    - (2) 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. 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.
    - (3) 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.
    - (4) Upon receipt of the letter of intent, the RSO will perform a close-out survey of the affected areas and equipment.
    - (5) 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).

- (6) 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.
- (7) At this point, further use of radioactive material and/or radiation producing equipment is strictly prohibited.
- (8) 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.
- (9) 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-license may request, in writing, to renew the deactivated status of the laboratory(s) for another term.
- (10) 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 applies. 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.
- (11) 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:
  - (a) A written request to reactivate a radiation use laboratory(s) must be made to the RSO.
  - (b) 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.
  - (c) The RSO will review the request and inspect the laboratory area(s) and make his recommendations to the Chairperson of the RSC.
  - (d) 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.

- (e) 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.

- 8. 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.

Any laboratory found (during routine inspections) not to be performing required periodic surveys will be suspended from general services.

#### 9. Custodial Service for Radiation Use Areas

- a. To obtain special custodial service (i.e., scrubbing, stripping, and finishing floors), call Custodial Services (744-1866).
- b. Prior to scheduling the cleaning, the following preparations must be made:
  - (1) 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.
  - (2) Custodial Services will schedule the work and call to confirm the date with the requester.
  - (3) The custodians will leave a checklist in the laboratory. The checklist must be completed and signed by the lab personnel.
  - (4) 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.
  - (5) The sub-licensee or a worker on that sub-license IS required to be in the lab during the cleaning.
- c. 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.
  - (1) The Sub-licensee will simply complete, sign and date a door card.

- (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.
- (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.

#### **10. Building, Maintenance And Construction (BM&C) Services**

- 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.
- 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.
- c. The sub-licensee or a worker IS required to be in the lab during the BM&C services.

#### **11. Other Services**

- 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.
- 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.
- c. The sub-licensee or a worker IS required to be in the lab during the services.

#### **12. Portable Moisture Density Gauges (neutron probe) - (often referred to as Neutron Meters, Neutron Probes, PMDG's, etc.)**

- 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.
- b. In addition to the Texas Regulations for the Control of Radiation, the following policies and procedures will apply to the TTU license:

- (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.
- (2) Subject to the discretion and scheduling of the primary authorized user, other as to isotope and activity.
- (3) The primary authorized user should establish a log to be kept at the location for permanent storage of the specific PMDG.
- (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.
- (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.
- (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.
- (7) Personnel monitoring badges shall be worn during transport and use of the PMDG.
- (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.

- (9) All PMDG's are required to have semi-annual leak tests and are to be included in semi-annual radioactive material inventories.

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.

**13. Radioactive Material in Animals** - The following procedures are to be used by researchers using radioactive materials in animals.

- 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..
- b. Policies concerning animal use:
  - (1) Animal cages are to be labeled with warning stickers.
  - (2) After sacrificing the animals 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).
  - (3) All bedding and food shall be placed separately in double bags.
  - (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.

- (5) The animal carcasses, bedding, and food shall be stored in a freezer until Radiation Safety Personnel receive it for disposal.
- (6) At least 24 hours notice shall be given to Radiation Safety for a pick up time.
- (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.
- (8) Surveys shall be performed and recorded in accordance with Item D of this section.
- (9) All cages, feeders, racks, and water bottles must be demonstrated to be free of contamination, by the researcher, to the RSO.

#### 14. Radioactive Waste Disposal Program

- 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.
- 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.

- (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.
- (2) Liquid wastes are separated into two categories: (1) aqueous bulk liquids and (2) mixed waste (organic) bulk liquids.
- (3) 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.
- (4) 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.
- (5) 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.

- (6) 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.).
- c. Responsibilities of the Generator (sub-licensee):
- (1) Proper collection and storage of all radioactive waste.

- (2) Compliance with state and local regulations and control of the wastes until removal by the RSO.
- (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).
- (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).
- (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.

NOTE: 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.
- (6) 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  $\mu\text{Ci}$  PER DAY.

**d. Laboratory Waste Handling and Storage**

- (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.
- (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.
- (3) Wastes must stored only in restricted areas where they can be secured against unauthorized removal.
- (4) Liquid wastes shall be stored in unbreakable polyethylene carboys and provided double containment.
- (5) Aqueous liquid wastes shall be neutralized prior to deposition in a waste container to prevent any violent or hazardous chemical reactions.
- (6) Each laboratory having radioactive waste containers shall display a "radioactive waste" sign in the area designated for radioactive waste.
- (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.

- (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)].
  - (9) All animal carcasses and parts thereof containing radioactive material or contaminated with radioactive material shall be stored frozen.
  - (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 generators (sub-licensee) waste management controls.
- e. Animal Carcasses and 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.
- f. Waste Pickup
- (1) Request for removal of radioactive waste from the lab by radiation safety may be made by telephone to the RSO.
  - (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.
- (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).
- 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. Disposal of ANY of the waste described above will be allowed provided:

- (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.
  - (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.
  - (3) Tissue in animal carcasses are frozen.
  - (4) The burial is coordinated with landfill personnel at least 24 hours in advance.
  - (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.
  - (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.
- 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.
- i. Sanitary Sewerage Disposal
- (1) The Radiation Safety Office is the only entity at TTU authorized to dispose of radioactive materials through the sanitary sewer.
  - (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.
  - (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.
- j. Other Disposal Information

- (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).
- (2) The generator (sub-licensee) shall maintain copies of all disposal forms with other required record keeping.
- (3) Tritium ( $^3\text{H}$ ) 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.
- (4) Lids shall remain on all waste containers at all times.
- (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.
- (6) The RSO shall maintain proper disposal records for all TTU campus-wide radioactive waste disposals in accordance with the TAC §289.202.
- (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.

## 15. Additional Policies and Procedures

### a. Radioactive Materials Use

- (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.
- (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.
- (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.
- b. Gas Chromatographs**
- (1) Radioactive material in gas chromatography units (GC) shall be regulated the same as any other radioactive material at TTU.
  - (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.

- (3) The radioactive foil shall not be removed or transferred from its identifying cell or laboratory without prior RSO approval.
- (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 area responsibility."
- (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.
- (6) The RSO will perform leak tests at the minimum of every 6 months, store radioactive foils, and maintain necessary records.
- 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].
- d. Use of Hoods
  - (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.
  - (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.
  - (3) No more than 10 mCi of any volatile isotope should be used in a hood without first contacting the RSO.

## I. Safety Procedures for Individual Users and Workers Using Radiation Sources Under Sub-licenses

- 1. 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:
  - a. ALL users of radiation sources SHALL fulfill TTU's radiation safety training requirements PRIOR to using radiation sources.
  - b. Radiation exposure of all individuals shall be maintained ALARA.
  - c. The prescribed personnel monitoring devices (such as film badges and pocket dosimeters) SHALL BE WORN in radiation areas and while using radiation sources.
  - d. Personnel monitoring devices shall be protected from inadvertent exposure and damage and shall be returned to the Radiation Safety Office as scheduled.
  - 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).

- 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.
- g. The following protective equipment shall be worn, and protective procedures followed, at all times when working with radiation sources:
  - (1) wear protective clothing, gloves, and (in some cases) shoe covers when working with unsealed radioactive materials;
  - (2) using protective barriers and shields whenever possible -- also protective eyewear if laser hazards exist;
  - (3) use mechanical devices (tongs, remote handling tools, etc.) to assist in reducing exposure;
  - (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;
  - (5) PIPETTING BY MOUTH IS STRICTLY PROHIBITED when working with radioactive materials AND/OR with chemically and biologically hazardous substances; and
  - (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].
- h. Eating, drinking, smoking, applying makeup, etc. in radiation laboratories and areas where unsealed radioactive materials are stored or used is strictly PROHIBITED.
- i. Radiation use and storage areas SHALL NOT be used jointly for storage of radioactive material and material for human consumption.
- j. 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).
- k. 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.
- l. Radiation use/storage areas, devices, and containers shall be periodically inspected for proper display of required warning signs and labels.
- m. 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.
- (6) 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.
- n. 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.
- o. 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.
- p. 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. The individual(s) shall cooperate in any and all attempts to evaluate his/her exposure.
  - (3) Perform emergency decontamination procedures, when required or necessary, and take the necessary precautions to prevent the spread of contamination to other areas and equipment.
  - (4) Comply with requests from the RSO for bioassays, body burden measurements and/or the submission of urine samples for internal radioassay.
  - (5) 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:
  - 1. NO PIPETTING BY MOUTH
  - 2. No open toed shoes (i.e. sandals, flip-flops, etc.) in radioactive material laboratories.

3. All radioactive material containers must be labeled as to isotope, activity, and date.
4. NO eating, drinking, smoking, food storage, application of cosmetics, or food preparation in radiation labs.
5. Place rad-waste in appropriately labeled waste receptacles.
6. NEVER mix different forms of rad-wastes.
7. Remove protective clothing and gloves before leaving radiation lab.
8. Monitor hands, shoes, and clothing before leaving radiation lab.
9. Personnel exposures shall be kept ALARA by using time, distance, and shielding safely and effectively.
10. Use the fume hood when needed.
11. Perform all required surveys and safety checks.
12. 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)

1. 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.
2. Proposed devices: Registration of proposed devices must be conducted through the RSO.
3. Personnel Protection
  - 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.
  - b. Personnel Safety - Personnel specifically responsible for such equipment shall:
    - (1) used or to be used;
    - (2) ensure that all rules and regulations (TTU, state and local) have been implemented and are followed;
    - (3) 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.
4. Facilities
  - a. Posting and Labeling:
    - (1) Areas: Areas in which radiation producing equipment are located or are being used shall be posted with a standard "CAUTION – X-RAY RADIATION" sign.
    - (2) Devices: 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.
  - 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..
5. Radiation Surveys And Record Keeping Requirements
  - a. Sub-licensee Requirements:
    - (1) Radiation surveys:



- (a) Radiation surveys will be conducted after every change that might increase radiation exposure hazard.
    - (b) Radiation surveys shall be conducted at least once a month.
    - (c) The results of each radiation survey shall be recorded in the log book
    - (d) Radiation surveys shall be performed using only the appropriate instrument.
  - (2) 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.
  - (3) Log book: Each log book (record) shall contain the following information:
    - (a) Users log (user, date, start, finish, power settings)
    - (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.
    - (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).
  - (4) Written Safety Procedures:
    - (a) Safety and Operating Procedures shall be written and updated as changes in that particular instrument or area warrant the need for revision.
    - (b) The written safety and operating procedures shall be available to all users.
- b. Radiation Safety Office Requirements**
- (1) A radiation survey of all radiation producing devices shall be conducted on a 6 month interval by the Radiation Safety Office.
  - (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.
- c. Additional Rules And Requirements**
- (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.

- (2) The structural shielding requirements of any new installation, or an existing one in which changes are contemplated, shall be reviewed with the RSO.
- (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.
- (4) No person shall bypass a safety device unless such person has obtained written permission from the RSO and the RSC.
- (5) All log books and current Operating Procedures shall be readily available to each radiation producing device or near the control panel.
- (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.
- (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.
- (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.
- (9) All radiation producing equipment shall be shipped to the following address:

ATTN: RSO  
Central Receiving  
Texas Tech University  
Lubbock, Texas 79409

- (10) Radiation producing equipment or lasers transferred within TTU must be coordinated with the RSO.
- (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**

### **1. Protection From Microwave Oven Radiation**

#### **a. Non-public use - (i.e. departmental, laboratory/research)**

- (1) Registration - Person(s) responsible for each microwave oven at TTU should notify the Radiation Safety Office of its presence.
- (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.
- (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.

#### **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.**

- (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.
- (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). Compliance surveys of the microwave oven(s) as described in TRCR Part 90 will be performed by the Radiation Safety Office. These measurements shall be performed semi-annually. 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. 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.
- (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.

- (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.
    - (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. Furthermore, 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.
    - (b) 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)).
    - (c) 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.
  - (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.
3. Safety Tips for Microwave Oven Users (published by the U.S. Govt. Bureau of Radiological Health)
- a. Follow the manufacturer's instruction manual for recommended operating procedures.
  - b. Examine the oven for evidence of shipping damage.
  - c. Never insert objects (for example, a wire) through the door grill or around the door seal.
  - d. Never tamper with or inactivate the oven safety interlocks.
  - e. Never operate an EMPTY oven.
  - f. Clean oven cavity, door, and seals frequently with water and mild detergent. DO NOT use scouring pads, steel wool, or other abrasives.
  - g. Have oven serviced regularly by a qualified serviceperson and inspected for signs of wear, damage, or tampering.
  - h. Additionally, users of microwave ovens manufactured prior to the new standards (prior to October 10, 1971) should follow these precautions:
    - i. Switch the oven off before opening the door.
    - 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 – LASER SAFETY PROGRAM

This section is reserved for future presentation of LASER safety policies and procedures.

PLEASE SEE LASER MANUAL

## SECTION V - EMERGENCY PROCEDURES

Introduction - This section outline 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 or laser 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. NOTES - 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.

### B. Organization And Authority

1. The responsibility of incident investigation shall be that of the RSO.
2. The RSO will promptly report all investigation findings to the RSC and to the Agency [reference TAC §289.202(xx)] for direction and action.
3. 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.
4. 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.
5. 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)
6. The RSO has the responsibility to see that each radiation sub-licensee/worker knows how to:
  - a. Recognize a radiation or laser emergency.

- b. Prevent or confine the accident.
  - c. Exclude all personnel from possible risk of exposure.
  - d. Immediately contact his/her supervisor, the RSO, and/or other emergency personnel for assistance.
7. 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.

#### C. Fires, Explosions, Or 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 fire fighting equipment.

#### D. 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.

**E. 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.

**F. 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.

**G. 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.

#### H. 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.

#### I. 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.

#### J. 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.

**K. Reporting Of Radiation Incidents**

1. 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.
2. 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.

**L. Decontamination Procedures -** There are many different methods of decontamination depending on the isotope and 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.

**1. 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.

**2. 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.

**3. Post-Operational Decontamination Procedure**

- a. Monitor all cleaning supplies and equipment before release.
- b. Use proper disposal procedures for all radioactive wastes.

**4. 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.

5. Personnel contamination

- 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).
- 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).

- 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.

EMERGENCY INFORMATION

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 V

## SECTION VI – RADIATION SURVEYS

### A. Guidelines For Surveys of Radiation Levels

General Information- 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). For high-level areas, accelerators, analytical x-ray instruments, etc. an ion-chamber type (i.e. Cutie Pie) is recommended over the GM 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); also, it will not saturate in high radiation fields. That is GM tube type meter may saturate and read zero - when exposed to high radiation levels. Therefore, personnel could be subjected to dangerously high radiation levels in belief that no radiation hazard existed.

Note: Survey rate-meters are required in all installations using radioactive material or Radiation Producing Equipment.

1. 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.
2. Performing a Survey
  - 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.
  - 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.

- 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.).

NOTE - 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.

3. Results/Reporting – Record all results in the proper units (mR/hr and/or cpm) in your log book or on the survey map. If surveys show areas that are greater than 2 mR/hr for radioactive material laboratories contact the RSO. For radiation producing equipment surveys that indicate areas more than 3 times the normal recorded reading.

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)**

1. 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).

- a. 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.

- b. Fixed Contamination - Is generally defined as radioactivity remaining on a surface after repeated decontamination efforts have failed to significantly reduce the contamination level.
- c. Equipment - Instrument used in surface contamination surveys should be sufficiently sensitive to detect the nuclides being monitored. Also uniform methods of collecting and analyzing these smears should be used over extended periods of time in order to evaluate trends.
- d. 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  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{35}\text{S}$ , or other beta emitters should be analyzed with a liquid scintillation counter or internal proportional counters.

- e. 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.
  - (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.
  - (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.
  - (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.

- (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.
- (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.
- (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.

- (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:
- (a) What isotopes have been used since the last survey?
  - (b) Where are/were they used?
  - (c) Where are they stored?
  - (d) Where is the waste stored?
  - (e) Have there been any contamination problems in surveys conducted by the lab personnel?
- (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.
- (9) Idiosyncrasies - Look for information regarding habits and misplaced items around the lab; feet on the desks, misplaced books and equipment, etc.
- (10) Materials - Look for changes in work areas, changes in previously recorded storage location, or waste storage areas, non-radioactive use of storage containers, etc.
- (11) Traffic - Look for high traffic areas. Particularly worn areas on the floor, high use equipment, floors near a desk, phone, sink, hood, etc, etc.
- (12) 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.
- f. Taking the Smear - 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 cm<sup>2</sup> or 16 square inches. 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.
- g. The smears are then transported to a counter capable of monitoring the radiation surveyed.

## 2. Frequency of Surveys

- 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.

- (1) Frequency - Surveys should be performed in direct proportion to isotope use.
- (2) EXAMPLE - If a person uses radioactive material once or twice a month then 1 or 2 surveys a month should be conducted.
- (3) 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.

## 3. Records of Surveys -

- a. Records shall be maintained in logbooks or on special forms as long as they are clear, legible, understandable, and reviewed by authorized individuals.
- b. Maintain the following information in the logbook or on a special form:
  - date of survey
  - counts per minute
  - diagram of laboratory
  - smear location
  - machine copy of results
  - dpm or standard reference source count
- c. Each batch of survey samples should include a standard reference source and a background sample count.
- d. Refer to TAC §289.202(ggg)(6) for contamination action levels and release limits.

## SECTION VII – FORMS AND RECORDS

- A. Radioactive Material Use Forms
- B. Radiation Producing Equipment Forms
- C. Additional Forms

THIS SECTION IS NOT AVAILABLE – PLEASE CONTACT THE RSO FOR FORMS

## **APPENDICES**

### **RADIATION SAFETY INFORMATION AND RESOURCES**

## APPENDIX A – REFERENCE INFORMATION

### A.1. 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:** 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 ( $HE, 50 = \sum w_T HT, 50$ ).

**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<sub>d</sub>):** Applies to external whole body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm<sup>2</sup>.) 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 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.

## A.2. INDEX OF ABBREVIATIONS AND ACRONYMS

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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

### A.3. List Of Symbols for Radiation Units and Terms

#### Measurements /Units

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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 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 this attachment*

## APPENDIX C - INSTRUMENT CALIBRATION PROCEDURES

### 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**):

- < 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 _____	
_____	

**TEXAS TECH UNIVERSITY  
ENVIRONMENTAL HEALTH AND SAFETY**

**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 \_\_\_\_\_ HV "As Found" Reading \_\_\_\_\_ Meter HV Adjusted Reading \_\_\_\_\_ Input Sensitivity \_\_\_\_\_

\_\_\_\_\_ Volts \_\_\_\_\_ Volts \_\_\_\_\_ Volts \_\_\_\_\_ 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 \_\_\_\_\_ .1 \_\_\_\_\_ 1 \_\_\_\_\_ 10 \_\_\_\_\_ 100 \_\_\_\_\_ 1000 \_\_\_\_\_ Ranges Calibrated Electronically

☐ Meter Within  $\pm 10\%$  \_\_\_\_\_ ☐ Within  $\pm 10 - 20\%$  Tolerance \_\_\_\_\_

Meter out of Tolerance  $> \pm 20\%$

Meter Requires Repair

Comments : \_\_\_\_\_

Calibrated by : \_\_\_\_\_ Date: \_\_\_\_\_

# Laser Safety Manual

(POLICIES AND PROCEDURES)

September 2002

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## SECTION I: MANAGEMENT OF LASER LICENSE

### **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 Laser Safety Committee.

### **D1 LASER SAFETY PROGRAM**

**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 (LSM) 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 II J.1.

**D1.5.2** Access Controls for Laser Areas: Access to the laser areas is controlled by II J.4 of the LSM. 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: II J.3 of the LSM provides for posting of the appropriate signage respective of the class(s) of the laser.
- D1.5.4** Training: II J.5 of the LSM addresses the required training for laboratory personnel.
- D1.5.5** Management of Required Records: Records management procedures are addressed in II J.11 of the LSM.
- D1.5.6** Personal Protective Equipment: II J.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 V of the LSM.

## **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** 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.
- D4.6.9** 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.

END OF SECTION I

## SECTION II: SUBLICENSE PROGRAM

### **INTRODUCTION**

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 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 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 applies. 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 particular 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 policies.

**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 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/DELIVERY**

#### **D13.1.1** Ordering lasers or laser equipment

**D13.1.1.1** Requestor will contact the LSO via email.

**D13.1.1.2** 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** 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:

- D13.1.2.2.1** Laser specifications;
- D13.1.2.2.2** To whom the equipment will be transferred;
- D13.1.2.2.3** Time frame for the transfer.

- D13.1.2.3** LSO will:

- D13.1.2.3.1** Verify status and document information
- D13.1.2.3.2** 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** LSO will:

- D13.1.3.2.1** Verify status of sublicense and paperwork;
- D13.1.3.2.2** Document information received;
- D13.1.3.2.3** 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

**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

**D13.6.1.1.1** It will be in good condition and comfortable.

**D13.6.1.1.2** It will be labeled with wavelength and optical density.

**D13.6.1.1.3** It will be inspected every year.

**D13.6.1.2** Protective clothing

**D13.6.1.2.1** It will be tightly woven material.

**D13.6.1.2.2** 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** MODIFICATIONS

- 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 sublicense 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.

**D13.13.1.3.1** The Sublicensee will complete, sign and date a door card.

**D13.13.1.3.2** 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 laser hazards.

**D13.13.1.3.3** 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

**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. 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

**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.

END OF SECTION II



## 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.

**D15.2.1** Radiance – The laser energy per unit area of the beam.

**D15.2.2** 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 – denotes lasers or laser systems that do not, under normal operating conditions, pose a hazard.

- D15.3.3** Class II – denotes 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 – denotes some 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. 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 – denotes 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 – denotes 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
- D15.4.1.2.1** Specular Reflection – The reflection is mirror-like due to smooth surfaces being less than the incident wavelength.

**D15.4.1.2.2** 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.

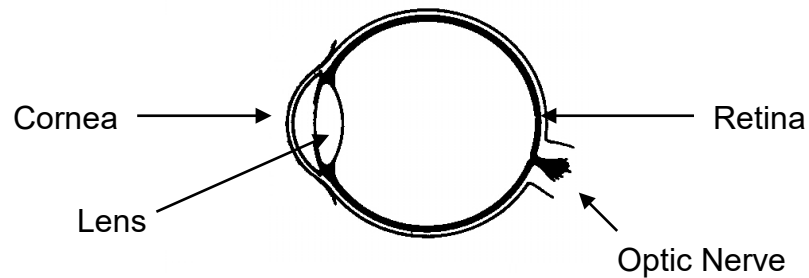
## **D15.5** BIOLOGICAL EFFECTS

**D15.5.1** The 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. However, safety and prevention are the best protection against personal injury.

### **D15.5.1.1** Eye

**D15.5.1.1.1** 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.

**D15.5.1.1.2** Diagram of Eye Structure



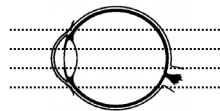
**D15.5.1.1.3** Photochemical – High energy laser light photons may interact with molecules in the eye tissue causing chemical bonds to be broken. The injury depends on the tissue of the eye affected.

**D15.5.1.1.4** 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.

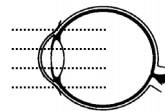
**D15.5.1.1.5** Summary – Types of eye damage from laser radiation are:

- |                |                               |
|----------------|-------------------------------|
| a) Cornea      | Corneal Burn                  |
| b) Lens        | Cataracts                     |
| c) Retina      | Decreased Vision/ Vision Loss |
| d) Optic Nerve | Blindness                     |

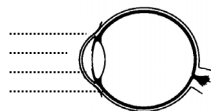
**D15.5.1.1.6** Electromagnetic Radiation to the Eye



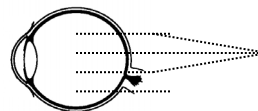
Microwaves and Gamma



Near Ultraviolet



Far Ultraviolet &  
Far Infrared



Visible & Near Infrared

**D15.5.1.2** Skin – Skin tissue is at risk from laser exposure. The effects to the skin are considered secondary. However, the higher the power of the laser, the greater the risk to the skin.

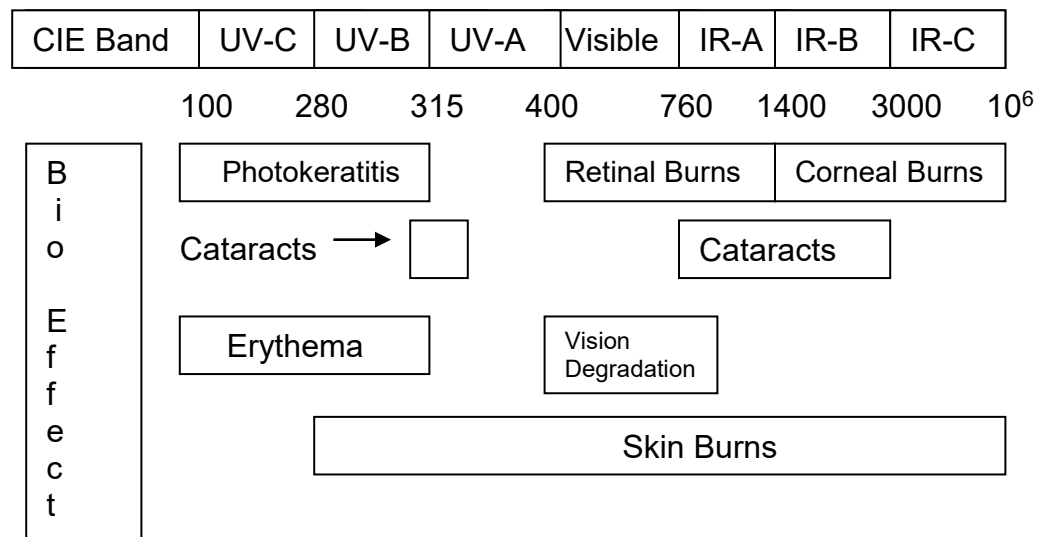
**D15.5.1.2.1** Thermal – It is an actual burn to the skin; the severity of the burn is dependent upon the penetration of the skin tissue.

**D15.5.1.2.2** Ultraviolet – Due to the intense ultraviolet beam exposure, the skin will be affected. Typically, this affect is equivalent to a sunburn.

**D15.5.1.2.3** 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.

**D15.5.1.2.4** Summary – Types of skin damage from laser radiation are sunburn, skin burns, skin cancer, and skin aging.

**D15.5.1.2.5** 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 ( $\text{J}/\text{cm}^2$ ).

**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.

$$\text{NHZ} = \frac{1}{N} \left\{ \frac{4P}{B (\text{MPE})} - a^2 \right\}^{1/2}$$

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  $\mu\text{W}$ 's.

$$\text{AEL} = \text{MPE} \times (\text{area of limiting aperture})$$

**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.

$$\text{OD} = \log \left\{ \frac{E_i}{\text{MPE}} \right\} \quad E_i = \text{incident beam irradiance in } \text{W}/\text{cm}^2$$

**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.

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, 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.

\*Users will report all laser incidents.

### **D18 ORGANIZATION AND AUTHORITY**

**D18.1** The LSO is responsible to investigate any laser incident at TTU.

**D18.2** 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.

**D18.3** 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.

**D18.4** 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:

**D18.5.1** Recognizes a laser emergency;

**D18.5.2** Has the training to prevent or confine a laser accident;



**D18.5.3** 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:

**D19.1.1** Notify all persons in the area to leave at once and turn off all electrical laser equipment..

**D19.1.2** 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.

**D19.1.3** 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

**D19.1.4** Be available to evaluate or help evaluate the extent of damage to materials and equipment.

**D19.1.5** All sublicensees and workers will be required to file an incident report with the LSO.

**D19.1.6** 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:

**D20.1.1** Immediately remove affected person(s) from the area and notify the LSO.

**D20.1.2** Secure the area.

**D20.1.3** 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.

**D20.1.4** Assist the LSO in obtaining all details of the incident.

**D20.1.5** 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.

**D20.1.6** 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

END OF SECTION IV

# Appendices

[Chemical / Laboratory Safety](#)

[Biosafety](#)

[Radiation Safety](#)

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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.

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](mailto: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

Room:	
PI:	
Date:	

*The purpose of this survey is to identify unsafe conditions and/or behaviors in laboratories where chemical, biological, and/or physical hazards are present. This is the checklist that EHS uses for their annual survey. Laboratory personnel are encouraged to utilize this survey to self-evaluate their work area on a regular basis. Safe science is smart science.*

<b>critical</b>	Critical finding: a safety departure that can result in personnel injury or exposure and/or environmental contamination. Noncritical 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.
-----------------	--

<b>non-critical</b>	Non-critical finding: a safety departure that presents a moderate hazard; are generally indicative of inadequate safe work practice(s).
---------------------	---

<b>admin</b>	Administrative safety departure: Indicates the lack of, or deficiency in, written safety policies, rules, supervision, schedules, and / or training with the goal of reducing the duration, frequency, and severity of exposure to hazardous materials or situations. Administrative safety departures can be critical or non-critical in nature.
--------------	---

Field ID Code	Sec.	Area of Interest				
	A	Procedural Safety	Y	N	N/A	COS
L3	3	Are SDSs available? Do lab personnel know SDS location?				
L4	4	Do lab personnel know location of the work area safety plan (WASP)?				
L5	5	Is there disinfectant/neutralizer/absorbent materials available for spills? (spill kit)				
L6	6	Have lab personnel taking the proper training? Is the training documentation available?				
	7	Are special hazard signs (e.g. Biohazard, LASER, Radiation, etc.) posted when required for the work area?				
	8	Is there a WASP for the work area? Is the WASP available in the work area?				
	9	Has the WASP been reviewed in the past 2 years and/or has it been revised to cover new hazards/operations introduced to the work area?				
	10	Have all lab personnel signed the WASP acknowledgement form?				
	11	Are written standard operating procedures available for all operations conducted and equipment used in the work area?				
	12	Is a safety captain assigned to the work area?				
	13	Do personnel know how and when to submit SCAN and incident reports?				
Code	B	Personal Protection	Y	N	N/A	COS
L7	1	Is appropriate protective equipment and apparel, such as lab coats, available?				
L8	2	Is protective apparel worn?				
L9	3	Are gloves available for chemical / biological / physical hazards present in the work area?				

L10	4	Are appropriate gloves worn while working with chemical / biological / physical hazards?				
L11	5	Are used disposable gloves immediately discarded after removal?				
L12	6	Is appropriate eye protection available?				
L13	7	Is appropriate eye protection worn?				
L14	8	Are respirators used by EHS-approved individuals only?				
	9	Is defective, soiled and/or damaged PPE removed from service?				
	10	Is soiled, reusable PPE decontaminated?				
	11	Is PPE stored in such a way that the inner surfaces that contact the user are not at risk of becoming contaminated?				
	12	Is PPE stored in the work area and not in public areas or offices?				
<b>Code</b>	<b>C</b>	<b>Housekeeping</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L15	1	Are aisles free of slip, trip, and fall hazards?				
L16	2	Are bench tops and work areas free of excess storage and clutter?				
L17	3	Is broken / chipped glass secured for repair or properly disposed of?				
	4	Are floors and vertical surfaces regularly decontaminated?				
<b>Code</b>	<b>D</b>	<b>Work Practices</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L18	1	Does hand washing occur after removal of gloves and before leaving the laboratory?				
L19	2	Are food, drink, medicine, cosmetics, or other personal hygiene products not stored or consumed in lab?				
L20	3	Is proper lab attire worn? (no shorts, open-toed shoes or cloth shoes)				
L21	4	Mouth pipetting is prohibited. Are mechanical pipetting devices available in the work area?				
L22	5	Are work surfaces and equipment decontaminated after any spill or splash?				
L23	6	Are appropriate disinfectants/neutralizers used for decontamination?				
L24	7	Are ignition sources kept from where flammable materials are used or stored?				
L25	8	Are pulleys, belts and other moving parts properly guarded?				
L26	9	Are closed systems under heat or pressure contained behind a blast shield or in a fume hood with the sash closed?				
L27	10	Are cryogenic liquids stored in Dewar flasks or cold traps wrapped with screens, friction tape, or a metal jacket?				
L28	11	Are needles kept from being recapped? If needles are recapped, is an EHS-approved SOP in place and posted?				
L29	12	Are sharps secured?				
L30	13	Are the doors to the work area kept closed? Are doors locked when the work area is vacant?				
L31	14	Are kitchen appliances and normal food/drink containers used for lab work properly labeled?				
L32	15	Are devices containing mercury secured with secondary containment?				
L33	16	Is broken or leaking equipment tagged out and secured for repair?				
L34	17	Are freezers periodically defrosted to prevent ice build-up?				

	18	Is an signed EHS decontamination form attached to equipment tagged out for surplus?				
	19	Do soldering stations have a 10 foot zone of clearance?				
	20	Are soldering stations using solder contain lead exhausted (i.e., local exhaust, inside a fume hood, or a table-top scrubber)?				
L108	21	Do liquid containers (including waste containers) stored on the floor have secondary containment?				
	22	Are sharps containers available in the immediate area where sharps are used?				
<b>Code</b>	<b>E</b>	<b>Compressed Gases/DI Bottles</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L35	1	Are cylinders upright/secured? Are securing devices in good condition?				
L36	2	When cylinders are stored or not in use, are the caps in place?				
L37	3	Are main valves closed and the pressure regulators released when not in use?				
L38	4	Are flammable gases present only where there is ongoing use?				
L39	5	Are flammable gases separated from oxidizing agents by at least 20ft?				
<b>Code</b>	<b>F</b>	<b>Facilities</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L40	1	If hand sinks are available are towels and soap present?				
L41	2	Are laboratory floors easily cleaned? (Carpets and rugs are inappropriate)				
L42	3	Are bench tops impervious to water and resistant to moderate heat and disinfectants?				
L43	4	Is lab furniture capable of supporting anticipated loading and uses?				
L44	5	Are spaces between benches, cabinets, and equipment accessible for cleaning?				
L45	6	Chairs covered with easily cleaned (non-fabric) material?				
L46	7	Are vacuum lines equipped with traps?				
	8	Are walkways unobstructed and at least 36 inches (~90cm) wide?				
	9	Is there a clearance of at least 32 inches (~80cm) at all work area exits?				
<b>Code</b>	<b>G</b>	<b>Special Procedures for Carcinogens, Teratogens, and Highly Toxic or Reactive Chemicals</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L47	1	Are designated work areas for these materials present and labeled?				
L48	2	Have adequate written procedures been created for the use of these materials?				
	3	Are safety procedures for these materials posted in the immediate work area?				
<b>Code</b>	<b>H</b>	<b>Emergency Equipment/Fire Safety</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L49	1	Are safety showers/eyewashes clearly visible and unobstructed?				
L50	2	Are fire extinguishers clearly visible and unobstructed?				
L51	3	Does lab staff know the location of emergency equipment?				
L52	4	Are exits and means of egress unlocked and unobstructed?				
L53	5	Is an eighteen inch vertical clearance maintained from sprinkler heads?				
L54	6	Are first aid kits maintained with unexpired/unopened items?				

	7	Are eyewashes flushed weekly?				
	8	Are eye wash covers in place?				
	9	Is there an 18 inch (~46 cm) clearance from the center of the spray from the safety shower?				
<b>Code</b>	<b>I</b>	<b>Electrical Hazards</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L55	1	Are electrical cords and plugs intact- not damaged or frayed and free of tape, splices or repairs?				
L56	2	Is no more than one item plugged into an individual receptacle?				
L57	3	Are extension cords used on a temporary basis only, not as a permanent source of electricity?				
L58	4	Do all electrical outlets within 6 ft of a water source have a Ground Fault Circuit Interrupter (GFCI)?				
L59	5	Are grounded or polarized plugs unaltered?				
L60	6	Are electrical cords not daisy-chained together?				
<b>Code</b>	<b>J</b>	<b>Waste</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L61	1	Are all cultures, stocks, and other regulated wastes decontaminated before disposal by an approved decontamination method (i.e., autoclaving, chemical disinfection?)				
L62	2	Are materials to be decontaminated outside of the immediate work area placed in a durable, leak-proof container and closed for transport?				
L63	3	Is clean broken glass/glass waste segregated from regular trash or other wastes?				
L64	4	Are glass waste container not overfilled?				
L65	5	Are only needles and other sharps disposed of in a sharps container?				
L66	6	Are sharps containers not overfilled?				
	7	Are glass waste containers appropriate?				
	8	Are needles intact and not bent/removed before disposal?				
	9	When sharps containers are full, is the lid secured for EHS pick up?				
<b>Code</b>	<b>K</b>	<b>Hazardous Waste Compliance</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L67	1	Do all chemical waste containers have the orange EHS label?				
L68	2	Are orange EHS labels correctly filled out and in good condition?				
L69	3	Are waste containers appropriate and in good condition?				
L70	4	Are waste containers properly capped?				
L71	5	Are funnels only used while filling waste containers?				
L72	6	Is chemical waste kept from being disposed down the sink or in regular waste bins?				
L73	7	Are wastes properly stored/segregated?				
L74	8	Is waste generated in the work area kept in the work area until pick up from EHS?				
L75	9	Is waste generated by work area personnel under the control of that work area personnel that generated the waste?				
L76	10	Is there not excess storage of waste (i.e., less than 40 gallons / ~150L total, excess biowaste)?				

	11	Are waste containers compatible with the contents?				
	12	Other than bench-top collection, is biowaste secured in leak-proof container(s) with lid(s) during accumulation?				
	13	Is treatment of liquid and solid biological waste logged?				
	14	Are waste containers filled no more than 3/4 full?				
	15	Are vented caps used for waste streams subject to pressurization?				
	16	Are waste containers free of contamination (e.g., outside of liquid collection containers in inner portions of solid collection containers)?				
	17	Are EHS-provided biological barrels properly prepared for pick up?				
	18	Is biowaste properly prepared for autoclaving?				
<b>Code</b>	<b>L</b>	<b>Chemical Fume Hoods</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L77	1	Are fume hoods used for volatile, flammable, and gaseous hazards?				
L78	2	Are fume hoods free of excess storage?				
L79	3	Are large pieces of equipment raised to allow air flow?				
L80	4	Are items placed and procedures conducted at least 6 inches inside fume hood?				
L81	5	Is there a visual indicator of fume hood flow?				
L82	6	Is the fume hood sash lowered as much as possible and not raised above the indicated height while working and closed when no one is actively working in the fume hood?				
L83	7	Are operations using heated perchloric acid performed in a perchloric acid fume hood?				
	8	Are fume hood baffles unobstructed?				
<b>Code</b>	<b>M</b>	<b>Biosafety Cabinets (BSC) and Laminar flow hoods</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L85	2	Are volatile and/or toxic chemicals not use in unducted BSCs?				
L86	3	Are BSCs tagged with annual inspection data?				
L87	4	Are laminar flow hoods used properly as sterile working surfaces such that viable organisms and/or hazardous chemicals are not used within the laminar flow hood?				
	6	Is storage within the BSC limited to pipets?				
	7	Are operations done at least 6 inches inside the BSC?				
	8	Are intake grilles unobstructed when the BSC is in use?				
	9	Are UV lights not used as the primary means of disinfecting the BSC?				
	10	Are UV lights properly maintained?				
	11	Are open flames not used in BSCs and laminar flow hoods?				
	12	Is the use of ethanol limited within the BSC?				
	13	Are disinfectants other than ethanol used to clean the BSC?				
	14	Are contaminated items decontaminated or properly contained prior to removal from the BSC?				
<b>Code</b>	<b>N</b>	<b>Chemical Handling and Storage Safety</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>	<b>COS</b>
L89	1	Is there a current chemical inventory?				

L90	2	Has the inventory been entered in EHS Assistant?				
L91	3	Are chemical containers in good condition?				
L92	4	Are original chemical container labels and EHS barcodes present and legible?				
L93	5	Are all chemicals segregated by storage group (as defined in Appendix AA of the Laboratory Safety Manual)? Is secondary containment used when needed?				
L94	6	When present, are acids and bases stored separately properly?				
L95	7	Are secondary containers labeled properly?				
L96	8	When present, are hydrofluoric, nitric, and perchloric acids stored properly with their own secondary container?				
L97	9	Are hydrofluoric acid (HF) safety procedures posted and observed?				
L98	10	Is unexpired calcium gluconate gel available where hydrofluoric acid (HF) is present?				
L99	11	Is picric acid stored hydrated at all times? Is an appropriate usage log maintained?				
L100	12	Are all flammable/combustible chemicals stored in approved flammable chemical storage cabinets?				
L101	13	Are all flammable/combustible chemicals stored in approved flammable chemical storage refrigerators?				
L102	14	Is the total flammable chemical storage limited to 80gallons for research and 20gallons for teaching labs of 200 sq. ft. or greater and half those amounts in smaller labs?				
L103	15	Are chemicals stored away from intense light sources?				
L104	16	Are large chemical containers stored near the floor?				
L105	17	Are bottle carriers and/or transportation carts utilized when moving chemicals from one room to another?				
L106	18	Are organic peroxide-forming compounds labeled with receipt date, open date and/or expiration date?				
L107	19	Are peroxide-forming compounds checked for peroxide formation every 6 months after the open date?				
L109	21	Are drawers/cabinets with visual barriers properly labeled when they contain chemicals or samples?				
L110	22	Are labels properly removed and completely defaced on reused chemical containers?				
L111	23	Are chemicals stored upright?				
	24	Are no more than 5 gallons (~20 liters) of flammable liquids used at one time in the work area?				
	25	Are secondary containers and/or containment appropriate?				
	26	Is equipment using volatile chemicals 1) inside a fume hood, 2) under local exhaust, or 3) are volatile chemical containers sealed/filtered?				
	27	Are storage group 9 chemicals that are also flammable stored in a desiccator inside of a flammables cabinet?				
	28	Do original chemical labels meet the requirements of the hazardous communication and laboratory standards (29 CFR 1910.1200 and 1910.1450)?				

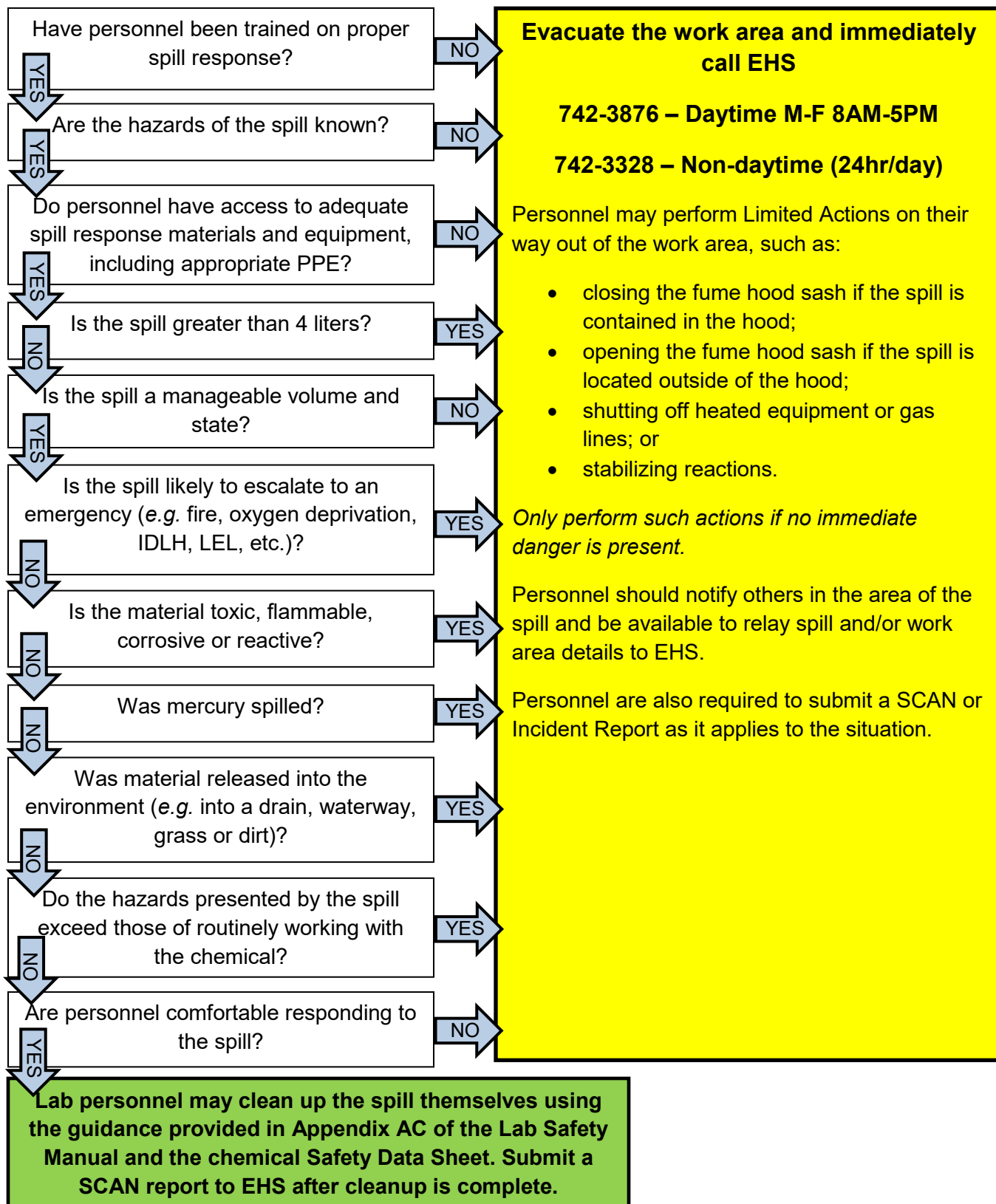
O	Biosafety Level 2, Lab must meet the criteria of sections A-N and O.	Y	N	N/A	COS
1	Does the lab have proper biohazard signs posted on all entrance doors to the work area?				
2	Lockable door provided for facilities that house restricted agents?				
3	Is TTU custodial staff not allowed to enter laboratory to remove trash and/or clean?				
4	Access to laboratory is limited when experiments are in progress?				
5	Does hand washing occur after handling viable material and before leaving the lab?				
6	If staff are potentially exposed to blood or bodily fluid, Blood borne Pathogen Training is required. Have all lab workers had this training?				
7	Are proficiency levels of lab workers checked? How?				
8	Is there a medical surveillance program in place?				
9	Does the lab have access to a copy of the CDC's most current edition of <i>Biosafety in Microbiological and Biomedical Laboratories</i> ?				
10	Does the lab have access to a copy of the NIH's most current edition of <i>Guidelines for Research Involving Recombinant DNA Molecules</i> ?				
11	Is there a laboratory-specific biosafety manual that includes written laboratory procedures and written emergency plan for the laboratory?				
12	Does lab equipment (refrigerator, incubator, cold rooms, freezers, storage cabinets, and biosafety cabinets) have proper biohazard signage?				
13	Are labeled, non-sharps biological waste containers available?				
14	Are there liquid biological waste disposal procedures in place?				
15	Are pathological waste procedures in place?				
16	Is the biological safety cabinet located away from doors, room ventilation, heavily traveled areas, and other disruptive equipment so as to maintain undisturbed airflow?				
17	Are emergency phone numbers easily accessible?				
18	Is there routine decontamination of equipment? (Is there a log?)				
19	Is equipment decontaminated after a splash or spill?				
20	Is appropriate PPE worn while in the laboratory?				
21	Are gloves worn when hands may contact viable materials, contaminated surfaces, or equipment?				



# Appendix AC

**DOES YOUR SPILL REQUIRE EHS RESPONSE?**

Follow the flow chart to determine if EHS should respond to your spill.





## 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](mailto:ehs.lab.safety@ttu.edu) if the EHS-provided spill kit was used for clean-up.

# Appendix AD

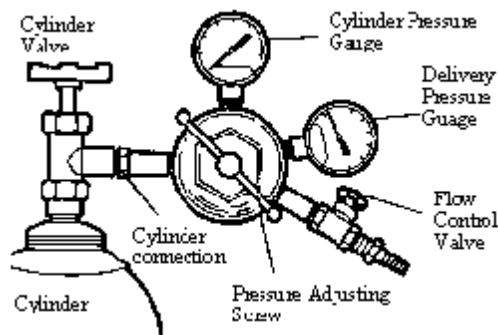


TEXAS TECH UNIVERSITY

## Environmental Health *and* Safety

### HANDLING AND OPERATING GAS CYLINDERS

The figure below depicts a regulator attached to a cylinder.



TTU laboratory operations require the use of compressed gases for a variety of different operations. Compressed gases present unique hazards. Depending on the particular gas, there is a potential for mechanical and chemical hazards. You must know the hazards of the compressed gas and compressed gas cylinders before using or transporting them. All individuals who work with compressed gasses must read the MSDS of the agent before handling the cylinders. They must use the proper Personal Protective Equipment (PPE), if needed, when working with or handling the cylinders.

Compressed gases are contained in heavy, highly pressurized metal containers; the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb. Inert gases can produce conditions of oxygen depletion that could lead to asphyxiation.

Many cylinders contain pressures that are in excess of 2000 pounds per square inch. A broken valve is all it takes for the cylinder to become an unguided missile. Never deliberately breathe, or allow others to breathe any compressed gas of any type. This can cause a depletion of oxygen in the bloodstream and/or poisoning, leading to rapid suffocation and death.

All laboratory workers must follow TTU policies for personal protection when working with compressed gasses. All personnel are required to complete the online Lab Safety Training through the Texas Tech University Environmental Health & Safety website or attend a Laboratory Safety Seminar presented by Texas Tech University Environmental Health & Safety. These trainings include an introduction to general chemical safety. Furthermore, all personnel shall read and fully adhere to this SOP when handling compressed gases.



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## Environmental Health *and* Safety

### General Handling and Operation

- Hand, eye, body and respiratory protection should be determined prior to the use of any compressed gasses.
- Cylinders with regulators usually have a number of valves, and individuals using the cylinders need to know the function of each valve before use.
- Use of safety glasses (preferably with a face shield) is recommended when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines.
- All laboratory workers must be trained in proper handling of compressed gas cylinders and recorded by PI. Compressed gases must only be handled by experienced and properly trained individuals.
- Laboratory workers must have proper equipment for fitting and securing a cylinder, including valves, regulators, wrenches, tubing, straps, racks, chain and clamps.
- Cylinders must be kept in an upright position and must be secured with chains or straps to an immovable object.
- Small cylinders must not be kept in drawers or cabinets. They must be kept in an upright position and secured with a chain or strap.
- The cylinder's valve must be closed at all times, except when in use.
- Wrenches or other tools must not be used for opening and closing valves. If a valve is not working, have it inspected and fixed.
- Leave the valve protection cap in place until the cylinder is secured. Valve protection caps should remain in place until ready to withdraw gas or connected to a regulator or manifold.
- Do not force connections that do not fit.
- When extracting gas from a cylinder, increase the flow rate slowly and inspect the system for leaks.
- All compressed gas cylinders must have safety pressure relief valves.
- Use the cylinder valve for turning gas off, not the regulator.
- Never heat a cylinder to raise the pressure of the gas (this can defeat the safety mechanisms built in by the supplier).
- Safety relief devices in the valve or on the cylinder must be free from any indication of tampering.
- Laboratory workers must monitor for leaks and ensure proper labeling of cylinders. All compressed gas cylinders must have their contents and precautionary labeling clearly marked on their exteriors.
- All compressed gas cylinders must regularly be inspected for corrosion, pitting, cuts, gouges, digs, bulges, neck defects, general distortion.



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- Empty, damaged and surplus cylinders must not be stored in the laboratory. If you have any questions, contact EHS at 742-3876.
- Never attempt to adapt fittings from one cylinder or regulator to another.
- Fittings or hoses must be compatible with the gas in the cylinder.
- Gases must never be transferred from one cylinder to another.
- Cylinders must not impede movement through isles or prevent egress in the event of an emergency.
- Never lubricate any part of the valve, cylinder, or attached equipment.
- Keep the cylinders in a dry, cool and well-ventilated area.
- Incompatible gas cylinders must be properly separated. Oxygen and flammable gas cylinders must be separated by a minimum of 20 feet.
- When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- Before removing a regulator from a cylinder, close the cylinder valve and release all pressure.
- Label all empty cylinders with tags so that everyone will know their status. Handle empty cylinders as carefully as full ones; residual pressure can be dangerous.
- **In the event of a fire, call 9-911 from a campus phone or 911 from a cell phone.**

### Moving Cylinders

- Use proper PPE when transferring or moving cylinders.
- Cylinders must be in good condition before transferring.
- Before moving cylinders, regulators must be removed, valves must be closed and the cap must be securely in place.
- When moving a cylinder outside of the laboratory, use an approved wheeled cylinder cart. The cylinder must be secured to the wheeled cart with a chain or strap.
- Never drag, slide or roll a cylinder.
- Do not drop cylinders or strike them against each other or against other surfaces violently.
- Do not use the valve cover to lift cylinders; they could be damaged and become unattached.





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### Preventing and Controlling Leaks

- Laboratory workers must check the cylinder's connections and hoses regularly for leaks.
- Convenient ways to check for leaks include flammable gas leak detectors (for flammable gases only) or a 50% glycerin in water solution. Bubble-forming solutions and leak detectors are available commercially. Never use a flame for leak detection.

**The following procedures must be used when a compressed gas cylinder leak cannot be remedied by simply tightening the valve:**

1. Attach a tag to the cylinder stating it is unserviceable.
2. **If the cylinder contains a flammable, inert, or oxidizing gas**, remove it to an isolated area, away from possible ignition sources. Allow it to remain isolated until the gas has discharged, making certain that appropriate warnings have been posted.
3. **If the gas is corrosive**, remove the cylinder to an isolated, well-ventilated area. The stream of leaking gas should be directed into an appropriate neutralizing material.
4. **If the gas is toxic**, remove the cylinder to an isolated, well-ventilated area, but only if this is possible while maintaining personal safety. It may be necessary to evacuate the facility.
5. Notify the gas supplier and follow his/her instructions as to the return of the cylinder.
6. If any risk of exposure exists, call EHS and evacuate the area before the tank is moved.
7. **For major leak, all laboratory workers must evacuate the laboratory immediately, close the doors and contact EHS at 742-3876.**

### Pressure Regulator for Cylinders

- Use the appropriate regulator for the type of tank and gas being used.
- Do not use any oil, grease, mercury or soapy water on regulator valve.
- Check that the regulator is free of foreign objects.
- Relief valves must be vented to a laboratory chemical hood or other safe location.
- Never attempt to repair a gas leak when the system is still pressurized or venting gas.
- While a cylinder is not being used, the regulator must be removed.



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### To open the cylinder:

1. Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.
2. Open the valve slowly and only with the proper regulator in place. Never leave pressure in a regulator when it is not in use.
3. Stand with the cylinder between yourself and the regulator when opening the cylinder valve (cylinder valve outlet facing away).
4. Acetylene or other flammable gas cylinder valves should not be opened more than  $\frac{1}{2}$  turns of the spindle, and preferably no more than  $\frac{3}{4}$  of a turn. This reduces the risk of explosion and allows for the cylinder valve to be closed quickly cutting off the gas flow. Do not use acetylene at operating pressures above 15 psig.
5. Oxygen cylinder valves must be opened all of the way during use.

### Resources

Listed below are a few resources that can be used to find safety and health information and standards.

#### **National Institute for Occupational Safety and Health, (NIOSH) Department of Health and Human Services**

Web site: [www.niosh.gov](http://www.niosh.gov)

#### **U.S. Department of Labor, Occupational Safety & Health Administration, (OSHA) Public Affairs Office**

Web site: [www.osha.gov](http://www.osha.gov)

#### **Compressed Gas Association (CGA)**

Web site: [www.cganet.com](http://www.cganet.com)

#### **Prudent Practices in the Laboratory**

Web site: [www.nap.edu.com](http://www.nap.edu.com)

# COMPRESSED GAS TRAINING LOG

**“I have read and understand this SOP for Handling and Operating of Gas Cylinders.**

**I agree to fully adhere to its requirements.”**

<b>Last (Print)</b>	<b>First (Print)</b>	<b>TTU R Number</b>	<b>Signature</b>	<b>Date</b>

# Appendix AE



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## Environmental Health *and* Safety

### 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.

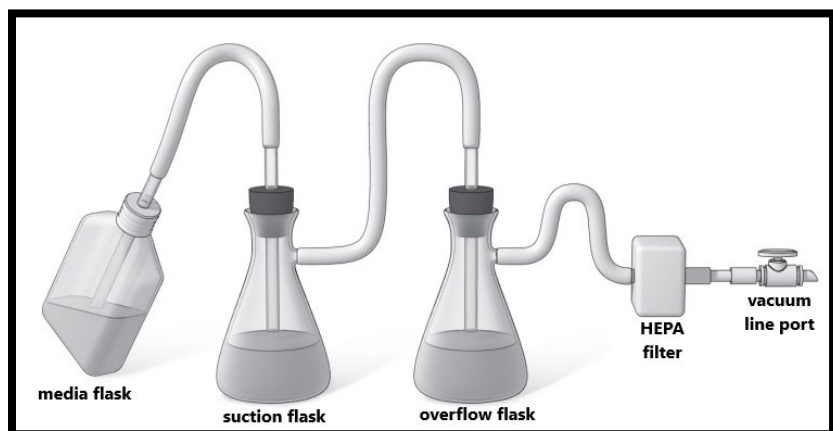
Improper trapping can allow vapor to be emitted from the exhaust of the vacuum system resulting in potential personnel exposure and/or entry into the work environment.

#### Proper Trapping Techniques

All lines leading from the equipment to the vacuum source must be equipped with a trap or filter as appropriate.

#### *Biological Materials*

- All vacuum lines used to aspirate supernatants, tissue culture media, and other liquids that may contain microorganisms should be protected from contamination using a collection flask and overflow flask containing an appropriate disinfectant. An appropriate disinfectant may be contained in the suction flask and discard in a timely manner or the contaminated fluids may be collected and disinfected just before disposal.
- Flasks stored outside of a biological safety cabinet should be stored in secondary containment to collect any spills.
- Collection tubes should extend at least two inches below the sidearm of the flask.
- A High Efficiency Particulate Air (HEPA) filter must be attached to the vacuum line when working with BSL2 or BSL3 agents to protect the system from aerosolized microorganisms (see Figure 1). The practice is also recommended for BSL1 laboratories.



**Figure 1:** One method to effectively protect a house vacuum system during aspiration of infectious fluids. The suction flask collects any contaminated fluids into a suitable decontamination solution. The overflow flask serves as an overflow collection vessel. The in-line HEPA filter protects the vacuum system from aerosolized microorganisms. (Image adapted from *BMBL*).



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## Environmental Health and Safety

### Particulates

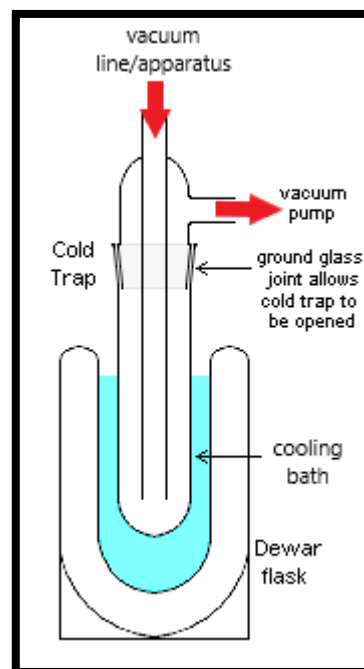
- Vacuum lines should be fitted with filtration capable of efficiently trapping the particulates in the size range being generated.

### 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  $-78^{\circ}\text{C}$ ). 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.
- 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.



**Figure 2:** An example of a cold trap in a vacuum line immersed in a cooling bath.



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## Environmental Health *and* Safety

- 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.

### *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.
- 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.



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### 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*. 5<sup>th</sup> 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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## Environmental Health *and* Safety

### 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](http://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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## Environmental Health *and* Safety

### **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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## Environmental Health *and* Safety

### 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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## Environmental Health *and* Safety

### 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 Compounds<sup>1</sup>

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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## Environmental Health *and* Safety

### Detection and Inhibition of Peroxides<sup>2</sup>

#### 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*, 2<sup>nd</sup> Ed.

# Appendix A1



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## 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?		
<b><u>If you answered 'NO' to any of these questions, contact the CHO for further evaluation to be performed.</u></b>		

# Appendix AJ



TEXAS TECH UNIVERSITY

## Environmental Health *and* Safety

### 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 axillary 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>B</b>	<b>Equipment</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>
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.			
<b>C</b>	<b>Chemical Hazards</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>
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.			

<b>D</b>	<b>Biological Hazards</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>
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			
<b>E</b>	<b>Radiation Hazards</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>
1	Notify the Radiation Safety Officer of the move. The RSO will direct decommissioning of the laboratory.			

<b>F</b>	<b>Laboratory - Specific Considerations in Decommissioning</b>	<b>Y</b>	<b>N</b>	<b>N/A</b>
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
<p><b>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.</b></p>				

# 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:

<http://www.dept.ehs.ttu.edu/ehs/EHSHome/scan/Create>

Link for Hazardous Waste Pick-Up request:

<https://www.dept.ehs.ttu.edu/ehs/wastepickup/Home/Index>

Forms included in Appendix AL:

- Incident Report Form
- Initial Investigation of Overexposure Form

# INCIDENT REPORT FORM

**Submit this form to EHS within 24 hours of the incident.**

The following section is to be completed by the **Person Injured/Involved** in the incident.

Last Name:	First Name:	Contact Information:	Sex: <input type="checkbox"/> M <input type="checkbox"/> F	DOB:
Part(s) of Body Involved:	Building & Room #:	Time of Incident: <input type="checkbox"/> am <input type="checkbox"/> pm	Date of Incident:	

Thoroughly describe what happened (cause of incident, location in room, type of first aid administered (if any), property damage, etc.)

First aid was administered at the time of the incident: ☐ Y ☐ N

Additional medical attention was offered? ☐ Y ☐ N      If yes, this medical attention was: ☐ Accepted ☐ Rejected

Signature of **Person Injured/Involved** in the incident:

The following section is to be completed by the **Supervisor/Teaching Assistant**.

Last Name:	First Name:	Department:	Class & Section (if any):
Was a safety rule violated? If yes, explain: <input type="checkbox"/> Y <input type="checkbox"/> N			Supervisor's Contact Information:

Thoroughly describe what happened (cause of incident, response, type of first aid administered (if any), property damage, etc.)

Signature of **Supervisor/Teaching Assistant**:

The following section is to be completed by the **Safety Coordinator/Responding Personnel**.

Last Name:	First Name:	Title:	Date Reported:
------------	-------------	--------	----------------

Safety Coordinator's/Responding Personnel's Actions:

Signature of **Safety Coordinator/Responding Personnel**:

Department Phone #:	Point of Contact Information:
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Submit form via fax to 806-742-3895 or scan and email to [ehs.lab.safety@ttu.edu](mailto: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 \_\_\_\_\_

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Witnesses: \_\_\_\_\_

\_\_\_\_\_

Location of injuries or sites of contact, e.g. eyes, skin: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Additional Information: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Signs and symptoms developed:

☐ Eye irritation

☐ Taste

☐ Breath odor

☐ Nausea

☐ Vomiting

☐ Headache

☐ Dizziness

☐ Shortness of breath

☐ Chest pain

☐ Pale skin

☐ Skin irritation

☐ Rash

☐ Blistering

☐ Tingling

Other \_\_\_\_\_

\_\_\_\_\_

Elapsed time for signs and symptoms to develop: \_\_\_\_\_

\_\_\_\_\_

Are signs and symptoms same as indicated on MSDS? ☐ Yes ☐ No If No, specify below.

\_\_\_\_\_

\_\_\_\_\_

Monitoring Equipment Used: ☐ PID ☐ Detector tubes ☐ Mercury Meter ☐ Miran 1BX

Additional Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name of Investigator

Signature

Date

NOTE: This information will be provided to the examining physician.

## 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



TEXAS TECH UNIVERSITY

## Environmental Health *and* Safety

### **BIOSAFETY LEVEL 1**

THIS INFORMATION WAS TAKEN DIRECTLY FROM THE BMBL.

Biosafety Level 1 is suitable for work involving well-characterized agents not known to consistently cause disease in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment. The laboratory is not necessarily separated from the general traffic patterns in the building. Work is generally conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is neither required nor generally used. Laboratory personnel have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related science.

The following standard and special practices, safety equipment and facilities apply to agents assigned to Biosafety Level 1:

#### **Standard Microbiological Practices**

1. Access to the laboratory is limited or restricted at the discretion of the laboratory director (responsible person for all work performed in the laboratory) when experiments or work with cultures and specimens are in progress.
2. Persons wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.
3. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human use are not permitted in the work areas. Persons who wear contact lenses in laboratories should also wear goggles or a face shield. Food is stored outside the work area in cabinets or refrigerators designated and used for this purpose only.
4. Mouth pipetting is prohibited; mechanical pipetting devices are used.
5. Policies for the safe handling of sharps are instituted.
6. All procedures are performed carefully to minimize the creation of splashes or aerosols.
7. Work surfaces are decontaminated at least once a day and after any spill of viable material.
8. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are to be placed in a durable, leak-proof container and closed for transport from the laboratory. Materials to be decontaminated outside of the immediate laboratory are packaged in accordance with applicable local, state, and federal regulations before removal from the facility.
9. A biohazard sign can be posted at the entrance to the laboratory whenever infectious agents are present. The sign may include the name of the agent(s) in use and the name and phone number of the investigator.
10. An insect and rodent control program is in effect.

#### **Special Practices None**

#### **Safety Equipment (Primary Barriers)**

1. Special containment devices or equipment such as biological safety cabinets are generally not required for manipulations of agents assigned to Biosafety Level 1.
2. It is recommended that laboratory coats, gowns, or uniforms are worn to prevent contamination or soiling of street clothes.
3. Gloves should be worn if the skin on the hands is broken or if a rash is present. Alternatives to powdered latex gloves should be available.

4. Protective eyewear should be worn for conduct of procedures in which splashes of microorganisms or other hazardous materials is anticipated.

**Laboratory Facilities (Secondary Barriers)**

1. Laboratories should have doors for access control.
2. Each laboratory contains a sink for hand washing.
3. The laboratory is designed so that it can be easily cleaned. Carpets and rugs in laboratories are not appropriate.
4. Bench tops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surface and equipment.
5. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning.
6. If the laboratory has windows that open to the exterior, they are fitted with fly screens.

# Appendix BB

## **BIOSAFETY LEVEL 2**

Biosafety Level 2 is similar to Biosafety Level 1 and is suitable for work involving agents of moderate potential hazard to personnel and the environment. It differs from BSL-1 in that (1) laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists; (2) access to the laboratory is limited when work is being conducted; (3) extreme precautions are taken with contaminated sharp items; and (4) certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

The following standard and special practices, safety equipment, and facilities apply to agents assigned to Biosafety Level 2:

### **Standard Microbiological Practices**

1. Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments are in progress.
2. Persons wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.
3. Eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in the work areas. Food is stored outside the work area in cabinets or refrigerators designated for this purpose only.
4. Mouth pipetting is prohibited; mechanical pipetting devices are used.
5. Policies for the safe handling of sharps are instituted.
6. All procedures are performed carefully to minimize the creation of splashes or aerosols.
7. Work surfaces are decontaminated on completion of work or at the end of the day and after any spill or splash of viable material with disinfectants that are effective against the agents of concern.
8. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are placed in a durable, leak-proof container and closed for transport from the laboratory. Materials to be decontaminated off-site from the facility are packaged in accordance with applicable local, state, and federal regulations, before removal from the facility.
9. An insect and rodent control program is in effect.

### **Special Practices**

1. Access to the laboratory is limited or restricted by the laboratory director when work with infectious agents is in progress. In general, persons who are at increased risk of acquiring infection, or for whom infection may have serious consequences, are not allowed in the laboratory or animal rooms. For example, persons who are immunocompromised or immunosuppressed may be at increased risk of acquiring infections. The laboratory director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory.
2. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential hazards and meet specific entry requirements (e.g., immunization) may enter the laboratory.
3. A biohazard sign must be posted on the entrance to the laboratory when etiologic agents are in use. Appropriate information to be posted includes the agent(s) in use, the biosafety level, the required immunizations, the investigator's name and telephone number, any personal protective equipment that must be worn in the laboratory, and any procedures required for exiting the laboratory.



4. Laboratory personnel receive appropriate immunizations or tests for the agents handled or potentially present in the laboratory (e.g., hepatitis B vaccine or TB skin testing).
5. When appropriate, considering the agent(s) handled, baseline serum samples for laboratory and other at-risk personnel are collected and stored. Additional serum specimens may be collected periodically, depending on the agents handled or the function of the facility.
6. Biosafety procedures are incorporated into standard operating procedures or in a biosafety manual adopted or prepared specifically for the laboratory by the laboratory director. Personnel are advised of special hazards and are required to read and follow instructions on practices and procedures.
7. The laboratory director ensures that laboratory and support personnel receive appropriate training on the potential hazards associated with the work involved, the necessary precautions to prevent exposures, and the exposure evaluation procedures. Personnel receive annual updates or additional training as necessary for procedural or policy changes.
8. A high degree of precaution must always be taken with any contaminated sharp items, including needles and syringes, slides, pipettes, capillary tubes, and scalpels.
  - (a) Needles and syringes or other sharp instruments should be restricted in the laboratory for use only when there is no alternative, such as parenteral injection, phlebotomy, or aspiration of fluids from laboratory animals and diaphragm bottles. Plastic ware should be substituted for glassware whenever possible.
  - (b) Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal; rather, they must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal. Non-disposable sharps must be placed in a hard-walled container for transport to a processing area for decontamination, preferably by autoclaving.
  - (c) Syringes which re-sheath the needle, needleless systems, and other safety devices are used when appropriate.
  - (d) Broken glassware must not be handled directly by hand, but must be removed by mechanical means such as a brush and dustpan, tongs, or forceps. Containers of contaminated needles, sharp equipment, and broken glass are decontaminated before disposal, according to any local, state, or federal regulations.
  - (e) Cultures, tissues, specimens of body fluids, or potentially infectious wastes are placed in a container with a cover that prevents leakage during collection, handling, processing, storage, transport, or shipping.
  - (f) Laboratory equipment and work surfaces should be decontaminated with an effective disinfectant on a routine basis, after work with infectious materials is finished, and especially after overt spills, splashes, or other contamination by infectious materials. Contaminated equipment must be decontaminated according to any local, state, or federal regulations before it is sent for repair or maintenance or packaged for transport in accordance with applicable local, state, or federal regulations, before removal from the facility.
  - (g) Spills and accidents that result in overt exposures to infectious materials are immediately reported to the laboratory director. Medical evaluation, surveillance, and treatment are provided as appropriate and written records are maintained.
  - (h) Animals not involved in the work being performed are not permitted in the lab.

### **Safety Equipment (Primary Barriers)**

1. Properly maintained biological safety cabinets, preferably Class II, or other appropriate personal protective equipment or physical containment devices are used whenever:
  - (a) Procedures with a potential for creating infectious aerosols or splashes are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of infectious materials whose internal pressures may be different from ambient pressures, inoculating animals intranasally, and harvesting infected tissues from animals or embryonate eggs.
  - (b) High concentrations or large volumes of infectious agents are used. Such materials may be centrifuged in the open laboratory if sealed rotor heads or centrifuge safety cups are used, and if these rotors or safety cups are opened only in a biological safety cabinet.
  - (c) Face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials to the face when the microorganisms must be manipulated outside the BSC.
  - (d) Protective laboratory coats, gowns, smocks, or uniforms designated for lab use are worn while in the laboratory. This protective clothing is removed and left in the laboratory before leaving for non-laboratory areas (e.g., cafeteria, library, and administrative offices). All protective clothing is either disposed of in the laboratory or laundered by the institution; it should never be taken home by personnel.
4. Gloves are worn when hands may contact potentially infectious materials, contaminated surfaces or equipment. Wearing two pairs of gloves may be appropriate. Gloves are disposed of when contaminated and removed when work with infectious materials is completed or when the integrity of the glove is compromised. Disposable gloves are not washed, reused, or used for touching "clean" surfaces (keyboards, telephones, etc.), and they should not be worn outside the lab. Alternatives to powdered latex gloves should be available. Hands are washed following removal of gloves.

### **Laboratory Facilities (Secondary Barriers)**

1. Provide lockable doors for facilities that house restricted agents (as defined in 42 CFR 72.6).
2. Consider locating new laboratories away from public areas.
3. Each laboratory contains a sink for hand washing.
4. The laboratory is designed so that it can be easily cleaned. Carpets and rugs in laboratories are inappropriate.
5. Bench tops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surfaces and equipment.
6. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning. Chairs and other furniture used in laboratory work should be covered with a non-fabric material that can be easily decontaminated.
7. Install biological safety cabinets in such a manner that fluctuations of the room supply and exhaust air do not cause the biological safety cabinets to operate outside their parameters for containment. Locate biological safety cabinets away from doors, from windows that can be opened, from heavily traveled laboratory areas, and from other potentially disruptive equipment so as to maintain the biological safety cabinets' air flow parameters for containment.
8. An eyewash station is readily available.
9. Illumination is adequate for all activities, avoiding reflections and glare that could impede vision.

10. There are no specific ventilation requirements. However, planning of new facilities should consider mechanical ventilation systems that provide an inward flow of air without recirculation to spaces outside of the laboratory. If the laboratory has windows that open to the exterior, they are fitted with fly screens.

# Appendix BC

## BIOSAFETY LEVEL 3

Biosafety Level 3 is applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents which may cause serious or potentially lethal disease as a result of exposure by the inhalation route. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents, and are supervised by competent scientists who are experienced in working with these agents.

All procedures involving the manipulation of infectious materials are conducted within biological safety cabinets or other physical containment devices, or by personnel wearing appropriate personal protective clothing and equipment. The laboratory has special engineering and design features.

It is recognized, however, that some existing facilities may not have all the facility features recommended for Biosafety Level 3 (*i.e.* double-door access zone and sealed penetrations). In this circumstance, an acceptable level of safety for the conduct of routine procedures, (*e.g.*, diagnostic procedures involving the propagation of an agent for identification, typing, susceptibility testing, etc.), may be achieved in a Biosafety Level 2 facility, providing: 1) the exhaust air from the laboratory room is discharged to the outdoors, 2) the ventilation to the laboratory is balanced to provide directional airflow into the room, 3) access to the laboratory is restricted when work is in progress, and 4) the recommended Standard Microbiological Practices, Special Practices, and Safety Equipment for Biosafety Level 3 are rigorously followed. The decision to implement this modification of Biosafety Level 3 recommendations should be made only by the laboratory director. The following standard and special safety practices, equipment and facilities apply to agents assigned to Biosafety Level 3:

### Standard Microbiological Practices

1. Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments are in progress.
2. Persons wash their hands after handling infectious materials, after removing gloves, and when they leave the laboratory.
3. Eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in the laboratory. Persons who wear contact lenses in laboratories should also wear goggles or a face shield. Food is stored outside the work area in cabinets or refrigerators designated for this purpose only.
4. Mouth pipetting is prohibited; mechanical pipetting devices are used.
5. Policies for the safe handling of sharps are instituted.
6. All procedures are performed carefully to minimize the creation of aerosols.
7. Work surfaces are decontaminated at least once a day and after any spill of viable material.
8. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method, such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are placed in a durable, leak-proof container and closed for transport from the laboratory. Infectious waste from BSL-3 laboratories should be decontaminated before removal for off-site disposal.
9. An insect and rodent control program is in effect.

### Special Practices

1. Laboratory doors are kept closed when experiments are in progress.
2. The laboratory director controls access to the laboratory and restricts access to persons whose presence is required for program or support purposes. Persons who are at increased risk of acquiring infection or for whom infection may have serious consequences are not allowed in the laboratory or animal rooms. For example, persons who are immunocompromised or

immunosuppressed may be at risk of acquiring infections. The director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory. No minors should be allowed in the laboratory.

3. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential biohazard, who meet any specific entry requirements (such as immunization), and who comply with all entry and exit procedures, enter the laboratory or animal rooms.
4. When infectious materials or infected animals are present in the laboratory or containment module, a hazard warning sign, incorporating the universal biohazard symbol, is posted on all laboratory and animal room access doors. The hazard warning sign identifies the agent, lists the name and telephone number of the laboratory director or other responsible person(s), and indicates any special requirements for entering the laboratory, such as the need for immunizations, respirators, or other personal protective measures.
5. Laboratory personnel receive the appropriate immunizations or tests for the agents handled or potentially present in the laboratory (e.g., hepatitis B vaccine or TB skin testing), and periodic testing as recommended for the agent being handled.
6. Baseline serum samples are collected as appropriate and stored for all laboratory and other at-risk personnel. Additional serum specimens may be periodically collected, depending on the agents handled or the function of the laboratory.
7. A biosafety manual specific to the laboratory is prepared or adopted by the laboratory director and biosafety precautions are incorporated into standard operating procedures. Personnel are advised of special hazards and are required to read and follow instructions on practices and procedures.
8. Laboratory and support personnel receive appropriate training on the potential hazards associated with the work involved, the necessary precautions to prevent exposures, and the exposure evaluation procedures. Personnel receive annual updates or additional training as necessary for procedural changes.
9. The laboratory director is responsible for ensuring that, before working with organisms at Biosafety Level 3, all personnel demonstrate proficiency in standard microbiological practices and techniques, and in the practices and operations specific to the laboratory facility. This might include prior experience in handling human pathogens or cell cultures, or a specific training program provided by the laboratory director or other competent scientist proficient in safe microbiological practices and techniques.
10. A high degree of precaution must always be taken with any contaminated sharp items, including needles and syringes, slides, pipettes, capillary tubes, and scalpels.
  - (a) Needles and syringes or other sharp instruments should be restricted in the laboratory for use only when there is no alternative, such as parenteral injection, phlebotomy, or aspiration of fluids from laboratory animals and diaphragm bottles. Plastic ware should be substituted for glassware whenever possible.
  - (b) Only needle-locking syringes or disposable syringe-needle units (*i.e.* needle is integral to the syringe) are used for injection or aspiration of infectious materials. Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal; rather, they must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal. Non-disposable sharps must be placed in a hard-walled container for transport to a processing area for decontamination, preferably by autoclaving.

- (c) Syringes which re-sheathe the needle, needleless systems, and other safe devices are used when appropriate.
  - (d) Broken glassware must not be handled directly by hand, but must be removed by mechanical means such as a brush and dustpan, tongs, or forceps. Containers of contaminated needles, sharp equipment, and broken glass should be decontaminated before disposal, and disposed of according to any local, state, or federal regulations.
11. All open manipulations involving infectious materials are conducted in biological safety cabinets or other physical containment devices within the containment module. No work in open vessels is conducted on the open bench. Clean up is facilitated by using plastic-backed paper toweling on non-perforated work surfaces within biological safety cabinets.
  12. Laboratory equipment and work surfaces should be decontaminated routinely with an effective disinfectant, after work with infectious materials is finished, and especially after overt spills, splashes, or other contamination with infectious materials.
    - (a) Spills of infectious materials are decontaminated, contained and cleaned up by appropriate professional staff, or others properly trained and equipped to work with concentrated infectious material. Spill procedures are developed and posted.
    - (b) Contaminated equipment must be decontaminated before removal from the facility for repair or maintenance or packaging for transport, in accordance with applicable local, state, or federal regulations.
  13. Cultures, tissues, specimens of body fluids, or wastes are placed in a container that prevents leakage during collection, handling, processing, storage, transport, or shipping.
  14. All potentially contaminated waste materials (e.g., gloves, lab coats, etc.) from laboratories are decontaminated before disposal or reuse.
  15. Spills and accidents that result in overt or potential exposures to infectious materials are immediately reported to the laboratory director. Appropriate medical evaluation, surveillance, and treatment are provided and written records are maintained.
  16. Animals and plants not related to the work being conducted are not permitted in the laboratory.

### **Safety Equipment (Primary Barriers)**

1. Protective laboratory clothing such as solid-front or wrap-around gowns, scrub suits, or coveralls are worn by workers when in the laboratory. Protective clothing is not worn outside the laboratory. Reusable clothing is decontaminated before being laundered.
2. Gloves must be worn when handling infectious materials, infected animals, and when handling contaminated equipment.
3. Frequent changing of gloves accompanied by hand washing is recommended. Disposable gloves are not reused.
4. All manipulations of infectious materials, necropsy of infected animals, harvesting of tissues or fluids from infected animals or embryonate eggs, etc., are conducted in a Class II or Class III biological safety cabinet.
5. When a procedure or process cannot be conducted within a biological safety cabinet, then appropriate combinations of personal protective equipment (e.g., respirators, face shields) and physical containment devices (e.g., centrifuge safety cups or sealed rotors) are used.
6. Respiratory and face protection are used when in rooms containing infected animals.

### **Laboratory Facilities (Secondary Barriers)**

1. The laboratory is separated from areas that are open to unrestricted traffic flow within the building, and access to the laboratory is restricted. Passage through a series of two self-closing doors is the basic requirement for entry into the laboratory from access corridors. Doors are lockable. A clothes change room may be included in the passageway.
2. Each laboratory room contains a sink for hand washing. The sink is hands-free or automatically operated and is located near the room exit door.
3. The interior surfaces of walls, floors, and ceilings of areas where BSL-3 agents are handled are constructed for easy cleaning and decontamination. Seams, if present, must be sealed. Walls, ceilings, and floors should be smooth, impermeable to liquids and resistant to the chemicals and disinfectants normally used in the laboratory. Floors should be monolithic and slip-resistant. Consideration should be given to the use of coved floor coverings. Penetrations in floors, walls, and ceiling surfaces are sealed. Openings such as around ducts and the spaces between doors and frames are capable of being sealed to facilitate decontamination.
4. Bench tops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and those chemicals used to decontaminate the work surfaces and equipment.
5. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning. Chairs and other furniture used in laboratory work should be covered with a non-fabric material that can be easily decontaminated.
6. All windows in the laboratory are closed and sealed.
7. A method for decontaminating all laboratory wastes is available in the facility and utilized, preferably within the laboratory (*i.e.* autoclave, chemical disinfection, incineration, or other approved decontamination method). Consideration should be given to means of decontaminating equipment. If waste is transported out of the laboratory, it should be properly sealed and not transported in public corridors.
8. Biological safety cabinets are required and are located away from doors, from room supply louvers, and from heavily-traveled laboratory areas.
9. A ducted exhaust air ventilation system is provided. This system creates directional airflow which draws air into the laboratory from "clean" areas and toward "contaminated" areas. The exhaust air is not recirculated to any other area of the building. Filtration and other treatments of the exhaust air are not required, but may be considered based on site requirements, and specific agent manipulations and use conditions. The outside exhaust must be dispersed away from occupied areas and air intakes, or the exhaust must be HEPA-filtered. Laboratory personnel must verify that the direction of the airflow (into the laboratory) is proper. It is recommended that a visual monitoring device that indicates and confirms directional inward airflow be provided at the laboratory entry. Consideration should be given to installing an HVAC control system to prevent sustained positive pressurization of the laboratory. Audible alarms should be considered to notify personnel of HVAC system failure.
10. HEPA-filtered exhaust air from a Class II biological safety cabinet can be recirculated into the laboratory if the cabinet is tested and certified at least annually. When exhaust air from Class II safety cabinets is to be discharged to the outside through the building exhaust air system, the cabinets must be connected in a manner that avoids any interference with the air balance of the cabinets or the building exhaust system (*e.g.*, an air gap between the cabinet exhaust and the exhaust duct). When Class III biological safety cabinets are used they should be directly connected to the exhaust system. If the Class III cabinets are connected to the supply system, it is done in a manner that prevents positive pressurization of the cabinets.



11. Continuous flow centrifuges or other equipment that may produce aerosols are contained in devices that exhaust air through HEPA filters before discharge into the laboratory. These HEPA systems are tested at least annually. Alternatively, the exhaust from such equipment may be vented to the outside if it is dispersed away from occupied areas and air intakes.
12. Vacuum lines are protected with liquid disinfectant traps and HEPA filters, or their equivalent. Filters must be replaced as needed. An alternative is to use portable vacuum pumps (also properly protected with traps and filters).
13. An eyewash station is readily available inside the laboratory.
14. Illumination is adequate for all activities, avoiding reflections and glare that could impede vision.
15. The Biosafety Level 3 facility design and operational procedures must be documented. The facility must be tested for verification that the design and operational parameters have been met prior to operation. Facilities should be re-verified, at least annually, against these procedures as modified by operational experience.
  16. Additional environmental protection (*e.g.*, personnel showers, HEPA filtration of exhaust air, containment of other piped services and the provision of effluent decontamination) should be considered if recommended by the agent summary statement, as determined by risk assessment, the site conditions, or other applicable federal, state, or local regulations.

# Appendix BD

## **ANIMAL BIOSAFETY LEVEL 1**

Animal Biosafety Level 1 is suitable for work with animals involving well-characterized agents that are not known to cause disease in healthy adult humans, and present minimal potential hazard to personnel and the environment.

ABSL-1 facilities are separated from the general traffic patterns of the building and should be restricted appropriately. Laboratory personnel have specific training in animal facility procedures and are supervised by a scientist with adequate knowledge of potential hazards and experimental animal procedures.

The following standard practices, safety equipment, and facility requirements apply to ABSL-1:

### **Standard Microbiological Practices**

1. Access to the laboratory is limited or restricted at the discretion of the laboratory director (responsible person for all work performed in the laboratory) when experiments or work with cultures and specimens are in progress.
2. Animal protocols are reviewed and approved by the Institutional Animal Care and Use Committee (IACUC) and the Institutional Biosafety Committee. These protocols address worker safety and health concerns as well as procedures.
3. A safety manual specific to the animal facility is prepared in consultation with the animal facility director and safety professionals. This manual is available and accessible to laboratory personnel, who are required to read it and follow its instructions on practices and procedures.
4. The supervisor ensures that animal care, laboratory, and support personnel receive appropriate training regarding their duties, animal husbandry procedures, potential hazards, manipulations of infectious agents, necessary precautions to prevent exposures, and hazard/exposure evaluation procedures. Personnel receive annual updates and additional training when procedures or policies change. Records are maintained for all hazard evaluations, employee training sessions, and staff attendance.
5. A medical surveillance program is in place.
6. Personnel using respirators must be enrolled in the Respiratory Protection Program through EHS.
7. A biohazard sign can be posted at the entrance to the laboratory whenever infectious agents are present. The sign may include the name of the agent(s) in use and the name and phone number of the investigator.
8. An emergency contingency plan is in place.
9. Access to the animal room is restricted to those authorized to enter through proper training. All personnel are advised of potential hazards and instructed on appropriate safeguards.
10. Protective lab coats, gowns, or uniforms are recommended to prevent contamination of personal clothing.
11. Gloves are worn to prevent skin contamination from infectious/hazardous materials and animals.
12. Persons wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.
13. PPE is removed in a manner that minimizes transfer of infectious materials outside of the areas where these materials and the animals are manipulated and/or housed.

14. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human use are not permitted in the work areas. Persons who wear contact lenses in laboratories should also wear goggles or a face shield. Food is stored outside the work area in cabinets or refrigerators designated and used for this purpose only.
15. All procedures are performed carefully to minimize the creation of splashes or aerosols.
16. Mouth pipetting is prohibited; mechanical pipetting devices are used.
17. Policies for the safe handling of sharps are instituted.
18. Work surfaces are decontaminated at least once a day and after any spill of viable material.
19. Animals/plants not associated with work performed are not permitted in areas where infectious materials and/or animals are housed or manipulated.
20. An insect and rodent control program is in effect.
21. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are to be placed in a durable, leak-proof container and closed for transport from the laboratory. Materials to be decontaminated outside of the immediate laboratory are packaged in accordance with applicable local, state, and federal regulations before removal from the facility.

**Special Practices: none required**

**Safety Equipment (Primary Barriers and PPE)**

1. A risk assessment determines the appropriate type of PPE required and special containment devices or equipment.
2. Special containment devices or equipment such as biological safety cabinets are generally not required for manipulations of agents assigned to Biosafety Level 1.
3. It is recommended that laboratory coats, gowns, or uniforms are worn to prevent contamination or soiling of street clothes. This protective clothing is not worn outside the facility or outside areas where infectious materials/animals are housed or manipulated.
4. Protective eyewear is worn when conducting procedures with the potential to create splashes of microorganisms or other hazardous materials and when entering areas with potentially high concentrations of airborne particulates.
5. Persons having contact with NHPs assess the risk of mucous membrane exposure and wear appropriate protective equipment such as masks, goggles, or face shields.
6. Gloves should be worn if the skin on the hands is broken or if a rash is present. Alternatives to powdered latex gloves should be available. A risk assessment is performed to identify the appropriate glove material for tasks.
7. Gloves are changed when contaminated, glove integrity is compromised, or when necessary.
8. Gloves are not worn outside animal rooms. They are removed to minimize transfer of infectious materials. Disposable gloves are not reused or washed but are disposed of.
9. Personnel wash their hands after handling animals, removing gloves, and before leaving areas where infectious materials/animals are housed or manipulated.

**Laboratory Facilities (Secondary Barriers)**

1. The animal facility is separated from areas open to unrestricted traffic in the building. External facility doors are self-closing and self-locking.

2. Access to the animal facilities is restricted. Doors to areas where infectious materials and/or animals are housed open inward, self-close, are kept closed when animals are present, and are never propped open. Doors to cubicles inside animal rooms may either open outward or slide.
3. The animal facility has a sink for hand washing. Sink traps are filled with water or decontaminant to prevent migration of vermin/gases.
4. The animal facility design facilitates cleaning and housekeeping. Interior surfaces are water resistant. Floors are slip resistant, chemical resistant, and impervious to liquids. Penetrations in interior surfaces are recommended to be sealed.
5. Cabinets and bench tops are impervious to water and resistant to heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surface and equipment.
6. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning.
7. Carpets and rugs in laboratories are not appropriate. Chairs in the animal area are covered with non-porous material.
8. If the laboratory has windows that open to the exterior, they are fitted with fly screens.
9. Ventilation is provided in accordance with the *Guide for Care and Use of Laboratory Animals*. It is recommended that animal rooms have negative air pressure. There is no recirculation of exhaust air.
10. Internal facility appurtenances are arranged to minimize horizontal surface areas for better cleaning.
11. In floor drains, traps are filled with water/disinfectant to prevent migration of vermin/gases.
12. Cages are washed either in a mechanical cage washer with a final rinse temperature of at least 180°F, or manually, using appropriate disinfectants.
13. Light is adequate for all activities, avoiding reflections and glare.
14. An emergency eyewash and shower is available.

# Appendix BE

## **ANIMAL BIOSAFETY LEVEL 2**

Animal Biosafety Level 2 builds upon practices, procedures, containment equipment, and facility requirements of ABSL-1. ABSL-2 is for work involving laboratory animals infected with agents associated with human disease and that pose moderate hazards to the environment and to personnel. ABSL-2 addresses hazards from ingestion, percutaneous exposure, and mucous membrane exposure.

ABSL-2 requires that access to the animal facility is restricted, personnel have specific training in animal facility procedures/handling of infected animals/manipulation of pathogens, personnel are supervised by those with adequate knowledge of potential hazards/microbiological agents/animal manipulations and husbandry procedures, and BSCs and other physical containment equipment is used when procedures involve manipulation of infectious materials or where aerosols/splashes may be created.

Appropriate PPE is utilized to reduce exposure to infectious agents, animals, and contaminated materials/equipment. An employee occupational health program should be considered.

The following standard and special practices, safety equipment, and facility requirements apply:

### **Standard Microbiological Practices**

1. The animal facility director establishes and enforces policies and protocols for institutional policies and emergencies. Worker safety/health concerns are addressed as part of the protocol review by the IACUC and Institutional Biosafety Committee.
2. There is a safety manual specific to the animal facility that is prepared by the animal facility director and appropriate safety professionals. The manual is available and accessible. Personnel are advised of potential hazards and must read/follow instructions on practices and procedures. Biosafety procedures are incorporated into standard operating procedures or in a biosafety manual adopted or prepared specifically for the laboratory by the laboratory director. Personnel are advised of special hazards and are required to read and follow instructions on practices and procedures.
3. The supervisor ensures that all personnel receive training regarding their duties, animal husbandry procedures, potential hazards, manipulations of infectious agents, precautions to prevent hazard or exposures, and hazard/exposure evaluation procedures. Personnel receive annual updates or additional training when procedures or policies change. The laboratory director ensures that laboratory and support personnel receive appropriate training on the potential hazards associated with the work involved, the necessary precautions to prevent exposures, and the exposure evaluation procedures. Personnel receive annual updates or additional training as necessary for procedural or policy changes.
4. Records are maintained for hazard evaluations, staff attendance, and employee training sessions.
5. A medical surveillance program is in place, with consideration for an animal allergy prevention program.
6. Facility supervisors ensure that medical staff is informed of potential occupational hazards in the animal facility, to include those associated with research, animal husbandry, and animal care and manipulations.
7. All personnel, particularly women of childbearing age, are provided information regarding immune competence and conditions that may predispose them to infection. Those with such conditions are encouraged to self-identify to TTU's healthcare provider.
8. Personnel using respirators are enrolled in the University Respiratory Protection Program

9. A sign with the universal biohazard symbol is posted at all entrances to areas where infectious materials and/or animals are housed or manipulated. The sign must include the animal biosafety level, general occupational health requirements, PPE requirements, the supervisor's name and names of other responsible personnel along with phone numbers, required procedures for entering/exiting the animal areas, and the names of all infectious agents if more than one is used in the area. A biohazard sign must be posted on the entrance to the laboratory when etiologic agents are in use. Appropriate information to be posted includes the agent(s) in use, the biosafety level, the required immunizations, the investigator's name and telephone number, any personal protective equipment that must be worn in the laboratory, and any procedures required for exiting the laboratory.
10. A contingency plan exists for man-made or natural disasters.
11. Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments are in progress. All personnel, as well as visitors and service workers, are advised of potential hazards and instructed on safeguards.
12. Protective lab coats, gowns, or uniforms are used to prevent contamination of personal clothing.
13. Gloves are used to prevent skin contact with contaminated, infectious, and hazardous materials when handling animals.
14. PPE is removed in a manner that prevents transfer of infectious materials.
15. Personnel wash their hands after removing gloves and before leaving areas where infectious materials and/or animals are housed or manipulated.
16. Eye, face, and respiratory protection may be necessary in rooms with infected animals.
17. Eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in the work areas. Food is stored outside the work area in cabinets or refrigerators designated for this purpose only.
18. All procedures are performed carefully to minimize the creation of splashes or aerosols.
19. Mouth pipetting is prohibited; mechanical pipetting devices are used.
20. A high degree of precaution must always be taken with any contaminated sharp items, including needles and syringes, slides, pipettes, capillary tubes, and scalpels.
  - (a) Needles and syringes or other sharp instruments should be restricted in the laboratory for use only when there is no alternative, such as parenteral injection, phlebotomy, or aspiration of fluids from laboratory animals and diaphragm bottles. Plastic ware should be substituted for glassware whenever possible.
  - (b) Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal; rather, they must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal. Non-disposable sharps must be placed in a hard-walled container for transport to a processing area for decontamination, preferably by autoclaving.
  - (c) Syringes which re-sheath the needle, needleless systems, and other safety devices are used when appropriate.
  - (d) Broken glassware must not be handled directly by hand, but must be removed by mechanical means such as a brush and dustpan, tongs, or forceps. Containers of contaminated needles, sharp equipment, and broken glass are decontaminated before disposal, according to any local, state, or federal regulations.



21. Work surfaces are decontaminated on completion of work or at the end of the day and after any spill or splash of viable material with disinfectants that are effective against the agents of concern.
22. Animals not involved in the work being performed are not permitted in the lab.
23. An insect and rodent control program is in effect.
24. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are placed in a durable, leak-proof container and closed for transport from the laboratory. Materials to be decontaminated off-site from the facility are packaged in accordance with applicable local, state, and federal regulations, before removal from the facility.
25. Decontaminate all potentially hazardous materials before disposal.

### **Special Practices**

1. Access to the laboratory is limited or restricted by the laboratory director when work with infectious agents is in progress. In general, persons who are at increased risk of acquiring infection, or for whom infection may have serious consequences, are not allowed in the laboratory or animal rooms. For example, persons who are immunocompromised or immunosuppressed may be at increased risk of acquiring infections. The laboratory director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory.
2. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential hazards and meet specific entry requirements (e.g., immunization) may enter the laboratory.
3. Animal care staff, as well as lab and support personnel, are provided a medical surveillance program. Laboratory personnel receive appropriate immunizations or tests for the agents handled or potentially present in the laboratory (e.g., hepatitis B vaccine or TB skin testing). When appropriate, considering the agent(s) handled, baseline serum samples for laboratory and other at-risk personnel are collected and stored. Additional serum specimens may be collected periodically, depending on the agents handled or the function of the facility.
4. Procedures involving a high potential for generating aerosols are conducted in a BSC or other physical containment device. If no devices are available, a combination of PPE and other containment devices is used.
5. Restraint devices and practices that reduce risk of exposure during animal manipulations are used.
6. All potentially infectious material and animal waste is decontaminated before transport outside the lab, including sharps, bedding, and unused feed. Cultures, tissues, specimens of body fluids, or potentially infectious wastes are placed in a container with a cover that prevents leakage during collection, handling, processing, storage, transport, or shipping.
7. A method for decontaminating husbandry equipment and sensitive electronic/medical equipment is identified and implemented.
8. Materials that are decontaminated outside of the immediate lab area must be placed in a durable, leak proof, covered container, and secured for transport. Before moving the materials, the outer surface of the container must be disinfected and must have a universal biohazard label on it.
9. Equipment, cages, and racks are handled to minimize contamination of other areas. Equipment is decontaminated before repair, maintenance, or removal from lab areas.

10. Laboratory equipment and work surfaces should be decontaminated with an effective disinfectant on a routine basis, after work with infectious materials is finished, and especially after overt spills, splashes, or other contamination by infectious materials. Contaminated equipment must be decontaminated according to any local, state, or federal regulations before it is sent for repair or maintenance or packaged for transport in accordance with applicable local, state, or federal regulations, before removal from the facility.
11. Spills and accidents that result in overt exposures to infectious materials are immediately reported to the laboratory director. Medical evaluation, surveillance, and treatment are provided as appropriate and written records are maintained.

### **Safety Equipment (Primary Barriers and PPE)**

1. Properly maintained biological safety cabinets, preferably Class II, or other appropriate personal protective equipment or physical containment devices are used whenever:
  - (a) Procedures with a potential for creating infectious aerosols or splashes are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of infectious materials whose internal pressures may be different from ambient pressures, inoculating animals intranasally, and harvesting infected tissues from animals or embryonate eggs.
  - (b) High concentrations or large volumes of infectious agents are used. Such materials may be centrifuged in the open laboratory if sealed rotor heads or centrifuge safety cups are used, and if these rotors or safety cups are opened only in a biological safety cabinet.
  - (c) Face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials to the face when the microorganisms must be manipulated outside the BSC.
  - (d) Protective laboratory coats, gowns, smocks, or uniforms designated for lab use are worn while in the laboratory. This protective clothing is removed and left in the laboratory before leaving for non-laboratory areas (e.g., cafeteria, library, and administrative offices). All protective clothing is either disposed of in the laboratory or laundered by the institution; it should never be taken home by personnel.
2. Animals are housed in primary biosafety containment equipment appropriate for the species
3. A risk assessment determines the appropriate type of PPE
4. Scrub suits and uniforms are removed before leaving the lab. Reusable clothing is contained and decontaminated before laundering. PPE is never taken home.
5. Gowns, uniforms, lab coats, and PPE are worn in areas where infectious materials and/or animals are housed or manipulated, and are removed before exiting.
6. Disposable PPE and other contaminated waste are contained and decontaminated before disposal.
7. Eye and face protection are used for manipulations that may result in splashes or sprays from hazardous materials and when the organism must be handled outside the BSC or containment device. Eye and face protection is either disposed of with other contaminated lab waste or decontaminated before reuse. Personnel who wear contact lenses wear eye protection when entering areas with potentially high concentrations of airborne particulates as well.
8. Personnel having contact with NHPs assess the risk of mucous membrane exposure and wear appropriate protective equipment including respiratory protection.

9. Gloves are worn when hands may contact potentially infectious materials, contaminated surfaces or equipment. Wearing two pairs of gloves may be appropriate. Gloves are disposed of when contaminated and removed when work with infectious materials is completed or when the integrity of the glove is compromised. Disposable gloves are not washed, reused, or used for touching "clean" surfaces (keyboards, telephones, etc.), and they should not be worn outside the lab. Alternatives to powdered latex gloves should be available. Hands are washed following removal of gloves.
10. Personnel wash their hands after handling animals and before leaving areas where infectious materials and/or animals are housed or manipulated. Hand washing occurs after glove removal.

#### **Laboratory Facilities (Secondary Barriers)**

1. The animal facility is separated from areas open to unrestricted traffic in the building. External facility doors are self-closing/self-locking.
2. Doors to lab areas where infectious materials and/or animals are housed open inward, self-close, are never propped open, and are kept closed when experimental animals are present. Doors to cubicles in animal rooms open outward or slide.
3. There is a hand-washing sink at the exit of general and segregated areas where infectious materials and/or animals are housed or are manipulated. Additional sinks for hand washing are located at other locations as necessary.
4. Sink traps are filled with water and/or disinfectant
5. The laboratory is designed so that it can be easily cleaned. Carpets and rugs in laboratories are inappropriate. Interior surfaces are water resistant. Penetrations in floors, walls, and ceilings are sealed. Floors are slip-resistant, impervious to liquids, and chemical-resistant.
6. Cabinets and bench tops are impervious to water and resistant to the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surfaces and equipment. Spaces between benches, cabinets, and other equipment are accessible for cleaning. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning. Chairs and other furniture used in laboratory work should be covered with a non-fabric material that can be easily decontaminated.
7. If the laboratory has windows that open to the exterior, they are fitted with fly screens.
9. Ventilation is provided in accordance with the *Guide for Care and Use of Laboratory Animals*. Animal rooms maintain negative directional airflow. A ducted ventilation system is provided, with exhaust air discharged to the outside without recirculation. Ventilation system design considers the heat and high moisture associated with cleaning and cage washing in animal rooms.
10. Internal facility appurtenances are arranged to minimize horizontal surface areas.
11. Floor drains are maintained and filled with water and/or disinfectant.
12. Cages are autoclaved or otherwise decontaminated before washing. The mechanical cage washer has a final rinse temperature of at least 180°F. The cage wash area is designed to accommodate the use of high-pressure spray systems, humidity, strong chemicals, and high water temperatures during the cleaning process.
13. Illumination is adequate for all activities, avoiding reflections and glare that could impede vision.

14. Install biological safety cabinets in such a manner that fluctuations of the room supply and exhaust air do not cause the biological safety cabinets to operate outside their parameters for containment. Locate biological safety cabinets away from doors, from windows that can be opened, from heavily traveled laboratory areas, and from other potentially disruptive equipment so as to maintain the biological safety cabinets' air flow parameters for containment.
15. HEPA-filtered exhaust air from Class II BSCs is safely recirculated into the lab if the cabinet is tested and certified at least annually and when moved and if the cabinet is operated properly. BSCs may also be connected to the lab exhaust system indirectly by canopy connection or directly through hard connection. Provisions to assure proper safety cabinet performance and air system operation is verified.
16. BSCs are recertified at least annually and are used according to the manufacturer's specifications.
17. Each vacuum service connection is fitted with liquid disinfectant traps. An in-line HEPA filter is placed as near as possible to each use point or service cock.
18. An autoclave is present in the animal facility for decontamination.
19. An emergency eyewash and shower are readily available.

# Appendix BF

## CHARACTERISTICS OF COMMON DISINFECTANTS

	Sodium Hypochlorite (Bleach) 5.25%	Phenols	Quaternary Ammonium Compounds (Quats)	Hydrogen Peroxide	Alcohols	Iodophors
<b>Usable Concentration</b>	1% to 20%	As directed	As directed	3%-8%	60-80%	As directed
<b>Shelf Life</b>	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
<b>Inactivated by Organic Matter</b>	YES	YES	YES Except 4th-generation quats	YES	NO	YES
<b>Irritant</b>	YES	YES	YES	YES, >6%	YES	YES
<b>Other Health Concerns &amp; Hazards</b>	REFER TO SDSs					
<b>Corrosive</b>	YES			YES, >10% Not appropriate for use with certain metals.	NO	YES
<b>Residue</b>	YES	YES	YES	NO	NO	YES
<b>Protective Controls</b>	PPE and ventilation.					
<b>Toxicity</b>	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 BG

## SELECT AGENT AND TOXINS LIST

Dept of Health and Human Services and the United States Dept of Agriculture

Registration with the Federal Select Agent Program is required to work with any of the agents listed in Appendix G. The following information was taken directly from the select agent website at <http://www.selectagents.gov/SelectAgentsandToxinsList.html> and is current as of April 2015. Please see the website or call EHS at 806-742-3872 for additional details.

The following biological agents and toxins have the potential to pose a severe threat to both human and animal health, to plant health, or to animal and plant products. An attenuated strain of a select agent or an inactive form of a select toxin may be excluded from the requirements of the Select Agent Regulations. A list of exclusions can be found at <http://www.selectagents.gov/SelectAgentsandToxinsExclusions.html>.

### HHS SELECT AGENTS AND TOXINS

- Abrin
- Botulinum neurotoxins\*
- Botulinum neurotoxin producing species of *Clostridium*\*
- Conotoxins (Short, paralytic alpha conotoxins containing the following amino acid sequence X<sub>1</sub>CCX<sub>2</sub>PACGX<sub>3</sub>X<sub>4</sub>X<sub>5</sub>X<sub>6</sub>CX<sub>7</sub>)
- *Coxiella burnetii*
- Crimean-Congo haemorrhagic fever virus
- Diacetoxyscirpenol
- Eastern Equine Encephalitis virus
- Ebola virus\*
- *Francisella tularensis*\*
- Lassa fever virus
- Lujo virus
- Marburg virus\*
- Monkeypox virus
- Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed 1918 Influenza virus)
- Ricin
- *Rickettsia prowazekii*
- SARS-associated coronavirus (SARS-CoV)
- Saxitoxin
- South American Haemorrhagic Fever viruses:
  - Chapare
  - Guanarito
  - Junin
  - Machupo
  - Sabia
- Staphylococcal enterotoxins A,B,C,D,E subtypes
- T-2 toxin
- Tetrodotoxin
- Tick-borne encephalitis complex (flavi) viruses:
  - Far Eastern subtype
  - Siberian subtype
- Kyasanur Forest disease virus
- Omsk hemorrhagic fever virus
- Variola major virus (Smallpox virus)\*
- Variola minor virus (Alastrim)\*
- *Yersinia pestis*\*



### OVERLAP SELECT AGENTS AND TOXINS

- *Bacillus anthracis*\*
- *Bacillus anthracis* Pasteur strain
- *Brucella abortus*
- *Brucella melitensis*
- *Brucella suis*
- *Burkholderia mallei*\*
- *Burkholderia pseudomallei*\*
- Hendra virus
- Nipah virus
- Rift Valley fever virus
- Venezuelan equine encephalitis virus

### USDA SELECT AGENTS AND TOXINS

- African horse sickness virus
- African swine fever virus
- Avian influenza virus
- Classical swine fever virus
- Foot-and-mouth disease virus\*
- Goat pox virus
- Lumpy skin disease virus
- *Mycoplasma capricolum*
- *Mycoplasma mycoides*
- Newcastle disease virus
- Peste des petits ruminants virus
- Rinderpest virus\*
- Sheep pox virus
- Swine vesicular disease virus

### USDA PLANT PROTECTION AND QUARANTINE (PPQ) SELECT AGENTS AND TOXINS

- *Peronosclerospora philippinensis*
- (*Peronosclerospora sacchari*)
- *Phoma glycinicola* (formerly *Pyrenochaeta glycines*)
- *Ralstonia solanacearum*
- *Rathayibacter toxicus*
- *Sclerophthora rayssiae*
- *Synchytrium endobioticum*
- *Xanthomonas oryzae*

\*Denotes Tier 1 Agent

# Appendix BH

## DEPARTMENT OF COMMERCE EXPORT ADMINISTRATION REGULATIONS (EAR)

### List of Controlled Items

#### 1. 1C351 Human and zoonotic pathogens and “toxins,” as follows:

##### a. Viruses

- Andes virus;
- Chapare virus;
- Chikungunya virus;
- Choclo virus;
- Congo-Crimean haemorrhagic fever virus (a.k.a. Crimean-Congo haemorrhagic fever virus);
- Dengue fever virus;
- Dobrava-Belgrade virus;
- Eastern equine encephalitis virus;
- Ebola virus;
- Guanarito virus;
- Hantaan virus;
- Hendra virus (Equine morbillivirus);
- Japanese encephalitis virus;
- Junin virus;
- Kyasanur Forest virus;
- Laguna Negra virus;
- Lassa fever virus;
- Louping ill virus;
- Lujo virus;
- Lymphocytic choriomeningitis virus;
- Machupo virus;
- Marburg virus;
- Monkey pox virus;
- Murray Valley encephalitis virus;
- Nipah virus;
- Omsk haemorrhagic fever virus;
- Oropouche virus;
- Powassan virus;
- Rift Valley fever virus;
- Rocio virus;
- Sabia virus;
- Seoul virus;
- Sin nombre virus;
- St. Louis encephalitis virus;
- Tick-borne encephalitis virus (Far Eastern subtype, formerly Russian Spring-Summer encephalitis virus);
- Variola virus;
- Venezuelan equine encephalitis virus;
- Western equine encephalitis virus;
- Yellow fever virus.

b. Viruses identified on the APHIS/CDC “select agents”

- Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments;
- SARS-associated coronavirus (SARS-CoV);
- Tick-borne encephalitis virus (Siberian subtype, formerly West Siberian virus)

c. Bacteria

- *Bacillus anthracis*;
- *Brucella abortus*;
- *Brucella melitensis*;
- *Brucella suis*;
- *Burkholderia mallei* (*Pseudomonas mallei*);
- *Burkholderia pseudomallei* (*Pseudomonas pseudomallei*);
- *Chlamydophila psittaci* (formerly *Chlamydia psittaci*);
- *Clostridium argentinense* (formerly *Clostridium botulinum* Type G), botulinum neurotoxin producing strains;
- *Clostridium baratii*, botulinum neurotoxin producing strains;
- *Clostridium botulinum*;
- *Clostridium butyricum*, botulinum neurotoxin producing strains;
- *Clostridium perfringens*, epsilon toxin producing types;
- *Coxiella burnetii*;
- *Francisella tularensis*;
- *Rickettsia prowazekii*;
- *Salmonella typhi*;
- Shiga toxin producing *Escherichia coli* (STEC) of serogroups O26, O45, O103, O104, O111, O121, O145, O157, and other shiga toxin producing serogroups;  
Note: Shiga toxin producing *Escherichia coli* (STEC) is also known as enterohaemorrhagic *E. coli* (EHEC) or verocytotoxin producing *E. coli* (VTEC).
- *Shigella dysenteriae*;
- *Vibrio cholerae*; or
- *Yersinia pestis*.

d. “Toxins” and “subunits” thereof

- Abrin;
- Aflatoxins;
- Botulinum toxins;
- Cholera toxin;
- *Clostridium perfringens* alpha, beta 1, beta 2, epsilon and iota toxins;
- Conotoxin;
- Diacetoxyscirpenol toxin;
- HT-2 toxin;
- Microcystin (Cyanoginsin);
- Modeccin toxin;
- Ricin;
- Saxitoxin;
- Shiga toxin;
- *Staphylococcus aureus* enterotoxins, hemolysin alpha toxin, and toxic shock syndrome toxin (formerly *Staphylococcus enterotoxin F*);
- T-2 toxin;
- Tetrodotoxin;
- Verotoxin and other Shiga-like ribosome inactivating proteins;
- Viscum Album Lectin 1 (Viscumin);
- Volkensin toxin.

e. “Fungi”, as follows:

- *Coccidioides immitis*;
- *Coccidioides posadasii*.

## **2. 1C352 Animal pathogens, as follows:**

a. Viruses, as follows:

- African swine fever virus;
- Avian influenza (AI) viruses identified as having high pathogenicity (HP), as follows:
  - AI viruses that have an intravenous pathogenicity index (IVPI) in 6-week old chickens greater than 1.2; or
  - AI viruses that cause at least 75% mortality in 4- to 8-week old chickens infected intravenously.
- Bluetongue virus;
- Foot and mouth disease virus;
- Goat pox virus;
- Porcine herpes virus (Aujeszky’s disease);
- Swine fever virus (Hog cholera virus);
- Rabies virus and all other members of the Lyssavirus genus;
- Newcastle disease virus;
- Peste des petits ruminants virus;
- Porcine enterovirus type 9 (swine vesicular disease virus);
- Rinderpest virus;
- Sheep pox virus;
- Teschen disease virus;
- Vesicular stomatitis virus;
- Lumpy skin disease virus;
- African horse sickness virus.

b. Bacteria, as follows:

- b.1 *Mycoplasma mycoides*, as follows:
  - *Mycoplasma mycoides* subspecies mycoides SC (small colony) (a.k.a. contagious bovine pleuropneumonia);
  - *Mycoplasma capricolum* subspecies capripneumoniae (“strain F38”).

## **3. 1C353 Genetic elements and genetically-modified organisms, as follows:**

a. Genetic elements

- Genetic elements that contain nucleic acid sequences associated with the pathogenicity of microorganisms controlled by 1C351.a to .c, 1C352, or 1C354,
- Genetic elements that contain nucleic acid sequences coding for any of the “toxins” controlled by 1C351.d or “sub-units of toxins” thereof.

b. Genetically modified organisms

- Genetically modified organisms that contain nucleic acid sequences associated with the pathogenicity of microorganisms controlled by 1C351.a to .c, 1C352, or 1C354;
- Genetically modified organisms that contain nucleic acid sequences coding for any of the “toxins” controlled by 1C351.d or “sub-units of toxins” thereof.

Technical Notes:

1. “Genetic elements” include, *inter alia*, chromosomes, genomes, plasmids, transposons, and vectors, whether genetically modified or unmodified, or chemically synthesized in whole or in part.
2. This ECCN does not control nucleic acid sequences associated with the pathogenicity of enterohaemorrhagic *Escherichia coli*, serotype O157 and other verotoxin producing strains, except those nucleic acid sequences that contain coding for the verotoxin or its sub-units.
3. “Nucleic acid sequences associated with the pathogenicity of any of the microorganisms controlled by 1C351.a to .c, 1C352, or 1C354” means any sequence specific to the relevant controlled microorganism that:
  - a. In itself or through its transcribed or translated products represents a significant hazard to human, animal or plant health; or
  - b. Is known to enhance the ability of a microorganism controlled by 1C351.a to .c, 1C352, or 1C354, or any other organism into which it may be inserted or otherwise integrated, to cause serious harm to human, animal or plant health.
4. “Genetically modified organisms” include organisms in which the genetic material (nucleic acid sequences) has been altered in a way that does not occur naturally by mating and/or natural recombination, and encompasses those produced artificially in whole or in part.

#### 4. 1C354 Plant pathogens

a. Bacteria, as follows:

- *Xanthomonas albilineans*;
- *Xanthomonas axonopodis* pv. *citri* (*Xanthomonas campestris* pv. *citri* A) (*Xanthomonas campestris* pv. *citri*);
- *Xanthomonas oryzae* [this species of proteobacteria is identified on the APHIS “select agents” list];
- *Clavibacter michiganensis* subspecies *sepedonicus* (syn. *Corynebacterium michiganensis* subspecies *sepedonicum* or *Corynebacterium sepedonicum*);
- *Ralstonia solanacearum*, race 3,
- biovar 2;
- *Raythayibactor toxicus* [this bacterium is identified on the APHIS “select agents” list].

b. Fungi

- *Colletotrichum kahawae* (*Colletotrichum coffeanum* var. *virulans*);
- *Cochliobolus miyabeanus*
- (*Helminthosporium oryzae*);
- *Microcyclus ulei* (syn. *Dothidella ulei*);
- *Puccinia graminis* ssp. *graminis* var. *graminis* / *Puccinia graminis* ssp. *graminis* var. *stakmanii* (*Puccinia graminis* [syn. *Puccinia graminis* f. sp. *tritici*]);
- *Puccinia striiformis* (syn. *Puccinia glumarum*);
- *Magnaporthe oryzae*
- (*Pyricularia oryzae*);
- *Peronosclerospora philippinensis*
- (*Peronosclerospora sacchari*);
- *Sclerophthora rayssiae* var. *zeae*;
- *Synchytrium endobioticum*;
- *Tilletia indica*;
- *Thecaphora solani*;
- *Phoma glycinicola* (formerly *Pyrenochaeta glycines*) [this fungus is identified on the APHIS “select agents”].

c. Viruses

- Andean potato latent virus (Potato Andean latent tymovirus);
- Potato spindle tuber viroid.

# Appendix B1

## 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:

<http://www.dept.ehs.ttu.edu/ehs/EHSHome/scan/Create>

Link for Hazardous Waste Pick-Up request:

<https://www.depts.ttu.edu/ehs/EHSServices/Services/HazMat/HWDRquestForm.aspx>

Forms included in Appendix BI:

- Biosafety Protocol Application
- Equipment Decontamination Form
- Laboratory Decommissioning Checklist



# Texas Tech University Institutional Biosafety Committee

## BIOSAFETY PROTOCOL REVIEW FORM

Texas Tech University-Institution Biosafety Committee, Box 1090, 742-3876

**Instructions:** All investigators must complete Section 1, 6, and 7; complete Sections 2-5 where appropriate and mark the applicable boxes below:

- ☐ SECTION 2 – RECOMBINANT DNA  
☐ SECTION 3 – MICROORGANISM USAGE (SEE APPENDIXES A, B AND C)  
☐ SECTION 4 – BIOLOGICAL TOXIN  
☐ SECTION 5 – HUMAN BLOOD/TISSUE/FLUID

### SECTION 1 – NEW SUBMISSION: Complete this section for all protocol submissions.

1.1. Principal Investigator(s) (PI):

Name: \_\_\_\_\_ Title: \_\_\_\_\_  
 College/department: \_\_\_\_\_ Campus address: \_\_\_\_\_  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_ E-mail: \_\_\_\_\_

1.2. Co-Principal Investigator(s) (Co-PI) (if any):

Name: \_\_\_\_\_ Title: \_\_\_\_\_  
 ▪ *\*If not faculty, have co-responsible faculty mentor also sign in the "Assurances and Signatures" section of this form.*  
 College/department: \_\_\_\_\_ Campus address: \_\_\_\_\_  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_ E-mail: \_\_\_\_\_  
 ▪ *If there are additional Co-PIs on this project, please attach a separate sheet with the same information on each Co-PI.*

1.3. Project title:

1.4. Research location(s):

Building & Room	Current BSL Rating	Date of Last Inspection:	Performed By:
	<input type="checkbox"/> BSL-1 <input type="checkbox"/> BSL-2 <input type="checkbox"/> BSL-3		
	<input type="checkbox"/> BSL-1 <input type="checkbox"/> BSL-2 <input type="checkbox"/> BSL-3		
	<input type="checkbox"/> BSL-1 <input type="checkbox"/> BSL-2 <input type="checkbox"/> BSL-3		

1.5. Research Classification/Type: (Check all that apply)

- ☐ Recombinant DNA Molecules ☐ Plants  
☐ Pathogenic Microorganisms ☐ Invertebrate Animals  
☐ Biological Toxins ☐ Vertebrate Animals  
☐ Human Fluids/Tissues

1.6. Do individual experiments involve more than 10 liters of cultures? ☐ Yes ☐ No

▪ *If yes, where (building and room #):*

1.7. Biosafety level required: ☐ BSL1 ☐ BSL2 ☐ BSL3 ☐ Exempt

1.8. Funding agency:

#### FOR IBC USE ONLY

IBC# \_\_\_\_\_

Date Approved \_\_\_\_\_ Expiration Date \_\_\_\_\_ IBC Chair Signature \_\_\_\_\_

- 1.9. Identify personnel conducting the experiments (including students and temporary staff). Specify project responsibilities and applicable training/experience including duration. *If additional personnel need to be listed, please attach an additional sheet.*

<b>Name:</b>	<b>Project Responsibilities:</b>
<b>Relevant Training/Experience:</b>	
<b>Name:</b>	<b>Project Responsibilities:</b>
<b>Relevant Training/Experience:</b>	
<b>Name:</b>	<b>Project Responsibilities:</b>
<b>Relevant Training/Experience:</b>	
<b>Name:</b>	<b>Project Responsibilities:</b>
<b>Relevant Training/Experience:</b>	
<b>Name:</b>	<b>Project Responsibilities:</b>
<b>Relevant Training/Experience:</b>	
<b>Name:</b>	<b>Project Responsibilities:</b>
<b>Relevant Training/Experience:</b>	

---

**SECTION 2 – RECOMBINANT DNA:** Complete this section if your project involves the use of Recombinant DNA.

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- 2.1. Source of insert DNA/RNA:
- *If biological source is a viable, intact microorganism in your laboratory, also complete **Section 3 – Microorganism Usage**.*
  - *If biological source is human, indicate whether human blood/tissue will be handled by laboratory personnel.* ☐ Yes ☐ No
  - *If biological source is virus, indicate percentage of genome to be used:* ☐ <1/2 ☐ 1/2 - 2/3 ☐ >2/3
- 2.2. Vector(s):  
Describe the vector(s) and its/their origin:
- *If viral vector is used, also complete **Section 3 – Microorganism Usage**.*
- 2.3. Do experiments involve the use of defective viruses in the presence of helper virus? ☐ Yes ☐ No
- *If yes, indicate the helper virus: \_\_\_\_\_ and complete **Section 3 – Microorganism Usage**.*
- 2.4. Recipient host [microorganism (give genus and species, and if *E. coli*, indicate the strain of *E. coli*), animal species, tissue culture/cell line (specify), plant name]:
- *If microorganism, also complete **Section 3 – Microorganism Usage** (EXCEPTION: Use of a non-pathogenic *E. coli* K-12, *Bacillus subtilis*, or *Saccharomyces cerevisiae* recipient is exempt from the Microorganism Usage Section when used in certified Host-Vector systems as listed in the current NIH Guidelines unless the organism(s) will be converted to a pathogenic strain.)*
- 2.5. Will a foreign gene(s) (*one that is not found in the host species/strain*) be expressed? ☐ Yes ☐ No
- *If yes, identify the gene(s) and its function (if known): \_\_\_\_\_*
- 2.6. Do experiments involve the use of animals or plants? ☐ Yes ☐ No
- 2.7. Do the DNA clones contain genes for the biosynthesis of toxic molecules lethal for vertebrates at an:
- ☐ a. LD<sub>50</sub> of <100 nanograms/kilogram body weight ☐ d. >100 micrograms/kilogram body weight
- ☐ b. LD<sub>50</sub> of 100-1000 nanograms/kilogram body weight ☐ e. Genes for biosynthesis of toxic molecules not involved
- ☐ c. LD<sub>50</sub> of 1-100 micrograms/kilogram body weight
- *If a-d is checked, complete **Section 4 – Biological Toxin**.*
- 2.8. Do experiments involve the release into the environment (outside the facility) of an organism containing recombinant DNA? ☐ Yes ☐ No
- *If yes, has approval for this release been filed with state or federal regulating agency?* ☐ Yes ☐ No
  - *If yes, identify the regulatory agency and date filed, and send copy of approval to the TTU EHS*  
Agency: \_\_\_\_\_ Date Filed: \_\_\_\_\_
- 2.10. Have all personnel involved with this project received training regarding the procedures for handling DNA/RNA? ☐ Yes ☐ No

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**SECTION 3 – MICROORGANISM USAGE:** Complete this section for all uses of microorganisms except non-*pathogenic E. coli* K-12, *Bacillus subtilis*, or *Saccharomyces cerevisiae* recipients in host-vector systems.

---

- 3.1. What microorganism(s) will be used in this project (indicate strain where appropriate, such as for adenovirus)?
- 3.2. Is the organism known to be pathogenic to:
- Humans? ☐ Yes ☐ No
- Other Animals? ☐ Yes ☐ No
- Plants? ☐ Yes ☐ No
- Explain as necessary:
- 3.3. Is the microorganism on the CDC Select Agent List (see **Appendix A**)? ☐ Yes ☐ No
- If yes, have you completed the APHIS/CDC Form 1 Application for Laboratory Registration for Possession, Use, and Transfer of Select Agents and Toxins and submitted it to Environmental Health & Safety? ☐ Yes ☐ No
- 3.4. Is the microorganism on the USDA/APHIS Restricted Animal/Plant Pathogen List (see **Appendix B**)?  
☐ Yes ☐ No
- 3.5. Where will the microorganism(s) be stored? (Building and Room No.)
- 3.6. Where will experiments be conducted? (Building and Room No.)
- If the building location is **different** in answers to questions 3.5. and 3.6. – discuss the method of transport including the use of secondary containers:
- 3.7. What is the appropriate biosafety level for the microorganism(s)? ☐ BSL1 ☐ BSL2 ☐ BSL3
- For microorganism use at BSL2 and above, please attach in Section 6 Standard Operating Procedures (SOPs) signed and dated by the PI, which will address how compliance with CDC/NIH Biosafety in Microbiological and Biomedical Laboratories guidelines will be met.
- 3.8. Does the experiment involve or does the microorganism synthesize a toxic molecule lethal for vertebrates at an LD<sub>50</sub> <100,000 ng/kg or is the toxin on the CDC Select Agent List (see **Appendix A**)?  
☐ Not Known ☐ Yes ☐ No
- If yes, indicate the toxin and complete **Section 4 – Biological Toxin**.
- 3.9. Does the experiment involve the infection of vertebrate animals? ☐ Yes ☐ No
- If yes, attach in Section 6 Standard Operating Procedures (SOPs) addressing safety precautions to be used by animal care technicians, whether the animal can shed the organism, and proper handling of excreta and animal carcasses. Include additional training requirements:
- 3.10. Is there a vaccine available and recommended for person handling this microorganism refer to recommendations of the Advisory Committee on Immunization Practices (ACIP)? ☐ Yes ☐ No
- If yes, please indicate name and service of vaccine:
- 3.11. Does the work involve the importation, production, manufacturing, or processing of new (intergeneric) microorganisms or significant new use of microorganisms for the purpose of obtaining an immediate or eventual commercial advantage for the researcher or the funding entity? ☐ Yes ☐ No
- If yes, has a Microbial Commercial Activity Notice (MCAN) been submitted to the United States Environmental Protection Agency? ☐ Yes ☐ No
- 3.12. Have all personnel involved with this project been trained in the procedures for safe handling of the specific microorganism(s)? ☐ Yes ☐ No
- If no, when and how will the training be given?

**SECTION 4 – BIOLOGICAL TOXIN:** Complete this section if you are working with a biological toxin or select agent listed on Appendix A, a microorganism which synthesizes a toxic molecule lethal for vertebrates below, or the biosynthesis of toxic molecules.

4.1. Identify the toxin(s) and their source, ☐ unfractionated mixture, ☐ purified conjugate, or ☐ microbial culture, capable of producing toxin that will be used in experiment:

4.2. Is the toxin on the Select Agent List? (See **Appendix A**) ☐ Yes ☐ No

4.3. What is the LD<sub>50</sub> of the toxin? (See **Appendix C**)

4.4. Identify all locations where the toxin will be produced, stored and/or weighed:

Building	Room #	Quantity

4.5. Identify the location(s) where experiments will be conducted:

- If the answers to questions 4.4. and 4.5. are **different**, discuss the means of transportation:

4.6. Does the experiment involve the administration of toxin to animals? ☐ Yes ☐ No

- If yes, attach in **Section 6** Standard Operating Procedures (SOPs) addressing safety precautions to be used by animal care technicians, whether the animal can excrete the toxin, and proper handling of excreta and animal carcasses. If the toxin can be released from animals into the environment, include information on how the toxin-containing materials (urine, blood, feces, bedding, etc.) will be inactivated.

4.7. Identify the method of disposal/deactivation of contaminated materials and remaining agent:

4.8. Is there an antidote available for persons exposed to the toxin? ☐ Yes ☐ No

- If yes, do you have it stored in your laboratory? ☐ Yes ☐ No
- If no, where is the closest location that has the antidote?

4.9. Have all personnel involved with this project received documented initial training and yearly updates regarding the procedures for handling the toxin? ☐ Yes ☐ No

4.10. In **Section 6** attach your written procedure covering the secure storage, safe handling and emergency procedures in case of an accident (exposure to staff or spill) for this toxin.

**SECTION 5 – HUMAN BLOOD/TISSUE/FLUID:** Complete this section if you are working with human blood, human blood components, human tissue, human line cell culture, human fluids, and products made from human blood.

5.1. Have all personnel involved with this project received documented initial training in the procedures for safe handling of the material including the proper use of protective equipment and an explanation of the Texas Tech Bloodborne Pathogen Exposure Control Program? ☐ Yes ☐ No

If no, when and how will the training be given?

5.2. In **Section 6** attach your written procedure covering the engineering and work practice controls in place to limit employee exposure and identify procedure in place for a spill or accidental exposure.

---

**SECTION 6 – DESCRIPTION OF USE OF MATERIALS:** This section is required for all applications.

---

- 6.1 In the following space, please describe your project clearly and simply. Address all specific biosafety concerns in sufficient detail for the IBC to make an informed evaluation:
- 6.2. Applicable Standard Operating Procedures: *(REMINDER: Attach appropriate Standard Operating Procedures (SOPs) for this specific protocol signed and dated by the PI as required and indicated in questions: 3.7., 3.9., 4.6. and)*

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**Please send this form to the Office of Environmental Safety, MS 1090.**

**NOTE: If changes in information provided on this application occur, a revised form must be submitted.**

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## **SECTION 7 – APPENDICES**

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Appendix A: Select Agent List

Appendix B: USDA/APHIS Restricted Animal/Plant Pathogen List

Appendix C: Known Toxin LD<sub>50</sub> Values

## Appendix A: Select Agent List

### **HHS Select Agents And Toxins**

- Abrin
- Botulinum neurotoxins
- Botulinum neurotoxin producing species of *Clostridium*
- Conotoxins
- *Coxiella burnetii*
- Crimean-Congo haemorrhagic fever virus
- Diacetoxyscirpenol
- Eastern Equine Encephalitis virus
- Ebola virus
- *Francisella tularensis*
- Lassa fever virus
- Lujo virus
- Marburg virus
- Monkeypox virus
- Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed1918 Influenza virus)
- Ricin
- *Rickettsia prowazekii*
- SARS-associated coronavirus (SARS-CoV)
- Saxitoxin
- South American Haemorrhagic Fever viruses: Chapare, Guanarito, Junin, Machupo, Sabia
- Staphylococcal enterotoxins A, B, C, D, E subtypes
- T-2 toxin
- Tetrodotoxin
- Tick-borne encephalitis complex (flavi) viruses: Far Eastern Tick-borne subtype, Siberian subtype
- Kyasanur Forest disease virus
- Omsk hemorrhagic fever virus
- Variola major virus (Smallpox virus)
- Variola minor virus (Alastrim)
- *Yersinia pestis*
- **OVERLAP Select Agents And Toxins**
- *Bacillus anthracis*
- *Brucella abortus* Pasteur strain
- *Brucella abortus*
- *Brucella melitensis*
- *Brucella suis*
- *Burkholderia mallei* (formerly *Pseudomonas mallei*)
- *Burkholderia pseudomallei* (formerly *Pseudomonas pseudomallei*)
- Hendra virus
- Nipah virus
- Rift Valley fever virus
- Venezuelan Equine encephalitis virus
- **USDA Select Agents And Toxins**
- African horse sickness virus
- African swine fever virus
- Avian influenza virus (highly pathogenic)
- Classical swine fever virus
- Foot-and-mouth disease virus
- Goat pox virus

- Lumpy skin disease virus
- *Mycoplasma capricolum*
- *Mycoplasma mycoides*
- Newcastle disease virus
- Peste des petits ruminants virus
- Rinderpest virus
- Sheep pox virus
- Swine vesicular disease virus
- USDA PLANT PROTECTION AND QUARANTINE (PPQ) Select Agents And Toxins
- *Peronosclerospora philippinensis* (*Peronosclerospora sacchari*)
- *Phoma glycinicola* (formerly *Pyrenochaeta glycines*)
- *Ralstonia solanacearum*
- *Rathayibacter toxicus*
- *Sclerophthora rayssiae*
- *Synchytrium endobioticum*
- *Xanthomonas oryzae*



## Appendix B – USDA/APHIS Restricted Animal and Plant Pathogen List

### **USDA HIGH CONSEQUENCE LIVESTOCK PATHOGENS AND TOXINS (NON-OVERLAP AGENTS AND TOXINS)**

Akabane virus  
Japanese encephalitis virus  
African swine fever virus  
Malignant catarrhal fever virus (Exotic)  
African horse sickness virus  
Menangle virus  
Avian influenza virus (highly pathogenic)  
*Mycoplasma capricolum* M.F38/ *M. mycoides capri*  
Blue tongue virus (Exotic)  
Bovine spongiform encephalopathy agent  
*Mycoplasma mycoides mycoides*  
Camel pox virus  
Newcastle disease virus (VVND)  
Classical swine fever virus  
Peste Des Petits Ruminants virus  
*Cordaria ruminantium* (Heartwater)  
Rinderpest virus  
Foot and mouth disease virus  
Sheep pox virusGoat pox virus  
Swine vesicular disease virus  
Lumpy skin disease virus  
Vesicular stomatitis virus (Exotic)

### **LISTED PLANT PATHOGENS**

*Liberobacter africanus*  
*Ralstonia solanacearum* race 3, biovar 2  
*Liberobacter asiaticus*  
*Sclerophthora rayssiae* var *zeae*  
*Peronosclerospora philippinensis*  
*Synchytrium endobioticum*  
*Phakopsora pachyrhizi*  
*Xanthomonas oryzae*  
Plum Pox Potyvirus  
*Xylella fastidiosa* (citrus variegated chlorosis strain)

## Appendix C – Toxins and Known LD50 Values

<b><u>Toxin</u></b>	<b><u>Route (if other than IP)</u></b>	<b><u>LD<sub>50</sub> (ng/kg)</u></b>
Abrin		20,000
Abrin reconstituted (A+B Mix)		6,000
Abrin A		10,000
Abrin B		25,000
Abrin C		16,000
Abrin D		31,000
Aflatoxin	Oral	1,750,000
	Intramuscular	2,020,000
Aflatoxin B/Aflatoxin B1		9,500,000
Aflatoxin B1 mixed with G1		680,000
Aflatoxin B2/dihydro B1	Oral	1,700,000
Aflatoxin G1	IP	14,900,000
	Oral	785,000
Aflatoxin G2/dihydro G1	Oral	2,450,000
Aflatoxin M1/4-hydroxy B1	Unreported	320,000
Aflatoxin M2/4-hydroxy B2	Unreported	281,000
Aflatoxin P1		150,000,000
Aflatoxin 485 Q1, Ro, Ro' and Aflatoxin B1 dichlorides, oxides, epoxides		No data available
β toxin		No data available
Coagulase		No data available
<i>Clostridium botulinum</i> ("natural product")		0.03
<i>C. botulinum</i> neurotoxin		0.2
<i>C. botulinum</i> toxin A		MLD 1.2
<i>C. botulinum</i> toxin B		1.2 – 2.0
<i>C. botulinum</i> toxin C1		1.1
<i>C. botulinum</i> toxin C2		1.2
<i>C. botulinum</i> toxin D		0.4
<i>C. botulinum</i> toxin E		1.1
<i>C. botulinum</i> toxin F		2.5
<i>Clostridium perfringens</i>		MLD 100
Conotoxins – GI, GIIIA, GIIIB, GIVA, MI, MVILA, SIA, SVIB		12,000 – 30,000
Diacetoxyscirpenol		7,839,000
Exfoliative toxins A, B		No data available
γ toxin		No data available
Pantovalentine leukocidin		No data available

Ricin/Ricine		2,000
Ricin A		5,000
Ricin A chain		No data available
Ricin B		35,000
Ricin C		17,500
Ricin D		0.248
Ricin D alanine-chain protein	Unreported	300,000
Ricin D isoleucine-chain reduced	Unreported	29,000
Ricin nitrogen	Inhalation	LC <sub>50</sub> 500,000
Ricin reduced		200,000
Ricin, total hydrolysate		4,100
Ricin toxin – Con A		41,500,000
Saxitoxin/Saxitoxin hydrate		8,000
Saxitoxin dihydrochloride/hydrochloride		8,000
Saxitoxin p-bromobenzenesulfonate		10,000
Shiga toxin		250
<i>Shigella shigae</i> neurotoxin		1,350
<i>Staphylococcus enterotoxins</i>		25,000 – 1,333,000
T-2 toxin		3,000,000
T-2 toxin tetraol		11,000,000
JT-2 hemisuccinate		7,500,000
Tetrodotoxin		8,000
Tetrodotoxin citrate, 2 hydroxy...	IV	8
Tetrodotoxin 4, 9-anhydro...	Oral	16,900,000
	IV	986,000
Tetrodotoxin 4, 9-anhydro, 8,9-diacetate		>50,000,000
Tetrodotoxin 4-amino-4-deoxy	Oral	26,100,000
	IV	477,000
Deoxytetrodotoxin	Oral	2,700,000
	IV	41,700,000
Ethoxytetrodotoxin		692,000
Methoxytetrodotoxin	Oral	12,700,000
	IV	322,000
Toxic Shock syndrome toxin	Subcutaneous	2,000
	IV	20,000

---

**ASSURANCES AND SIGNATURES**


---

Pursuant to applicable State and Federal laws and regulations and Texas Tech University policies and procedures:

- To the best of my knowledge, I affirm that all information contained herein is accurate and complete.
- I agree to comply with federal, state and university requirements pertaining to the handling, shipment, transfer and disposal of biological materials, to include annual lab inspections.
- I agree to accept responsibility for the training of all personnel involved in this research and that all personnel have been trained.
- I understand that IBC approval of this protocol constitutes approval to work with the specified agents (recombinant DNA, microorganisms, select agents, biological toxins, regulated and particularly hazardous chemicals) using the specified biosafety procedures/practices and laboratory facilities described herein.
- I affirm that all personnel working on the project covered by this protocol have read and are in compliance with the federal law defined in the USA Patriot Act.
- I affirm that I am aware of and have read the NIH Guidelines for Research Involving Recombinant DNA Molecules (NIH GUIDELINES).
- I understand that all changes in agents, procedures/practices and facilities must be reported in writing to the IBC in the prescribed format and that IBC approval shall be obtained prior to implementation of these changes.
- I understand that unauthorized use of recombinant DNA, microorganisms, select agents, biological toxins, regulated and particularly hazardous chemicals or deviation from an approved BC protocol may result in suspension of research privileges and/or disciplinary action.
- I understand that IBC approval is a prerequisite for obtaining IACUC approval for studies using live vertebrate animals if recombinant DNA, microorganisms, select agents and/or biological toxins are involved.
- I understand that IBC approval is a prerequisite for obtaining IRB approval for studies using human subjects if recombinant DNA, microorganisms, select agents and/or biological toxins are involved.
- I understand that IBC approval does not confer approval to work with radioactive materials or lasers.

_____ Principal Investigator Name	_____ Principal Investigator Signature	_____ Date
_____ Co-Responsible Faculty Name	_____ Co-Responsible Faculty Signature	_____ Date
_____ Department Chair Name	_____ Department Chair Signature	_____ Date
_____ Research Personnel Name	_____ Research Personnel Signature	_____ Date
_____ Research Personnel Name	_____ Research Personnel Signature	_____ Date
_____ Research Personnel Name	_____ Research Personnel Signature	_____ Date

**Please send this form to the Office of Environmental Safety, MS 1090.**

**NOTE: If changes in information provided on this application occur, a revised signature form must be submitted.**

# Appendix BJ

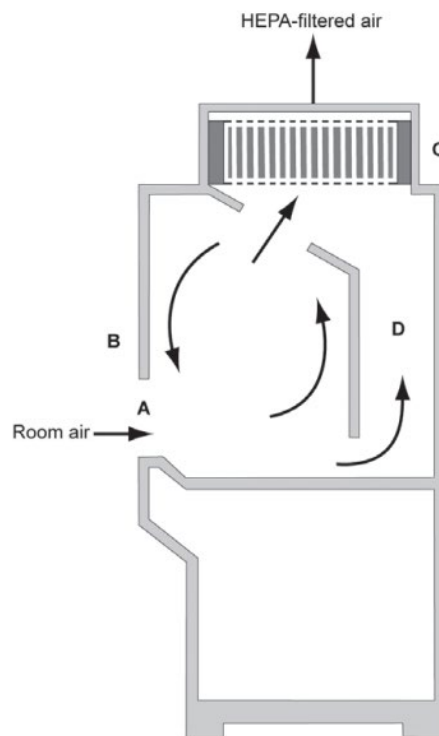
## BIOLOGICAL SAFETY CABINETS

Additional information can be found in Appendix A of the BMBL, pg. 290-325.  
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 and B2
- 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.

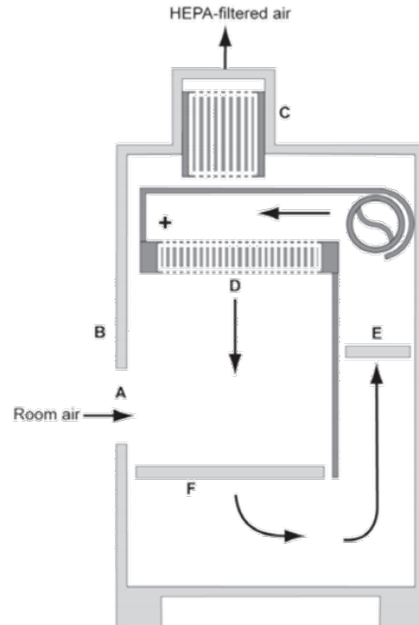
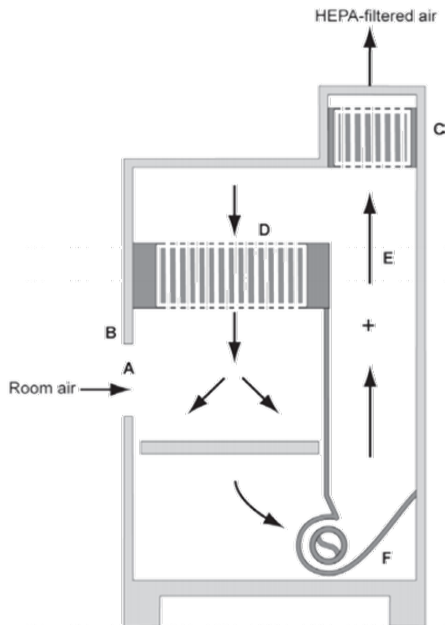
Figures 2 and 3. Class II, Type A1 BSC (left); Class II, Type A2 BSC (right).

Figures 4 and 5. Class II, Type B1 BSC (left); Class II, Type B1 BSC – classic design (right).

Figure 6, Class II Type B2

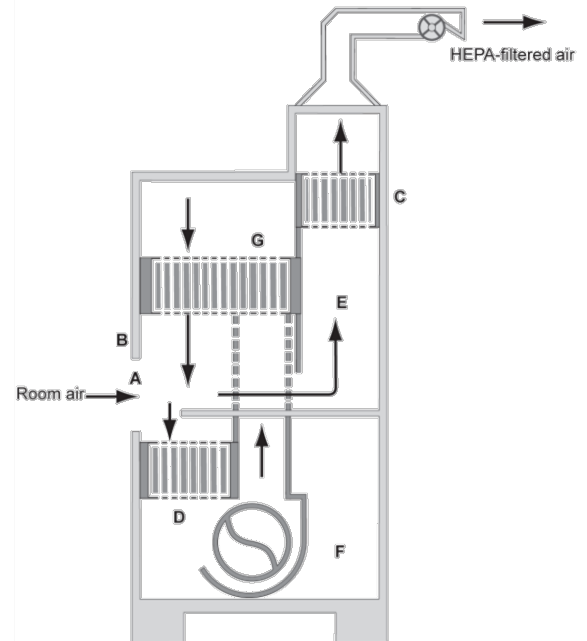
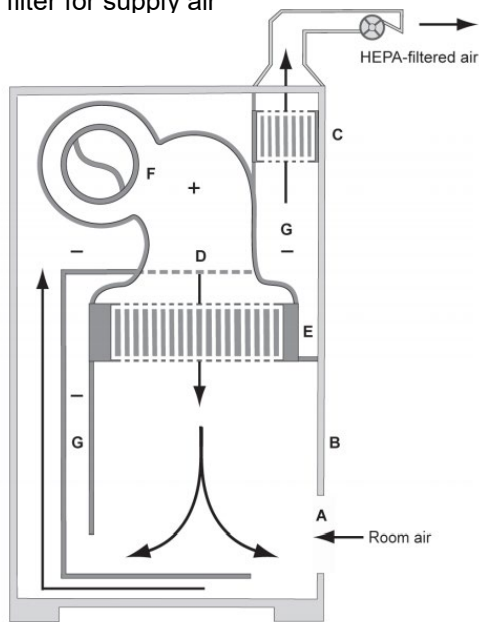
**Left: FIGURE 2. Class II, Type A1 BSC** A)Front opening; B)Sash; C)Exhaust HEPA filter; D)Supply HEPA filter; E)Common plenum; F) Blower/fan.

**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



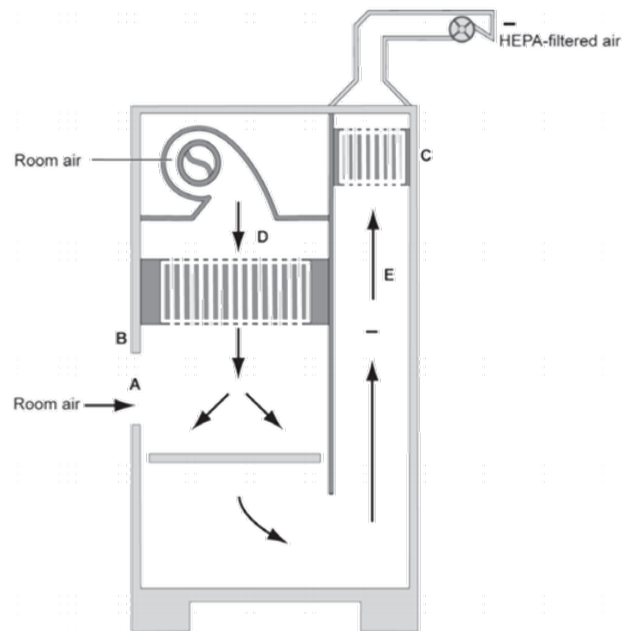
**Left: FIGURE 4. Class II, Type B1 BSC** A)Front opening; B)Sash; C)Exhaust HEPA filter; D)Supply plenum; E) Supply HEPA filter ; F) Blower/fan; G)Negative pressure exhaust plenum (ducted to building)

**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





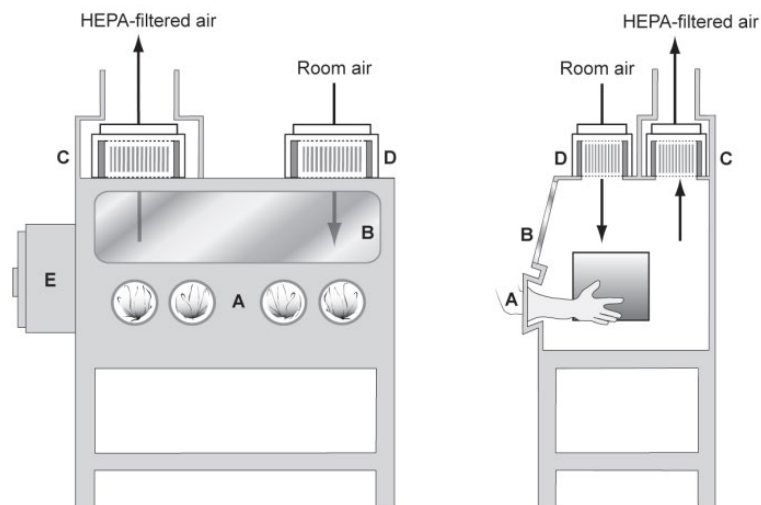
**FIGURE 6. Class II, Type B2 BSC** A)Front opening; B)Sash; C)Exhaust HEPA filter; D)Supply HEPA filter; E)Negative pressure exhaust plenum (ducted to building exhaust with additional filters for chemical use).



### 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 7. 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 BK

## **Autoclave Testing Documents**

- Procedure
- Record Log
- Report Form

Documents start on the following page.



TEXAS TECH UNIVERSITY

## Environmental Health *and* Safety

### Standard Operating Procedure for Periodic Autoclave Testing & Reporting

#### 1. 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 insure 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 microorganisms<sup>1</sup>.” 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.7.3 of the Texas Tech University Biosafety Manual.

#### 2. 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.7.3 of the Texas Tech University Biosafety Manual for more details regarding autoclave use and regulations prior to drafting a laboratory-specific SOP.



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## Environmental Health *and* Safety

### 3. 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. Be especially careful not to stand too close when opening an autoclave. It is best to stand behind the hatch door when possible.
- Place autoclavable bags containing waste in a secondary containment vessel 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 which process biowaste consisting of BSL1 materials shall be evaluated annually with a biological indicator by EHS. A laboratory may voluntarily self-test more frequently if desired.
- Autoclaves which process biowaste from BSL2 materials shall be evaluated by laboratory personnel at least monthly or at the follow 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 indicator *Geobacillus stearothermophilus* (i.e. Sterikon® plus Bioindicator) should be placed under standard operating conditions (i.e. within a normal to large load of non-waste or with a non-hazardous "dummy" load of comparable size. If using a non-waste load, the materials to be autoclaved must be able to withstand the autoclave conditions of the biowaste cycle.
- 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.



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## Environmental Health *and* Safety

- Laboratories depending on EHS for incubation can coordinate the test date and confirm through the following email: [safety@ttu.edu](mailto:safety@ttu.edu). Please submit questions, comments or otherwise need assistance to this email as well. For immediate assistance, please call EHS at 806-742-3876.
- Test vial(s) must be picked up by EHS personnel same day as the test cycle is completed. Email/phone confirmation is required to coordinate these tests with EHS. If the lab is self-incubating, lab personnel can determine test date, time and read/record test results internally according to their convenience on the attached record log.

### 4. Use of Biological Indicators

EHS will be assisting in monitoring autoclave performance by issuing bioindicators and, if needed, will incubate the ampoule after the cycle. Bio-indicators contain the *G. stearothermophilis* spores in a nutrient broth and are supplied in a serializable pouch.

- **Do not open or adjust the pouch closure.** The pouch will contain the bio-indicator material in case of accidental ampoule breakage.
- Bio-indicators must be stored 2-8°C (in the refrigerator) in the pouches.
- Indicators are not to be used in loads that exceed 125°C as this may result in a false positive.
- More than one indicator may be required to test an autoclave. Autoclaves with a capacity up to 250L should be evaluated with 2 ampoules. Those with greater than 250L capacity should be evaluated with at least 6 ampoules.

Instructions for indicator use are outlined below.

1. Vigorously shake ampule to disperse spores. Place the indicator and pouch in a glass beaker within the secondary container in a normal-sized load as described above and load autoclave as usual. Do not open the pouch. 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, remove the pouch from the load and transfer to an incubator. A control ampoule (an ampule which is not autoclaved) from the same lot must be incubated with every test ampule set. Incubate the test and control ampoules at 60 +/- 2°C for 48 hours.
3. After incubation, place the test ampoule and control ampoule side by side to compare the test results. The control ampoule should turn yellow to yellow-orange and may or may not be turbid indicating the growth of spores. If the test is successful, the test ampoule should be pink/purple/red indicating complete destruction of the spores.
4. If the test ampoule turns yellow like the control ampoule, the autoclave test fails.  
If the control ampoule does not turn yellow to yellow-orange with or without turbidity the test should be considered invalid and repeated.



TEXAS TECH UNIVERSITY

## Environmental Health *and* Safety

### 5. 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 responsible party for the autoclave to initiate a service call.
2. Do not use the autoclave until it has been inspected, repaired and successfully challenged with a biological indicator in 3 consecutive “dummy” of non-hazardous loads with control tests for each.
3. If lab personnel are conducting the testing, record and report all results to EHS.

### 6. Results



**RED-VIOLET** indicates adequate sterilization was achieved (*i.e.* a successful test). Vial has the same appearance as during storage prior to use.

**YELLOW-ORANGE** indicates growth (*i.e.* a successful control vial or a failed test vial).

### 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, Nov 2015.

# Periodic Autoclave Testing Log

Building Name: \_\_\_\_\_

Room No.: \_\_\_\_\_

PI/Contact: \_\_\_\_\_

Email: \_\_\_\_\_

Autoclave Make: \_\_\_\_\_

Model/Serial No.: \_\_\_\_\_

[illegible]





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 [safety@ttu.edu](mailto: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 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 ( $HE, 50 = \sum W_T HT, 50$ ).

**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<sub>d</sub>):** Applies to external whole body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm<sup>2</sup>.) 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 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 produces 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><b>TEXAS TECH UNIVERSITY</b></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

HV "As Found" Reading

Meter HV Adjusted Reading

Input Sensitivity

\_\_\_\_\_  
Volts

\_\_\_\_\_  
Volts

\_\_\_\_\_  
Volts

\_\_\_\_\_  
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  $\pm 10\%$     ☐ With in  $\pm 10 - 20\%$  Tolerance

☐ Meter out of Tolerance  $> \pm 20\%$     ☐ 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

<b>Manufacturer</b>	<b>Model Number</b>	<b>Serial Number</b>	<b>Building</b>	<b>Room Number</b>	<b>Status</b> (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

<b>Class</b> (I,II,III,IV)	<b>Laser Setup *</b> Refer to Illustrations (A,B,C)	<b>Emission Duration Range</b> (seconds)	<b>Emission Power Range</b> (Watts or Joules)	<b>Emission Wavelength Range</b>
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

<b>Laser</b>	<b>Type</b> (dye, gas, solid state..)	<b>Active Material</b> (Ar,HeNe,GaAs,Nd Yag..)	<b>Excitation Mechanism</b> (optical,electrical,chemi cal..)	<b>Time-Dependent Properties</b> (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 SUBLICENSE

	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 SUBLICENSEE APPLICATION WILL COMPLY WITH THE STATE OF TEXAS LASER LICENSES REQUIREMENTS, REGULATIONS, AND ALL SPECIFIC CONDITIONS REQUIRED BY THE RADIATION SAFETY COMMITTEE, 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	<u>ANSWER WHEN DELETING PERSONNEL</u>	
			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 SUBLICENSE

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 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 SUBLICENSE 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 SUBLICENSEE

\_\_\_\_\_  
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

# SOP TRAINING ACKNOWLEDGEMENT

I CERTIFY THAT I HAVE READ AND HAVE BEEN TRAINED ON ALL THE STANDARD OPERATING PROCEDURES AND PERSONAL PROTECTIVE EQUIPMENT. I WILL COMPLY WITH THE SAFETY REQUIREMENTS.

NAME	SIGNATURE	DATE
Please Print		



## USAGE LOGS

Operator must be date and initial each time that the laser is operated: include notes of adjustment, operation conditions, maintenance, servicing, and problems.

Modifications that significantly change SOP's and performance **shall not** be operated until approved by LSO. Modifications not reported are in violation of the terms of the sublicense.

NAME	PROCEDURE	DATE
Please Print		

## 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 (J).

ENERGY DENSITY - means the emittance (M) or irradiance (E) of electromagnetic radiation, energy per unit area, e.g., joules/meter<sup>2</sup> or joules/centimeter<sup>2</sup>.

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 that element, expressed in watts per square centimeter (W/cm<sup>2</sup>).

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 or 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 ( $\lambda$ ) 1064 nanometers .

NOMINAL HAZARD ZONE (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 lasing 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 ( $\text{J/cm}^2$ ).

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 ( $\text{w/Sr}$ ).

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: VV-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