UPEI LAB SAFETY MANUAL

2018-2019

Emergency Phone Numbers	**Emergencies:** call **9-911** (UPEI phone) **or 911** (cell phone) **UPEI Security Services:** call **0384 (**UPEI phone) **or 566-0384** (cell phone) **Poison Centre: 9-1-800-565-8161** (UPEI phone) **or 1-800-565-8161** (cell phone)

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TABLE OF CONTENTS

DEFINITIONS

AIR PURIFYING RESPIRATOR (APR): A half or full face respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH): An organization open to all practitioners in industrial hygiene, occupational health, environmental health, or safety. Their web site is http://www.acgih.org/. ACGIH establishes the Threshold Limit Values (TLVs).

AMERICAN NATIONAL STANDARDS INSTITUTE (**ANSI):** A private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States.

ASSIGNED PROTECTION FACTOR (APF): The minimum anticipated protection provided by a properly functioning respirator or class of respirators to a given percentage of properly fitted and trained users.

ATMOSPHERE SUPPLYING RESPIRATOR: A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere, and includes supplied- air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

AUTOIGNITION TEMPERATURE: The temperature at or above which a substance will spontaneously ignite (catch fire) without an external spark or flame.

BIOHAZARD or **Biological Hazard:** An organism or substance derived from an organism, that poses a threat to health. This can include medical waste, samples of a microorganism, virus, or toxin (from a biological source) that can impact human health. It can also include substances harmful to animals. The term and its associated symbol are generally used as a warning, so that those potentially exposed to the substances will know to take precautions.

BIOSAFETY: Safety from exposure to infectious agents.

BIOSAFETY CABINET: Cabinets that provide primary containment in the laboratory when using potentially infectious materials.

BOILING POINT: The temperature at which a liquid changes to a gas (vapour) at normal atmospheric pressure.

BREAKTHROUGH: The penetration of challenge material(s) through a gas or a vapour air-purifying element. The quantity or extent of breakthrough during service life testing is often referred to as the percentage of the input concentration.

CANISTER or **CARTRIDGE:** A container with a filter, sorbent, catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

CARCINOGEN: A carcinogen is a substance that causes cancer or is believed to cause cancer.

COMPRESSED GAS ASSOCIATION (CGA): An American trade association for the industrial and medical gas supply industries which publishes standard s and practices that codify industry practices.

CONTROLLED PRODUCTS: Hazardous materials that can affect the health and safety of workers and the workplace.

CSA GROUP (CSA): Formerly the Canadian Standards Association. A standards development organization and certification body.

DISPOSABLE RESPIRATOR: A respirator that is discarded after the end of its recommended period of use, after excessive resistance, physical damage, odour breakthrough, or other warning indicators render the respirator unsuitable for further use.

DUE DILIGENCE: Doing everything reasonable, under the circumstances, to protect health and safety in the workplace.

DUST: A solid, mechanically produced particle with a size ranging from submicroscopic to macroscopic.

EMERGENCY RESPIRATOR USE SITUATION: Any occurrence such as, but not limited to, equipment failure, rupture of containers, failure of control equipment, accident, or mechanical failure that may or does result in an uncontrolled significant release of airborne contaminant that requires the use of respirators due to the unplanned generation of a hazardous atmosphere (often of unknown composition) and that requires evacuation of personnel or immediate entry for rescue or corrective action.

EMPLOYEE EXPOSURE: Exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

EMPLOYER: Person who employs one or more workers (pays for service) or contracts for the services of one or more workers, which may include a constructor or contractor.

ENVIRONMENTAL STEWARDSHIP: Is a shared responsibility of everyone to do everything reasonable to protect the environment from harm, including but not limited to, safe hazardous material handling (storing, using, and disposing), recycling, conservation, regeneration, and restoration.

FILTER or **AIR-PURIFYING ELEMENT:** A component used in respirators to remove solid or liquid aerosols from the inspired air.

FILTERING FACE-PIECE: A particulate respirator with a filter as an integral part of the face-piece or with the entire face-piece composed of the filtering medium.

FIT FACTOR: A quantitative measure of fit of a specific respirator face-piece to a particular individual. Typically estimates the ratio of substance concentration in ambient air to its concentration inside the respirator when worn.

FIT TEST: Use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. [See also Qualitative fit test (QLFT) and Quantitative fit test (QNFT)].

FLAMMABLE LIMITS: The concentration range in which a flammable substance can produce a fire or explosion when an ignition source (such as a spark or open flame) is present. Generally applies to vapours.

FLASH POINT: Lowest temperature at which a liquid can gives off sufficient vapour to ignite in air near the surface of the liquid. The lower the flash point, the easier it is to ignite the material.

FUME: A solid condensation particle, usually of a vapourized metal.

FUME HOOD: Type of local exhaust ventilation system (engineering control). Typically a cabinet with a moveable front sash (window) made out of safety glass. Air is drawn into the hood under the sash when open and is exhausted through openings in the rear and top of the cabinet to a remote point such as an exhaust stack on the roof of the building.

GAS: An aeriform fluid that is in a gaseous state at standard temperature and pressure. A gas is composed of molecules in constant random motion, has no fixed shape, and will take on the shape of the space available.

HIGH-EFFICIENCY PARTICULATE AIR (HEPA) FILTER: A filter usually designed to remove at least 99.97% of airborne particles of 0.3 micrometers or greater in diameter. The equivalent NIOSH 42 Code of Federal Regulations (CFR) Part 84 air-purifying particulate respirator filters are the N100, R100, and P100 filters (N for not resistant to oil, R for resistant to oil, P for oil proof).

HOOD: A respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH): Exposure to airborne contaminants that is likely to cause death, immediate or delayed permanent adverse health effects, or prevent escape from such an environment.

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (**IARC):** The International Agency for Research on Cancer (IARC) is part of the World Health Organization. IARC coordinates and conducts both epidemiological and laboratory research into the causes of human cancer.

INTERNATIONAL AIR TRANSPORTATION ASSOCIATION (IATA): Is the trade association for the world's airlines and supports aviation with global standards for airline safety,

security, efficiency and sustainability.

LABORATORY: A place equipped for experimental study, testing, or analysis. For the purpose of this manual includes any of the following: research laboratory, teaching laboratory, clinic, field site (on or off island), and/or animal holding facilities.

LOWER FLAMMABLE LIMIT (LFL): The lowest concentration of a flammable mixture of gas or vapour in air that can ignite at a given temperature and pressure.

MIST: A liquid condensation particulate.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA): A voluntary membership organization whose aim is to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes.

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH): The United States federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness.

NEGATIVE PRESSURE RESPIRATOR (TIGHT FITTING): A respirator in which the air pressure inside the face-piece is lower (negative) during inhalation as compared to the ambient air pressure outside the respirator.

OXYGEN DEFICIENT ATMOSPHERE: An atmosphere with oxygen content below 19.5% by volume.

PARTS PER MILLION (PPM): Out of a million. Usually describes the concentration of something.

PERMISSIBLE EXPOSURE LIMIT (PEL): The maximum amount or concentration of a chemical that a worker may be exposed to as determined by the ACGIH.

PERSONAL PROTECTIVE EQUIPMENT (PPE): All clothing and work accessories designed to create a barrier against workplace hazards. Examples include safety goggles, blast shield, hard hat, hearing protection, gloves, respirator, apron, and work boots.

POSITIVE PRESSURE RESPIRATOR: A respirator in which the pressure inside the face-piece is higher (positive) as compared to the ambient air pressure outside the respirator.

POWERED AIR-PURIFYING RESPIRATOR (PAPR): An air-purifying respirator that uses a blower to force ambient air through the air-purifying elements into the face-piece.

PRIMARY SPACE SUPERVISOR: A person with authority of workers or charge of a specific work area/department (workplace). This person can be a Dean, Chair, Director, Manager, Researcher, etc. that has the accountability to act on any identified hazard, risk, or incident within their area of responsibility to prevent injury or illness.

QUALITATIVE FIT TEST (QLFT): A pass/fail test to assess the adequacy of respirator fit that relies on the individual's response to a test agent.

QUANTITATIVE FIT TEST (QNFT): An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

RECOMMENDED EXPOSURE LIMIT (REL): An 8- or 10-hour time-weighted average (TWA) or ceiling (C) exposure concentration recommended by NIOSH that is based on an evaluation of the health effects data.

RESPIRATOR: A device which has been designed to protect the wearer from inhalation of harmful atmospheres.

RESPIRATORY INLET COVERING: The portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device, breathing air source, or both. It may be a face-piece, helmet, hood, suit, or mouth-piece respirator with nose clamp.

SAFETY DATA SHEET (SDS): Provides the necessary information for you to understand and deal with the potential hazards associated with a particular hazardous substance. Formerly referred to as Material Safety Data Sheet (MSDS).

SELF-CONTAINED BREATHING APPARATUS (SCBA): An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user. Used in emergencies and when the atmosphere is immediately dangerous to life and health (IDLH).

SERVICE LIFE: The period of time that a respirator, filter, sorbent, respiratory equipment, or other personal protective equipment (PPE) provides adequate protection to the wearer.

SHORT TERM EXPOSURE LIMIT (STEL): The concentration to which workers can be exposed continuously for a short period of time without suffering negative health effects (defined by ACGIH).

SIMULATED WORKPLACE PROTECTION FACTOR (SWPF): A surrogate measure of the workplace protection provided by a respirator.

SINGLE-USE DUST or **DUST AND MIST RESPIRATORS:** Respirators approved for use against dusts or mists that may cause pneumoconiosis and fibrosis.

STANDARD OPERATING PROCEDURES (SOP): A written set of step-by-step instructions that explain how to carry out a routine operation. They aim to achieve efficiency, quality output, and uniformity of performance, while reducing the potential for error, injury/illness, and non-compliance to legislation, standards, or best practice.

SUPERVISOR: Any person that has either charge of a workplace, or authority over a worker.

SUPPLIED AIR RESPIRATOR (SAR) or **AIRLINE RESPIRATOR:** An atmosphere-

supplying respirator for which the source of breathing air is not carried by the user.

THRESHOLD LIMIT VALUES (TLV): Guidelines (not standards) prepared by the ACGIH to assist industrial hygienists in making decisions regarding safe levels of exposure to various hazards found in the workplace. TLV is the concentration of a material to which nearly all workers can be exposed day after day without adverse effects. This value is based upon an 8 hour exposure and a 40 hour work week.

TIGHT-FITTING FACE-PIECE: A respiratory inlet covering that forms a complete seal with the face.

TIME WEIGHTED AVERAGE (TWA): Average time, over a given work period (eg 8-hour workday), of a person's exposure to a chemical or agent. The average is determined by sampling for the contaminant throughout the time period.

TRANSPORTATION OF DANGEROUS GOODS (TDG): Canadian Legislation and Regulations developed for transportation of dangerous goods by all modes (Air, Marine, Rail or Road) of transport.

UPPER FLAMMABLE LIMIT (UFL): The highest concentration of a vapour or gas (the highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At concentrations higher than the UFL, the mixture is too rich to burn. Also known as the Upper Explosive Limit (UEL).

USER SEAL CHECK: An action conducted by the respirator user to determine if the respirator is properly seated to the face.

VAPOUR: The gaseous state of a substance that is solid or liquid at temperatures and pressures normally encountered.

VENTILATION: Process of supplying fresh air to an enclosed space in order to refresh/remove/replace the existing atmosphere. Ventilation is commonly used to remove contaminants such as fumes, dusts, or vapours to provide a healthy and safe working environment.

VIVARIA: An enclosure, container, or structure adapted or prepared for keeping animals under semi natural conditions for observation or study or as pets; an aquarium or terrarium

WORKER: A person employed in a workplace; a person in a workplace for any purpose in connection therewith.

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS): Canadian legislation covering the use of hazardous materials in the workplace.

WORKPLACE PROTECTION FACTOR (WPF): A measure of the protection provided in the workplace by a properly functioning respirator when correctly worn and used.

INTRODUCTION

University of Prince Edward Island (UPEI) is a world-class research and teaching institution in which laboratory-based programs are a vital component. On a daily basis workers, faculty, students, and visitors engage in work that involves hazardous substances, processes, and equipment. Providing a safe environment in the University's laboratories is a shared responsibility of all those involved in laboratory programs, including the University administration, area leaders, departmental chairs, laboratory supervisors, workers, students, and visitors. Recognizing the need for a manual specific to laboratories, the UPEI Joint Occupational Health and Safety Committee (JOHSC) recommended that a subcommittee be established to draft the *UPEI Laboratory Safety Manual*. This manual provides health and safety guidelines and regulations to the supervisors, employees, students and visitors who work in the labs, clinics, and animal holding facilities of UPEI and who do fieldwork off-campus.

It is the collective aspiration of this subcommittee to produce a document that will be used extensively. We are confident that this *UPEI Laboratory Safety Manual* provides the means for supervisors, employees, students, and visitors to work safely in the laboratory settings.

The University maintains a website (http://www.upei.ca/) that provides easy access to important University information. To find this Laboratory Safety Manual simply click on the following link http://www.upei.ca/vpaf/. This link provides direct access to health and safety documentation created by UPEI to ensure the campus community has pertinent information to protect their health and safety.

Although available online and accessible to non-UPEI organizations, it is not intended to be advice, practice, or legislated compliance for any other organization other than UPEI. The *UPEI Laboratory Safety Manual* is not intended to be all-inclusive for the necessary legal requirements of the University, but a tool used to achieve the highest possible level of safety within laboratories, clinics, animal holding facilities, and while out in the field (on or off Prince Edward Island).

For further information, a list of additional sources can be found in **Appendix A.**

For the purposes of this manual, a **laboratory** includes any of the following: Research laboratory, teaching laboratory, clinic, field site (on or off island), and/or animal holding facilities

For the purposes of this manual, **Lab User** includes faculty, workers, students, and visitors.

1. LEGAL FRAMEWORK

The University of Prince Edward Island's Health, Safety and Environment Policy, approved by the UPEI Board of Governors, outlines the duties and responsibilities of workplace parties to comply with Occupational Health and Safety Legislation of Prince Edward Island and to ensure the protection of health, safety and the environment. This policy can be found at: http://www.upei.ca/policy/. The UPEI President also provided his written commitment to Health, Safety and Environmental Stewardship. These documents promote the Internal Responsibility System which expects all workplace parties to collaborate to identify, assess and control workplace hazards to prevent harm to people and demonstrate environmental stewardship. Both of these documents provide the foundation for the UPEI Health, Safety and Environment Management System and demonstrate the employer's resolve to ensure a safe environment that supports work and study. The President's commitment statement can be found on the UPEI website link: http://www.upei.ca/vpaf/.

Individuals in laboratories need to be aware of the laws, regulations, and procedures that place special responsibilities on them while in the lab environment.

To provide a safe and healthy environment, UPEI relies upon the people who work in our laboratories. Everyone must be aware of their responsibilities and demonstrate due diligence at all times to reasonably protect themselves and others from harm while working in a laboratory setting.

1.1 Regulations

Links to acts, regulations, codes, and standards related to this manual and applicable within Prince Edward Island can be found in **Appendix A**.

1.1.1 Provincial/Federal Occupational Health and Safety Legislation

The Prince Edward Island Occupational Health and Safety Act and its regulations prescribe duties of employers, supervisors, and workers, and outline the minimum requirements to ensure successful health and safety programs are established by all workplaces. The Workplace Hazardous Materials Information System (WHMIS) Regulations is one such regulation that has particular application to UPEI laboratories.

Federal, provincial, and municipal environmental laws affect laboratory operations by regulating the discharge of chemicals and biological wastes and by establishing allowable waste-disposal practices. For example, federal regulations apply to PCBs, biohazardous materials, radiation usage, declaration of chemicals used, and ozone-depleting or greenhouse gases.

1.1.2 Building and Fire Codes

Because laboratories present unique hazards, special provisions of the National Building and National Fire Codes of Canada apply to the design and operation of laboratories. Provincial and municipal agencies administer the codes and officers from these agencies periodically inspect

UPEI buildings to ensure compliance. In some highly specific areas, regulatory agencies use guidelines and codes developed by the US National Fire Protection Association (NFPA).

1.1.3 Transportation of Dangerous Goods (TDG)

Whenever dangerous goods are transported by road, rail, air, or sea the Federal Transportation of Dangerous Goods Regulations (TDG) and International Air Transportation Association Regulations (IATA) apply. The shipper must ensure that the hazardous material is classified, labeled, packaged, and that the appropriate dangerous goods placards are placed on the mode of transportation as prescribed by these regulations. TDG also requires receivers to maintain records of shipments received. These regulations specify that shippers and receivers of dangerous goods must receive specific TDG training. For controlled substances coming into UPEI laboratories, the shipping/receiving clerk handles much of the work related to the transport of dangerous goods. When a laboratory ships a controlled product for analysis in preparation for a field program or as part of an inter-laboratory collaboration, the TDG Regulations and IATA Regulations still apply. In these cases, the laboratory assumes the responsibilities of the shipper. The laboratory supervisor must ensure that the shipment meets the requirements of the TDG and/or the IATA Regulations prior to releasing the shipment.

1.1.4 Other Legislation

Other federal and provincial legislation affect some UPEI laboratories. Supervisors must be aware that other regulations relating to safety may apply. It is expected that a competent supervisor will know all the legislation that applies to their work or workplaces.

1.2 University Campus Safety Contacts

1.2.1 Joint Occupational Health and Safety Committee (JOHSC) and Local Health and Safety Working Groups

The JOHSC is an integral component of the Internal Responsibility System that collaborates, inspects, investigates, and makes recommendations to the employer and other workplace parties to ensure an effective Occupational Health, Safety and Environment Management System exists at UPEI. In addition, five local health safety working groups deal with the day-to-day safety issues that arise within their respective jurisdictions. These Working Groups are:

- Atlantic Veterinary College Health and Safety Working Group
- Science Health and Safety Working Group
- Main Campus Health and Safety Working Group
- Facilities Management Health and Safety Working Group
- Faculty of Sustainable Design Engineering Health and Safety Working Group

JOHSC and Working Group members represent the University's employee groups, management, and administration, as well as both undergraduate and graduate students. The Working Groups meet regularly to provide a forum to discuss health and safety concerns and advise the JOHSC of any health and safety issues that cannot be resolved at the local level. The JOHSC will advise the

Senior Executive Team (SET) by following the legislated recommendation to employer process. Current JOHSC members and contact information can be found at http://www.upei.ca/vpaf/ or on the Occupational Health and Safety (OHS) information board on the second floor of Kelley Memorial Building.

1.2.2 UPEI Health and Safety Manager

The UPEI Health and Safety Manager is responsible for the general co-ordination, promotion, and education of health and safety on campus. In the event you need information about health and safety, assistance with reporting an incident/hazard/injury, or any issue/concern related to health, safety or environment please feel free to contact the UPEI Health and Safety Manager at 902-566-0516. If you would like to contact members of the JOHSC or the Local Health and Safety Working Groups you can find their names and contact information on the OHS information board on the second floor of Kelley Memorial Building or online at: http://www.upei.ca/vpaf/ .

1.3 Supervisors

As defined by the UPEI Health, Safety and Environment Policy:
Supervisor: a person who has charge of a workplace or authority over a worker.

This term is used throughout this document for simplicity. A supervisor is determined based on the role, not the title. Examples of UPEI supervisors are: Deans, Chairs, Directors, Managers and Foremen. Depending on the situation Faculty, Researchers and Principle Investors can be supervisors if they instruct, direct, or supervise workers and/or students, or have control over a work area or authority over those that perform work for them.

Supervisors are responsible for ensuring that activities undertaken by individuals in their laboratories are consistent with UPEI's Health, Safety and Environment policy to provide a safe workplace for laboratory workers, students, visitors, and service providers that enter their work areas. The definition of a supervisor has been approved by the UPEI Board of Governors.

Supervisors must conduct hazard analyses to identify, assess, and control laboratory hazards that increase the risks of injury/illness posed by laboratory activities or adverse outcomes to the environment. The goal is to minimize the likelihood of harm to a person in the laboratory and this is demonstrated through safe procedures/practices. Controls must be implemented to eliminate, or at minimum, reduce the potential for injury/illness from hazards using the accepted hierarchy of controls that range from most effective (1) to least effective (4):

1. Elimination or substitution
2. Engineering
3. Administrative
4. Personal Protective Equipment

Usually combinations of these controls are implemented to reasonably protect people and the

environment from harm. Refer to the Health, Safety and Environment System elements on the UPEI website at http://www.upei.ca/vpaf/ for a more in-depth explanation of the Hierarchy of Controls.

Although the supervisor may not always be present in the work area (e.g. laboratory) when workers or students are still present this does not absolve them of their occupational health and safety responsibilities under the legislation. Supervisors must ensure adequate supervision is provided by a competent person or ensure that those working have demonstrated competence to complete the work without direct supervision. Supervisors have to ensure that laboratory personnel follow safe practices and use the equipment necessary to complete the work safely. The supervisor must ensure their due diligence is documented by having workers sign attendance forms that identify the topic of instruction or training provided (on how to complete the work safely) and that the individual has demonstrated competency to complete the work as described in the standard operating procedures (SOPs) or safe work practices. There have been supervisors charged under OHS legislation when a serious, critical or fatal injury occurred even when they were not present.

Supervisors must follow the requirements of the UPEI *Working Alone Policy* found on the UPEI website: http://www.upei.ca/policy/. If alternate arrangements can be implemented to eliminate workers having to work alone, they must be explored (e.g. completing lab work during hours when others are in the lab and when supervision is available or present). If working alone is not avoidable then, a detailed plan must be developed to ensure the worker has communication with another UPEI person (e.g. security dispatch, supervisor or other worker), regular communication (specific intervals) will be required and the worker must have a means to communicate (e.g. phone) with the other UPEI person.

2. LABORATORY PRACTICES

2.1 Policy and Procedures

It is the responsibility of the employer (UPEI), workers, and supervisors to minimize risks of injury, illness, and environmental damage related to activities in laboratories. Laboratory supervisors and workers are instructed to become versed in, and put into everyday practice, guidelines from this laboratory safety manual which promote the Health, Safety and Environment Policy of UPEI.

Standard Operation Procedures (SOPs) must be established for all routine laboratory work. To demonstrate due diligence supervisors must instruct/train all workers/students in standard operating procedures for their safety. All training records must be documented and supervisors shall ensure that those trained can demonstrate competency to adhere to the SOP. SOP instruction/training will re-inforce that the main steps of the routine procedure are understood, hazards/risks inherent in each step (including hazards associated with the equipment/tools to be used) are identified, and the safety measures required are utilized for the protection of those completing the work.

SOPs have many advantages besides demonstrating supervisor due diligence, including but not limited to:

1. Educational documentation
2. Ensuring consistency in procedures
3. Increasing quality of work
4. Increasing productivity
5. Reducing the probability of injury/illness
6. Critical resource to assist in investigation of any incident occurring while performing the procedure
7. Demonstrating the supervisor's commitment to worker/student safety.
8. Ensuring compliance with industry standards, legislation, best practices, etc.

2.2 Supervisor Responsibilities

Laboratory supervisors are responsible to supervise all activities within their laboratories, provide information, advice, training, and personal protective equipment as required for the protection of anyone within their work area.

Supervisors are required to provide written standard operating procedures (SOPs) for all processes involving hazardous substances and/or equipment (See section 3.1.2 for a guide to writing SOPs). Special attention must be given to the UPEI *Working Alone Policy* when assessing the hazards of procedures. This policy can be found at: http://www.upei.ca/policy/.

Only activities authorized by laboratory supervisors are permitted in UPEI laboratories.

Supervisors must ensure that in laboratories under their supervision:

- Site-specific safety training is conducted and documented.
- All laboratory workers must have current WHMIS training.
- Updated SDSs (Safety Data Sheets) are available for all controlled/hazardous products.
- WHMIS and other safety labels are used as required.
- Workers (when required) are trained and certified in Transportation of Dangerous Goods.
- Accurate chemical and biohazardous material inventories are maintained.
- Chemicals and biohazardous materials are safely stored.
- Laboratory waste is disposed of properly.
- Equipment is maintained in safe operating condition.
- Laboratory workers are aware of the location of emergency equipment (eyewash, drench showers, fire extinguishers, etc.) in close proximity to their work area and receive adequate training on the use and maintenance of this emergency equipment.
- Workers are trained in emergency evacuation procedures for their work areas and building.
- All incidents/hazards/near misses are immediately reported to their supervisor and submitted to the Health, Safety and Environment Department or emailed to incident@upei.ca to ensure appropriate actions are taken to prevent a recurrence.
- Incident reports are completed and submitted to the UPEI Health, Safety and Environment Department in Kelley Memorial Building (third floor) immediately.
- All incidents will be investigated by the supervisor (in consultation with other UPEI stakeholders if necessary) to determine causes and identify reasonable corrective measures (temporary and permanent) to prevent recurrence.

Incident reporting kits are available electronically on the UPEI website by clicking on the following link: http://www.upei.ca/vpaf/ or in hard copy at each department administration desk or at the Health, Safety and Environment Department (Kelley Memorial Building, third floor).

Supervisors must make every reasonable effort to ensure workers are able to attend all relevant safety training/courses and are afforded the time to complete online WHMIS training program.

Supervisors may add site-specific safety rules to the laboratories under their responsibility.

2.3 Laboratory Workers Responsibilities

Laboratory workers are responsible for working safely by:

- Following the supervisor's directions, standard operating procedures (SOPs), and all relevant UPEI policies/guidelines.
- Seeking help before undertaking laboratory activities with which they are not fully familiar and which might pose a hazard to themselves or others.
- Conducting only activities authorized by the supervisor.
- Completing relevant safety training programs including WHMIS and site-specific safety training, as well as, Transportation of Dangerous Goods when required.
- Using the WHMIS training to consult SDS for safe handling, storage, use, disposal, spill clean-up, and first-aid procedures for all controlled and/or hazardous materials.
- Ensuring all controlled/hazardous products have appropriate WHMIS labels.
- Abiding by precautions outlined in this *Manual* to minimize the dangers posed by:
    - chemicals
    - compressed gases
    - pathogens and potentially infectious materials
    - high or low pressures
    - high voltage
    - extremes in temperature
    - sharps and broken glassware
    - radioisotopes or other sources of radiation (lasers, UV, etc)
- Working in such a way as to minimize both their own exposure and their coworkers' exposure to any hazardous materials or processes.
- Wearing PPE as directed by the work area supervisor and/or as written in an SOP.
- Only operating equipment that they have been trained to use, as designated by their supervisor and in accordance with SOPs, as applicable.
- Not using any piece of equipment that is not in safe working condition e.g. missing guards, interlocks, safety devices, or with frayed cords or worn switches.

- Immediately reporting incidents to their supervisor; and
- completing and submitting the UPEI Incident Report Form.

To Avoid Harming Yourself or Others:

- Warn co-workers about any unusual dangers associated with work you are doing.
- Adhere to the SOPs applicable to the laboratory you are working in.
- Do not wear personal protective equipment outside the laboratory.
- Avoid touching doorknobs, computers, telephones, and other common surfaces with contaminated gloves.
- Do not eat, drink, or store food in the laboratory.
- Tie back long hair, remove neck ties/scarves/long jewelry, and avoid loose clothing around mechanical equipment.
- Keep work space tidy.
- Clean up spills promptly, using approved procedures.
- Keep volumes of music low to enable workers to hear any sounds of trouble. The use of earbuds or headphones is strongly discouraged and may be prohibited in some laboratories based on hazards/risks.
- If working alone, follow working alone procedures as described in section 2.4.
- When leaving procedures unattended, follow appropriate guidelines as described in section 2.5 (Refer to **Appendix B**).
- Practice good hand hygiene at all times especially when leaving the laboratory.

2.4 Working Alone

Some laboratory procedures require long hours and it is often not possible to work a “9 to 5” schedule. Working alone can be dangerous and should only occur when all other reasonable options are not possible. Without someone around who is able to help, an incident that would ordinarily be fairly minor could be very serious.

If You Must Work Alone

Refer to the university *Working Alone Policy* to develop safe work procedures. This policy can be found on the UPEI Policy website: http://www.upei.ca/policy/.

2.5 Unattended Operations

Some laboratory procedures must run for extended periods and people may not always be present throughout the procedure; however, it is encouraged that unattended operations occur only as necessary. Most unattended procedures do not pose significant health or safety risks when carried out properly. However, in some cases, the failure of a control, the interruption of utilities, or a mechanical failure could cause damage. In serious cases, such a failure could endanger building occupants, custodians, service people, security officers, or other emergency responders.

Failures that could cause property damage, health, safety or environmental hazards include:

- Loss of cooling capacity resulting from interruption in supply of coolant or leakage in coolant lines.
- Interruption in supply of propane, electricity, compressed air, or other gas.
- Break in gas, water or other lines charged for the procedure.
- Failure of a stirrer, thermostat, level indicator, pump, motor, fume hood, biological safety cabinet, or other mechanical device.
- Failure of a flow regulator or temperature controller.

When planning an unattended operation, laboratory workers should carefully consider the possible implications of such failures. If deemed hazardous a protocol should then be developed that minimizes the likelihood and the consequences of a failure. Doors must be kept locked. The protocol must include the posting of a notice at the work station and on the lab doors indicating an unattended experiment is in progress and provides the following information:

- the nature of the experiment and the hazard(s),
- the services required for safe operation (e.g., water cooling, vacuum, heating),
- name and phone number of the emergency contact person,
- name and phone number of the supervisor or alternate contact; and
- the supervisor must complete a visual inspection of the set up (connections, etc.) to verify it is set up correctly prior to leaving it in operation and unattended.

For an example of a form to use for leaving experiments unattended, *Unattended Operations Notice*, refer to **Appendix B**.

2.6 Laboratory Inspections

Inspections are an important part of any laboratory safety program. Workers must continuously inspect their lab surroundings to ensure the safety of themselves and others. Laboratory supervisors must complete regular inspections and document the hazards/risks identified and their actions taken to reasonably protect people in their lab. This demonstrates their due diligence as required by OHS legislation.

Annual laboratory inspections will be scheduled and completed by a member of the appropriate local area health and safety working group (inspection lead) and a UPEI JOHSC member. The Primary Space Supervisor (or a competent designate) will be responsible to guide the inspection team throughout the work areas (e.g. laboratories) for their safety and to ensure appropriate corrective actions are taken (temporary/permanent) in a timely fashion to protect those within the

laboratory. The completed inspection form will be provided to the Primary Space Supervisor (or designate) of the laboratory for their corrective actions on hazards/risks identified by the inspection team. When reasonable corrective actions are implemented (or a plan of implementation is provided on the inspection form) the Primary Space Supervisor must date, sign and return it to the inspection team leader. The inspection leader will forward the completed inspection form to the Joint Occupational Health and Safety Committee for review and filing to comply with OHS legislation.

The purpose of an inspection is twofold. The inspection surveys the physical facility, as well as, the laboratory's work practices to identify situations that could lead to an incident or an injury. Having identified a problem, the inspection also includes a follow-up component that corrects the problem. Area supervisors for each department will be designated by Primary Space Supervisors (Chairs, Deans, Directors, etc.) as the liaison for the inspection team, to facilitate the timing of the inspection and follow-up actions that may be required.

Laboratory supervisors demonstrate their commitment to and support for laboratory safety by following up on the actions recommended in the inspection report. If the corrective actions are not reasonable or not implemented to the satisfaction of the local health and safety working group they will advise the JOHSC who will follow up with the Primary Space Supervisor. If the JOHSC is not satisfied with the Primary Space Supervisor's response then, a written recommendation will be sent to the employer (Senior Executive Team – Vice Presidents and President) seeking reasonable corrective actions to be provided in writing within 30 days as per OHS legislation. See JOHSC Recommendation to the Employer Form at: http://www.upei.ca/vpaf/ .

To assist those who wish to use an inspection form, the *Laboratory/Barn/S&R form for Laboratory Employees* can be found in **Appendix C**. An electronic version is available on the University Health and Safety website: http://www.upei.ca/vpaf/health-and-safety.

2.7 Laboratory Security

UPEI requires that supervisors and lab users control access to their laboratories to prevent accidental exposure to hazardous materials, processes and equipment by unauthorized individuals.

It is required that:

- No hazardous material is handled or equipment operated in any laboratory without the permission of the laboratory supervisor.
- All areas with hazardous materials and equipment are locked or otherwise secured at all times.
- UPEI have a biosecurity plan for containment level 2 labs.
- Supervisors and users of labs must be trained and follow the biosecurity plan to

safeguard the hazardous material from unauthorized access, theft and misuse.

- All biosecurity incidents must be immediately reported to the Biosafety Officer, documented on the UPEI Incident Report Form and submitted to the Health, Safety and Environment Department in person (Kelley Memorial Building, third floor) or electronically via incident@upei.ca. An investigation must be completed by the supervisor to determine reasonable corrective actions, dates of implementation, identification of the responsible person for action and submitted to the Health, Safety and Environment Department within 3 days. The incident reporting kits can be found on the UPEI website at: http://www.upei.ca/vpaf/ or at each department's reception area.

- All laboratories have a hazard placard on their lab door which identifies the hazards within, as well as, emergency contact information. These can be ordered through the Facilities Management work order system.

- Appropriate signage be used to indicate restricted access and identify where hazards exist (e.g., UV light, radiation, laser, biohazards, etc.).

2.8 Procurement Procedures

2.8.1 Purchasing Chemicals

Many hazardous and non-hazardous chemicals are routinely used at UPEI. In the past, there has been a tendency to purchase large quantities because of the decreased cost per unit. Upon project completion, excess quantities of chemicals are often stored for long periods of time. Sometimes these older chemicals are no longer fit for use. Labels may get worn or fall off. Some chemicals may become unstable or extremely reactive. When they are needed again, new lots must be ordered and the old stored chemical disposed of through an approved vendor. Before being disposed of, their presence may clutter limited spaces, detract from an overall safe environment, and increase the risk of incidents. Excess chemicals increase the labour required to maintain inventories and safety data sheets. Costs incurred as a result of these unneeded chemicals include analysis, storage, packaging, transport, and disposal.

Prior to purchasing chemicals supervisors and workers should:

- Conduct a risk assessment for any new chemical, to ensure that risks due to exposure are controlled (eliminated or at minimum reduced) to prevent harm. See **Appendix D** for *A Quick Guide to Risk Assessment for Hazardous Chemicals.*
- Anticipate upcoming needs and order chemicals and quantities accordingly.
- Borrow small quantities from another lab to test new procedures that may not be repeated. Check with your chemical inventory coordinator for further information.
- Substitute or eliminate hazardous materials with less hazardous or nonhazardous materials whenever it is possible to do so.

- Reduce the scale of experiments and protocols to the minimum size/quantity necessary to achieve research objectives.
- Be aware that import permits or external notifications may be required when ordering certain chemicals or biological materials.
- Have appropriate engineering, administrative and personal protective equipment (PPE) controls and spill cleanup measures in place to safely handle and work with each controlled product brought into the laboratory.
- Ensure that the controlled product has a place to be stored properly and safely (adequate space, temperature, compatibility, flammable liquid (or acid or base) cabinet, locked, etc. as necessary).
- Monitor the stability and condition of the controlled product (e.g. Picric acid needs to be stored wet; cannot have crystals forming).

For Further Reference

1. National Research Council (US) Committee on Prudent Practices in the Laboratory. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards: Updated Version. Washington (DC): National Academies Press (US); 2011. Available from: https://www.ncbi.nlm.nih.gov/books/NBK55878/

2. Frederick M. Garfield, Eugene Klesta, Jerry Hirsch. *Quality Assurance Principles for Analytical Laboratories*, 3rd Edition, 2000, Ch. 6, pp. 75–90.

2.8.2 Purchasing Biological Materials/Microorganisms

Prior to purchasing biological materials/microorganisms, ensure all applicable UPEI policies and regulations are followed. Prior to any purchasing of a Risk Group 2 pathogen the Biosafety Officer must be notified. An import permit may be necessary. Refer to the UPEI Biosafety Policy or the UPEI Biosafety Program Guide at: http://www.upei.ca/vpaf/

2.8.3 Purchasing Equipment

A UPEI Equipment Purchase Information Form must be completed prior to ordering equipment over $1000. The information will be used by Facilities Management to assess the intended location, electrical, plumbing, venting, heating, cooling, and structural requirements of the equipment before it is ordered. Facilities Management must approve the order before Procurement Services will order the equipment. This form is available through both departments.

2.9 Creating New or Altering Laboratory Space/Environment

Before a new laboratory space is created at UPEI in a previously non-lab space, it is important that the design be considered during the planning stages. This is also true for lab spaces that are being renovated or severely altered. Contact Facilities Management regarding the mechanical/structural aspects of a new or renovated lab space.

Consideration needs to be taken regarding the following safety items:

- **Hazard assessment** - Have all hazards been identified, assessed, and controlled? e.g. A biological lab may need to be decommissioned prior to renovations to make the space safe to work in.

- **Ventilation** - Is the room sufficiently ventilated for the determined use of that area? Is the equipment properly ventilated (e.g. animal handling space)?

- **Engineering controls** - What type of local exhaust ventilation system (e.g. fume hood) is needed, if any?

- **Storage of controlled products -** Will controlled products be properly stored/secured (e.g. are specific cabinets required for the controlled product e.g. acid or bases, flammable materials)? Are compressed cylinders secure and upright? Are controlled products stored in close proximity to other chemicals, doorways, emergency equipment, etc.?

- **Plumbing** - Is proper plumbing in place for the needs of this lab space?

- **Safety equipment -** Is a safety eyewash station and/or safety shower available for this lab space? Is a first aid kit needed? Are proper spill containment and cleanup supplies available? Are workers trained on how to use the emergency provisions?

- **Fire Safety** - Is an appropriate fire extinguisher(s) located in the lab or readily available? Do workers know how to use a fire extinguisher?

- **Signage** - Is proper signage in place e.g. exit signs, personal protective equipment requirements, hazard signs, placards, do not eat or drink in the lab, emergency contact name(s) and number(s) on the doors, emergency provision signage, etc.

- Notify facilities management regarding special needs and conditions within a lab (e.g. power outage, water shutdown, etc.)?

- **Documentation** - **A**re appropriate documents, resources, procedures, standards, regulations, SDS, manuals, etc. available in the lab?

- **Electrical, lighting, heating and cooling** - **I**s the electrical capacity appropriate? Is emergency lighting or backup power required for certain equipment (freezers, etc.)?

- **Proper surfaces -** Are counters, lab benches, chairs, stools, walls, flooring, etc., made of appropriate materials for your lab setting (e.g. cleanable, chemical and biological resistant)?

- **Containment** - Is the lab space designed so that processes take place safely within the space and will not adversely affect surrounding areas?

- **Room Occupancy** - Does the room size fit the air space (8.5 m^3 /employee) requirements of the PEI Occupational Health and Safety Regulations (Part 11, Ventilation) for the number of expected occupants?

Air flow to laboratories is generally balanced to maintain a negative pressure to the lab. This is intended to prevent movement of air from laboratories to corridors and other building areas. It is important that windows and doors to laboratories are kept closed so that this negative pressure is maintained, and that the flow of air from the lab occurs through the proper exhaust system.

The NFPA 45 Standard states in Section 9.2.1.1 "Chemicals shall not be brought into a laboratory work area unless design, construction, and fire protection of receiving and storage facilities are commensurate with the quantities and hazards of chemicals involved". (REFERENCE: *NFPA 45 Standards*, Section 9.2.1.1)

2.10 Vacating Laboratory Spaces at UPEI

A decommissioning process must occur when faculty, workers, graduate, and/or research students are planning to vacate their laboratory at UPEI for any reason.

The purpose is to ensure that hazardous chemicals (including all solutions and synthesized products), radioactive materials, infectious and biological agents, gas cylinders, and laboratory equipment are either safely disposed of, decontaminated, removed from campus, or assigned to a responsible person, who will be subsequently responsible for their safe handling, storage, use, and/or disposal.

The person leaving is required to:

- Make an inventory list of the chemicals, radioactive materials, infectious agents, gas cylinders, and equipment for which he/she is responsible.

- Meet with his/her Supervisor or Chair to decide which items will be disposed of, removed from UPEI, and which will become the responsibility of another faculty, worker, or graduate student.

- Make the appropriate arrangements together with his/her Supervisor and/or Chair.

- Fill out a *Vacating a Lab Form for Laboratory Employee* (see **Appendix E**) and/or the *Containment Level 2 Laboratory Decommissioning Checklist* (see **Appendix F**) and submit to your departmental Chair. These forms can be found at: http://www.upei.ca/vpaf/

2.11 Fieldwork

2.11.1 Introduction

As an institution of scholarship and research, faculty, workers, and students will engage in field-related teaching and research activities outside the conventional laboratory setting. These activities for the most part occur outside the physical boundaries of the University, and in many cases outside the province or country. UPEI encourages and supports such activities and takes every reasonable precaution to protect the personal health and safety of its participating members.

2.11.2 General Field Safety Guidelines

Fieldwork covers a range of activities that can occur outdoors. These activities may be terrestrial, aquatic, or marine-based. The risks associated with these may include transportation of related items, physical and environmental hazards, animals and pests, and diseases. There are also special licenses, certified training requirements, insurance issues, as well as government and institutional regulations which must be considered when working in the field. One of the most important aspects when contemplating fieldwork is the planning and preparation for the fieldwork itself, to ensure a safe trip. A written plan shall be prepared and left with a responsible contact in your home department. The plan must include information on the general nature of your activities and an itinerary with locations, arrival and departure times, and the names of all the fieldwork participants. You should also learn about potentially hazardous plants, animals, terrain, and weather conditions and prepare a hazard and risk assessment of your proposed activity, particularly if it is a new activity or in an unfamiliar location.

Whenever possible, fieldwork activities should be performed in teams of a least two people. Solitary fieldwork should be strongly discouraged, particularly when it involves remote or hazardous locations, high-risk activities, or unusual conditions. Refer to the university *Working Alone Policy* on the UPEI website: http://www.upei.ca/policy/.

The participants should be in a satisfactory state of fitness, and any health issues including allergies should be acknowledged with appropriate mitigation measures put in place.

General safety provisions may include:

- First aid kit (including someone trained in First Aid/CPR/AED)
- Insect repellent and allergy treatments (if you have allergies)
- Sun screen, hat and water
- Vehicle emergency kit
- Flashlight
- Flares
- Cell phone or two-way radio
- Gloves, warm hat, dry clothes (wintertime)
- Matches or a lighter
- PPE for fieldwork activities (glasses/goggles, gloves, sturdy boots, etc.)

Transportation

Transportation safety relates to the movement of participants to/from and within field sites. University motor vehicle operation is governed by the *University Vehicle Use Policy* which can be found at*: http://www.upei.ca/policy/*. Operators must have the appropriate license (class IV for a 15- passenger vehicle) and a *Driver's Approval Form* on file with the Comptroller's Office. Operators are solely responsible for the safe operation of the vehicle they are driving. Trailers towed by vehicles are also the responsibility of the operator and this includes ensuring that they are safe to use (tires properly inflated, load secured, lights operational, and safety chains secured) and that they have a safety inspection sticker (this applies to PEI; other jurisdictions may have different regulations). Operators who transport dangerous goods must also ensure that they comply and are certified with TDG training.

Boats and Watercraft

Fieldwork may involve the use of boats and other types of watercraft such as canoes. Water safety is particularly important as conditions can be unpredictable and unforgiving. All operators of watercraft must comply with the safety regulations from the Office of Boating Safety at Transport Canada**,** including acquisition of a Pleasure Craft Operators Card. See Transport Canada for details (website: http://www.tc.gc.ca/eng/marinesafety/debs-obs-menu-1362.htm). It is also important to check with **Environment Canada** for up-to-date weather forecasts and current marine conditions. A properly fitted Personal Floatation Device (PFD) must be worn when using boats, canoes, and other watercraft. PFD's can be removed when preparing to dive or complete other underwater activities for fieldwork.

Physical Demands

Physical demands could include the following activities:

- Manual lifting, carrying, or handling of heavy loads
- Climbing (cliffs, trees, etc.)
- Extreme cold or heat
- Unstable footing
- High altitude
- Diving and other underwater activities

Most of the above activities require special training and in some cases certification. There are specially designed safety equipment and procedures to reduce risks and in the case of diving, the **UPEI SCUBA Diving Safety Manual** (found at: http://www.upei.ca/research/) must be consulted. The fitness of the individuals should always be considered when undertaking any activity with extraordinary physical demands.

Physical Hazards

Physical hazards could include the following:

- Dehydration
- Sunburn

- Heat exhaustion/heat stroke
- Frostbite
- Hypothermia
- Drowning
- Poisonous plants (poison ivy)
- Hunting season (be aware of the seasons)
- Health risks associated with underwater diving

Animals, Pests, Diseases, and Other Biohazards

UPEI's Biosafety Policy can be found at: http://www.upei.ca/vpaf/. Dangerous wild animal encounters may not be a significant problem on PEI. However, appropriate safeguards should be in place when live-trapping both small (rodents) and large mammals (coyotes). Offsite visits by AVC employees may place individuals in situations where safety could be compromised. Appropriate safety procedures must be practiced, including ensuring that students and workers follow the *UPEI Working Alone Policy*.

Local pests can present some problems. Mosquitos are a vector for West Nile Virus, the range of West Nile Virus is very limited in Canada but it is common in other countries *(use insect repellant)*. Fleas and ticks can carry diseases, including Lyme disease *(wear clothing of tightly woven material and pull socks over pants legs)*. Bee and wasp stings can be lethal for those individuals with severe allergies *(carry an epi-pen or antihistamine)*. Deer mice, red-backed vole and white-footed mice are potential hosts of Hanta Virus. Their feces, urine, or saliva can be vectors for Hanta Virus *(keep areas clean to avoid attracting rodents, wear a respirator and gloves if you are handling wild rodents or their feces)*. Hanta Virus is very rare in Canada. Some common Canadian examples of zoonoses are: salmonella (frequently transmitted by bird contact) and Giardia (aka beaver fever which can be transmitted via contaminated water). Maintaining high standards of hygiene and cleanliness will reduce the potential for worker illness when working in the field.

Canadian and International Fieldwork

Travel and fieldwork outside the province and country adds a whole new dimension for safety and minimizing risks. In some countries there is little or no provision for occupational health and safety. Insurance coverage varies and access to health care is not guaranteed. Regulations and certification standards for many types of fieldwork activities should be researched before traveling abroad to ensure compliance. The environmental and climatic conditions can be very different. Extremes in temperatures, unfamiliar dangerous animals, poisonous plants, pests, and diseases can pose a serious threat to the health and safety of individuals. All participants must be properly immunized. Water quality can be a serious problem. Political unrest and crime can seriously compromise personnel safety. Before any international fieldwork is carried out, the Federal Department of Foreign Affairs should be consulted and the Canadian Embassy in the host country contacted. Human Resources Department should also be contacted regarding group insurance implications.

2.12 Visitors in Laboratories

The Invitee Access Agreement forms must be completed by visitors who will engage in work in the laboratory. The forms can be found at: http://www.upei.ca/finance/comptroller/comptroller-forms**.**

2.12.1 Purpose

UPEI is a fascinating environment for visitors/minors (persons under the age of full legal responsibility or with a learning disability that prevents them from understanding the hazards/risks associated with the laboratory setting persons under 16 years of age), but it also can be a dangerous one.

Teaching and research laboratories often use hazardous materials and are equipped with sensitive, expensive, and sometimes dangerous equipment. Visitors/minors in laboratories may inadvertently be exposed to biohazardous waste, dangerous chemical substances, and ionizing radiation, or be injured by or damage laboratory equipment.

Animals presented to the Veterinary Teaching Hospital (VTH) may have zoonotic disease and may be dangerous to individuals untrained in their restraint. Heavy equipment used to manage large animals may pose physical risk to those in the immediate vicinity. Visitors/minors present in the VTH are most vulnerable to these risks. Visitors/minors in the VTH may also inadvertently compromise patient care and the learning experience by directing the attention of students, workers, and clinicians away from the patient.

2.12.2 Procedure

With the exception of special events such as guided tours and open houses, where preparations will include eliminating or at minimum reducing the hazards that could harm visitors/minors (persons under the age of full legal responsibility or with a learning disability that prevents them from understanding the hazards/risks associated with the laboratory setting), the expectation is that:

- Visitors/minors are not permitted in UPEI laboratories unless accompanied by a UPEI employee or a competent student (that is approved to guide visitors by the Dean (or designate)). A reference AVC policy can be found at: https://portal.upei.ca/facultystaff/administrativeservices/avc_dean/Pages/default.aspx .

- Visitors/minors are prohibited in areas of UPEI buildings posted with a radiation hazard symbol, including areas in the AVC, Physics, Biology, Chemistry, and Sustainable Design Engineering unless approved by the applicable Dean (or designate) and accompanied by a competent UPEI employee/student.

- Minors are not permitted to attend clinical rotations in the VTH.

- Special areas of concern would include areas such as biosafety level 2 laboratories.

2.13 Health Concerns

It is the responsibility of individuals who are pregnant or who have health issues/concerns, such as allergies, sensitivities, respiratory problems, immune deficiencies, injuries, or other illnesses, to contact their physician and to notify their supervisor. UPEI has a medical surveillance plan/policy that can be accessed if applicable. The policy can be found at: http://www.upei.ca/policy/.

The university is a scent free environment. Please refer to the UPEI *Scent-Free Initiative* policy that can be found at: http://www.upei.ca/policy/

2.14 Service animals

UPEI recognizes the value Service Animals have to improve the quality of life, independence and access for persons with disabilities. The university will do everything reasonable to ensure the health and safety of anyone that works, studies or visits campus including accommodating persons who utilize Service Animals (Partner). Each situation will be unique and will require collaboration of all necessary campus community stakeholders to create a plan that ensures the safety of all involved. This evaluation will include a review of all applicable legislation and by-laws related to persons that utilize Service Animals. Service Animals will not be permitted in any area where legislation or by-laws (Federal, Provincial or Municipal) prohibit animals in specific areas (e.g. food preparation or processing areas).

For more information please refer to the UPEI *Service Animal Policy* that can be found at: http://www.upei.ca/policy/ .

Specific arrangements will have to be determined and implemented prior to allowing Service Animals to enter laboratories. In some laboratories Service Animals will be prohibited due to the inherent hazards/risks within the space that could cause harm to the Service Animal or could increase the potential for cross contamination or migration of contaminants/infectious organisms to other areas of the university. The Laboratory Supervisor, in consultation with the Health, Safety and Environment Department, will complete an initial assessment of the laboratory to identify any actual and potential hazards/risks with the intent to outline recommendations for accommodating the Service Animal. Any expenses, as outlined in the recommendations, may be the responsibility of the Partner (e.g. protective equipment for the Service Animal: drop sheets for the floor, dog booties, etc.). Once the recommendations are reviewed and reasonable accommodation actions that must be implemented are agreed upon by all appropriate stakeholders to eliminate or at minimum reduce the identified hazards/risks, then the Partner will make the final decision on if they want to expose their Service Animal to the outlined hazards/risks. There will always be the potential for the Service Animal to be exposed to inherent lab hazards/risks (e.g. contact with chemicals through ingestion, absorption, inhalation, etc.) that will have to be considered by the Partner when making their final decision.

Costs, including clean-up costs, legal costs, and damages arising from civil liability claims due to non-compliance with UPEI's policies, guidelines and procedures, shall be the Partner's responsibility. The liability for any harm to the Service Animal will not be the responsibility of

UPEI or its affiliates, students, etc.

2.15 Barns/Animal Holding Facilities

The following link includes all applicable policies and procedures established by the Atlantic Veterinary College and is accessible to all applicable staff, faculty and students.
https://portal.upei.ca/facultystaff/administrativeservices/avc_dean/Pages/default.aspx

Some specific topics covered include:

1. Infection control protocol
2. Cleaning and disinfection protocol of large animal barns/stalls
3. Appropriate clothing to be worn in specific areas
4. Visitation of minors in the AVC
5. Immunizations for workers
6. Hazardous waste disposal

There are two aquatic vivaria not operated by the AVC: Memorial Hall Aquatic Animal Facility and the Duffy Aquatic Animal Facility. The supervisors of these areas must ensure the appropriate policies and procedures are established and all applicable workers are competent to ensure their health and safety.

Research and teaching vivaria (e.g. CAF, NAAF, AAF A and B) supervisors must ensure the necessary policies and procedures are in place and everyone that works in these areas are competent to ensure their health and safety.

3. CHEMICAL SAFETY

3.1 Chemical Hazards

3.1.1 Chemical Hazard Awareness

Chemicals routinely used in laboratories at UPEI include organic solvents, acids and bases, dangerously reactive compounds, toxins, and compressed gases. These are all controlled products that fall into two hazard groups (Physical and Health Hazards) and each hazard group consists of hazard classes (based on specific hazard properties) under WHMIS 2015. Each hazard class has at least 1 Category. Category 1 is always the greatest level of hazard in that class and Category 2 within the same hazard class is more hazardous than category 3, and so on.

Below is a list of some of the hazard classes in the Physical and Health Hazard Groups.

Physical Hazards	Health Hazards
• Flammable gases • Flammable aerosols • Oxidizing gases • Gases under pressure • Flammable liquids • Flammable solids • Self-reactive substances and mixtures • Pyrophoric liquids • Pyrophoric solids • Self-heating substances and mixtures • Substances and mixtures which, in contact with water, emit flammable gases • Oxidizing liquids • Oxidizing solids • Organic peroxides • Corrosive to metals • Combustible dusts • Simple asphyxiates • Pyrophoric gases • Physical hazards not otherwise classified	• Acute toxicity • Skin corrosion/irritation • Serious eye damage/eye irritation • Respiratory or skin sensitization • Germ cell mutagenicity • Carcinogenicity • Reproductive toxicity • Specific target organ toxicity – single exposure • Specific target organ toxicity – repeated exposure • Aspiration hazard • Biohazardous infectious materials • Health hazards not otherwise classified

Before using any of these products, workers are required to:

- Complete WHMIS training (available online. For access instructions see the UPEI Health, Safety and Environment website: http://www.upei.ca/vpaf/health-and-safety).

- Read SDS documents to learn safe handling, storage, disposal, spill, and first aid procedures.
- Use the appropriate personal protective equipment.
- Ensure that all products have WHMIS labels
- Complete site-specific WHMIS safety training

Some of these chemicals have serious health effects. As an example, many are *Known, Probable and Potential Carcinogenic Chemicals* (see **Appendix G** for a partial listing).

Before purchasing a new chemical, see **Appendix D** - *Quick Guide to Risk Assessment for Hazardous Chemicals*.

3.1.2 Standard Operating Procedures

Standard operating procedures (SOPs) are required for working with all hazardous chemicals. In order to help supervisors implement the safety requirements of the UPEI Health, Safety and Environment Policy, certain generic SOPs are made available for the University community through the UPEI Website: http://www.upei.ca/ or http://www.upei.ca/vpaf/health-and-safety. If you type any of the names below into the search field you will be directed to the applicable SOP.

Seven Laboratory Safety SOPs are available:

1.	Acids and Caustics	SOPS5.101.01
2.	Organic Solvents (Non-Halogenated)	SOPS5.102.01
3.	Halogenated Solvents	SOPS5.103.01
4.	Toxic Compounds	SOPS5.104.01
5.	Reactive Compounds	SOPS5.105.01
6.	Documenting Safety Training Records	SOP2.10201
7.	Site Specific Training with LS-SOPs	SOP2.10301

Since Laboratory Supervisors are required “to provide workers with written SOPs for all hazardous processes”, these SOPs are designed to help Laboratory Supervisors meet this requirement.

Laboratory Supervisors are also required “to document that laboratory workers have been educated in relevant safety issues”. The following SOPs (can be found on the UPEI website by simply typing in the names in the search field) to assist with documenting this training:

- Documenting Safety Training at UPEI - SOP2.102
- Site-Specific Training with UPEI’s Laboratory Safety SOPs - SOP2.103
- CL2 Lab orientation; Biosafety Program Guide

Recommendations for establishing new Laboratory Safety SOPs can be made by contacting the UPEI Joint Occupational Health and Safety Committee.

NOTE: These SOPs are meant to compliment, but not to replace other classes of SOP's which are required in laboratories (such as those related to specific equipment and procedures) and which must also contain relevant safety information and/or references.

3.2 Chemical Inventory

To comply with provincial legislation and to aid the fire department and other emergency responders, laboratory supervisors and managers of units within the University must maintain current inventories of their respective chemicals. The inventory update procedure for each area or department will be part of site-specific safety training. UPEI Security Services is responsible for ensuring that the total inventory for each area is available as required by emergency responders and others who may need this information.

Chemical Inventory Maintenance Requires that:

- Laboratory Supervisors and managers of support units/departments that use chemicals shall create and maintain up-to-date inventories of chemicals present in their laboratories or work areas. The inventory should contain:
  - the name of the chemical
  - container size
  - room number
  - storage location (e.g., cupboard, freezer)
  - hazard assessment

- The inventory shall be readily available to lab users who work with or in the vicinity of the chemicals

3.3 Storage of Chemicals within the Laboratory

The way in which chemicals are stored can have a major impact on laboratory safety.

Storage of chemicals and chemical wastes in UPEI laboratories is guided by the National Fire Code of Canada and the National Fire Protection Association (NFPA):

a) *Flammable and Combustible Liquids Code 30,* ANSI and NFPA https://www.ansi.org/

b) *NFPA Standard 45 — Fire Protection for Laboratories Using Chemicals*
www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp

3.3.1 General Storage Procedures

When not in actual use, chemicals in UPEI laboratories shall be stored according to the following procedure:

- Upon receipt, chemicals shall be entered into the laboratory chemical inventory. It is good practice to label all chemicals with both the date of receipt and the

owner’s name or initials. For chemicals that degrade over time, the date of opening should be noted on the label.

- Chemicals should be purchased in safety-coated bottles when possible.
- Chemicals should be stored in the supplier's original container or in a container that provides adequate protection for the contents.
- Chemicals may be stored in ground glass stoppered containers only when the stopper does not create a hazard.
- Chemicals shall be stored in containers bearing a WHMIS label showing the chemical name, safe handling instructions, and reference to the SDS.
- Chemicals shall be stored securely, in the minimum practical quantities, away from entrances and protected from exposure to excessive heat, cold, or damage.
- Shelving systems should be anchored to walls to increase stability and prevent them from toppling over.
- It is not recommended that chemicals be stored on the floor (with the exception of large containers such as drums: secondary spill containment must be considered to prevent releases to the environment) or on shelves higher than shoulder height. Shelving should not have an open back or sides which could allow the chemical to fall off the shelf.
- Chemicals should be stored away from incompatible items (e.g. store acids and bases separately to avoid dangerous reactions).
- The SDS of all hazardous chemicals must be readily available and reviewed to ensure compatibility with other chemicals, proper storage information, and much more health and safety information for the protection of those that may be exposed to the chemical.
- Synthesized products also require proper labeling and storage. A record of products must be included in the chemical inventory.
- Adequate spill kits (and trained responders) must be readily available in the event of a release/spill.

3.3.2 Containers

Most laboratories store their chemicals in the supplier/manufacturer containers. These containers are usually acceptable for storing chemicals in UPEI laboratories. Solvents must be stored only in glass containers with no greater than 5 L due to their flammability and toxicity. Diethyl ether must be only stored in glass containers, preferably with a volume of 1 L due to its extreme

flammability and ability to form explosive peroxides. If the laboratory must store a larger volume of a solvent, it must be stored in an approved safety can with a capacity no greater than 25 L.

It is important to carefully choose containers for stock solutions and reagent preparations. Many laboratories use plastic containers. When there are concerns about leaching contaminants from plastic containers, glass containers are probably better choices. Although less popular today than in the past, some laboratories still use ground glass stoppered containers, e.g. peroxides. However, some chemicals, such as concentrated sodium hydroxide, attack the glass and may "freeze" stoppers.

There are several instances in which ground glass stoppered containers are dangerous. Ground glass can catalyze the violent decomposition of some reactive chemicals. Other chemicals, such as some perchlorates, many peroxides, and picric acid, can be detonated by the friction of removing the stopper.

Picric acid, when stored, may dry out and develop crystals. Removing the cover or agitating the container could detonate the acid and cause very serious injuries. Laboratory workers and students working with such dangerous chemicals should always check the SDS before beginning work.

3.3.3 Solvents, Flammable, and Combustible Liquids

The National Building Code of Canada (www.nationalcodes.nrc.gc.ca/eng/nbc/index.html) classifies liquids according to their fire hazards:

Flammable liquids - liquids with flash points below 37.8 °C and which have vapour pressures less than 275.8 kPa

Combustible liquids - liquids with flash points greater than 37.8 °C but, less than 93.3°C.

See **Appendices H and I** for a listing of various flammable liquids, solids, and gases. See **Appendix H** for *Fire Properties of Some Common Laboratory Liquids and Volatile Solids*.

Solvents

Solvents (including non-combustible, largely halogenated solvents) present serious fire and toxicity hazards. Although many factors influence the extent of the hazard, quantity is an important one. In recognition of the risk that solvents present, UPEI will follow the standards (national building/fire codes) that limit solvent container sizes and volumes of solvents. Container sizes or volumes in excess of these limits must be stored in approved solvent storage rooms.

Refluxing, and particularly refluxing over reactive materials (solvent stills), shall not be used for the ongoing preparation of solvents. When solvent preparation is an ongoing requirement to complete lab work then, a commercial low-temperature unit shall be used.

Solvents in laboratories shall be stored in:

- Approved safety cans, or in the supplier's original container or equivalent.
- Maximum solvent container sizes: glass — 5L, safety can — 25L (with the exception of diethyl ether that is not inhibited to reduce chances of peroxide formation, which should not be stored in containers exceeding 1L capacity).
- No quantities above the following:

Total Solvent Volume (L. per sq. m. of lab area) (Source: National Building Code of Canada)	
Excluding quantities in safety cans or safety cabinets	Including quantities in safety cans or safety cabinets
0.8	2.5

The following table lists commonly used flammable and toxic solvents to which storage limitations apply. Specialty solvents with low flash points must also be kept in limited quantities. Consult the chemical SDS.

Ethers:	Diethyl ether, Tetrahydrofuran, 1,2-Dimethoxyethane, p-Dioxane
Aliphatic Hydrocarbons:	Pentanes, Hexanes, Petroleum ether, Ligroin, Cyclopentane, Cyclohexane
Aromatic Hydrocarbons:	Benzene, Toluene, Xylene
Ketones:	Acetone, Methyl ethyl ketone
Alcohols:	Methanol, Ethanol, Propanols, Butanols
Esters:	Ethyl acetate, Butyl acetates, Amyl acetates
Chlorinated Solvents:	Carbon tetrachloride, Chloroform, 1,2-Dichloroethane, Methylenechloride, Tetrachloroethylene, 1,1,1-Trichlorethane
Other Solvents:	Pyridine

Flammable and Combustible Liquids

Many laboratories use flammable and combustible liquids as reagents rather than solvents. Although these materials are generally used and stored in relatively small volumes, they nevertheless present a fire risk.

Storage of flammable liquids at a reduced temperature poses some special hazards. Ordinary household refrigerators contain thermostats, lamps, and other electric components that are potential sources of sparks. These electrical connections are a serious hazard if flammable solvents are present particularly in the event of a power failure. Cooling a flammable liquid in a refrigerator or freezer reduces the vapour pressure sometimes to the point where the flash point is

below the temperature in the unit. Under such conditions, a spark would not ignite the vapours. However, if the power fails, the temperature in the unit will rise as will the flammable vapour levels. For many common flammable liquids, vapour concentrations in the fridge could climb, reaching the lower flammable limit. When the power is restored and the unit restarts, a spark could easily cause an explosion.

Flammable chemicals may not be stored in a refrigerator or freezer unless the unit was manufactured for flammable chemical storage or has been appropriately modified to eliminate possible solvent vapour ignition. Refrigerators and freezers that are used to store flammable liquids must carry signage indicating that flammable liquids are present.

Workers and students should understand that even water-based solutions of flammable liquids can still have flash points below room temperature. For example, 24 °C (75 °F) is the flash point of a 50 per cent solution of ethyl alcohol in water. Thus a 50 per cent solution still meets the flammable liquid criteria and may only be stored in refrigerators or freezers designed for storing flammable liquids.

Flammable and combustible liquid reagents shall be stored with regard for their flammability, reactivity, and toxicological properties.

3.3.4 Separation of Incompatible Chemicals

Storing incompatible chemicals separately is an important means of avoiding inadvertent contact between them.

Generally, chemicals are grouped into the following incompatibility classes:

- acids and bases
- solvents
- dangerously reactive chemicals
- oxidizers
- toxins
- other reagents

NOTE: nitric acid must be stored on its own, away from other acids.

Professional judgement must be exercised in devising a storage system that properly separates incompatible chemicals in any particular laboratory, but, in general, chemicals in each of these incompatible classes should be stored separately. See **Appendix J** for a listing of some incompatible chemicals.

Acids and Bases

- Store acids and bases separately and away from other chemicals.
- Nitric acid must be stored away from other acids.
- Provide a secondary means to contain a liquid spill.

- Exercise care when removing acids or bases or returning them to storage as mixing of acids and bases can generate significant heat.

- Store acetic acid and formic acid as flammable liquids rather than as acids.

- Store perchloric acid as an oxidizer rather than as an acid.

Solvents

- Follow guidelines such as the National Building Code of Canada regarding container size and laboratory volume limit.

- Store solvents where possible in a flammable liquid cabinet.

- Provide a secondary means of containment to control a liquid spill, if solvents are stored outside of a flammable liquid cabinet.

- Protect solvents from exposure to flames or other sources of heat.

- Refrigerators or freezers storing solvents must be designed for storage of flammable liquids.

Dangerously Reactive Chemicals

- Store reactive chemicals, with regard to their reactive properties, well apart (definitive distance e.g. 20 feet) from incompatible chemicals. See **Appendix J** for a listing of *Some Incompatible Chemical Combinations.*

- Do regular peroxide testing on ether and other peroxide forming materials. See **Appendix K** for a list of some *Peroxide-Forming Chemicals* and a *Test for Peroxides in Ethers.*

Oxidizers

- Store oxidizers separately from combustible materials and particularly from reducing agents.

Toxic Materials

- Store toxic chemicals in a secure location.

3.4 Compressed Gas Safety

Compressed gas cylinders are used in laboratories across campus. Because they are so common, it is easy to forget that they pose a hazard. Gas cylinders present several hazards, including

asphyxiation by displacing breathable air, sudden decompression resulting in a cylinder being propelled across a laboratory, and mechanical injuries.

A full-sized cylinder can be pressurized to 2,500 pounds per square inch, which is a lot of potential energy just waiting to be released. A broken valve on a fully charged cylinder can produce a rocket (or a pin-wheel motion) or shrapnel that can do a great deal of damage or result in a serious injury**.**

It is also easy to lose sight of the fact that there is a lot of gas in a cylinder. A leak in a small, poorly ventilated room or an elevator car can easily create an explosive or toxic atmosphere. Even if the cylinder contains non-toxic nitrogen or helium, a leak in a small room could reduce the oxygen levels to less than that required to support life.

Compressed gases such as fluorine, hydrogen fluoride, and nickel tetracarbonyl are sufficiently toxic or reactive that they, along with similar gases, need to be used very carefully. Some gases, including acetylene and hydrogen, are explosive. To prevent an accident, flow limiting valves (with some very toxic gases) and flash back arrestors must be used when performing hot work with flammable gases (e.g. torches that use acetylene and oxygen). More information on these devices is available from the Health and Safety Manager or your supplier of compressed gases.

See **Appendix L** for *Hazards of Common Laboratory Gases Obtained in High Pressure Cylinders* and **Appendix I** for *Fire Properties of Some Common Laboratory Gases*.

To avoid compressed gas accidents:

- Move a cylinder by securing it to a transport cart designed for that purpose. Ensure that the regulator is removed and the valve cap is in place.
- Secure all cylinders to a bench or a wall using an insulated chain or non-conductive belt in the upright position before removing the cylinder cap.
- Store and use cylinders in a well-ventilated area away from exposure to strong sunlight or other sources of heat.
- Check SDSs to ensure that incompatible compressed gases are not being stored together.
- Only use an approved regulator designed for the specific gas. To be sure, check that the cylinder's CGA (Compressed Gas Association) designation matches the regulator's CGA#. If you have any doubts, contact the supplier. See **Appendix M** for *Compressed Gas Association Fitting Designations*.
- Treat all cylinders as if they were full.
- Minimize quantities of cylinders required.

- Never allow a cylinder to fall or bang against another cylinder.
- Never use grease or oil on a regulator or valve.
- Never transfer gases between cylinders.

3.5 Cryogenic Liquids and Dry Ice

The very cold cryogenic liquids (liquid nitrogen, liquid oxygen, and liquid helium), as well as dry ice (solid carbon dioxide), can all do immediate damage to exposed skin on contact. People who work with these materials, regardless of volume, need to be continually aware of the potential for an incident. They need to follow proper procedures when handling these chemicals, particularly the liquids, and wear the appropriate protective equipment, e.g. cryogen gloves, face shields, etc. Appropriate containers must be used to store and transport these substances. Storage areas must be well-ventilated.

Cryogenic liquids and dry ice present several other hazards. Evapouration of these materials can release very large volumes of gas. In closed containers, there is the potential for pressurization and, possibly, explosion. Although none of these gases are toxic, in confined spaces there is potential for changes in atmospheric composition. “Inert” nitrogen, helium, and carbon dioxide can all displace oxygen to produce an atmosphere in which the oxygen component is less than 21 per cent at sea level. Oxygen level below 19.5% (minimum safe breathing level) is deemed oxygen deficient (effects human body functions e.g. 16% impairs judgement and breathing, 14% faulty judgement increased fatigue and 6% difficulty breathing and death in minutes) and oxygen levels above 23% are deemed oxygen enriched (Extreme fire hazard). ***An individual inadvertently entering a confined, unventilated room, where there has been a leak of only a few liters of one of these inert cryogenic gases, could lose consciousness almost immediately. Without immediate assistance, death is possible.***

3.5.1 Unique Hazards of Liquid Oxygen

Liquid oxygen, which often appears pale blue, presents a particular hazard. Evapouration enriches rather than depletes the oxygen content of the air in the room. Enriched oxygen atmospheres (above 23% oxygen) can create an extreme fire hazard. Similar situations could develop if oxygen were to leak into a confined space from a compressed gas cylinder. Liquid oxygen is, of course, a very powerful oxidizer. Contact between liquid oxygen and easily oxidizable materials can result in a violent explosion. Use of liquid nitrogen and liquid helium can result in the formation of liquid oxygen through condensation from air. This can create a high risk of fire and/or explosion. ***Care and caution cannot be stressed enough.***

3.6 Moving Chemicals, Compressed Gases, and Toxic Materials

3.6.1 Between and Within UPEI Buildings

Laboratory workers shall not transport chemicals, compressed gases, toxic, or infectious materials between and within UPEI buildings without having current WHMIS training and

follow all appropriate training on applicable UPEI procedures.

Care is needed to prevent incidents while transporting chemicals, compressed gases, and toxic materials within a building, and particularly through public areas of UPEI buildings. Exercise extreme care if you use an elevator. Because elevators are so confined, a spill or leak of a chemical or other substance could result in a severe exposure. In addition, a liquid spill could contaminate the entire elevator shaft. Workers must adhere to established procedures when transporting hazardous materials covered under specific policies (e.g. liquid nitrogen, compressed cylinders, etc.)

To move chemicals safely in UPEI buildings:

- Use a cart to move chemicals in containers larger than can be carried easily in one hand.
- Move liquids in a leak-proof secondary container.
- Move inorganic acids and other corrosive liquids in “rubber buckets”.
- Moving chemicals as received in the supplier's original shipping package is permitted.
- Be careful using elevators or stairs to move chemicals.

To move compressed gases safely in UPEI buildings:

- Move a cylinder by securing it to a cart designed for that purpose. Ensure that the regulator is removed and the valve cap is in place.
- Never ride with a cylinder in an elevator or enter an elevator which currently has a cylinder in transport.

To move infectious materials safely in UPEI buildings:

- Refer to the *Health Canada Laboratory Biosafety Guidelines*, 3rd edition, 2004 (www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index.html)

3.7 Hazardous waste

Policy

UPEI is committed to dealing with hazardous laboratory waste in a fashion that does not endanger the health and safety of the individual and complies with all environmental protection legislation. A condensed version of the lab waste management information is available in a flowchart see **Appendix N.**

Laboratory waste can include the following categories:

1. General lab waste (non-hazardous)
2. Biohazardous waste
3. Biomedical waste (VTH, Animal Resources and AVC Junior Surgery ONLY)
4. Metal sharps
5. Glass and broken glass
6. Hazardous chemicals and containers for external disposal
7. Other waste (radioactive waste, non-biohazardous anatomical waste, mixed waste, toxins, batteries)

3.7.1 General Lab Waste (non-hazardous)

All general lab waste is to be placed in an **ORANGE** bag. General lab waste is all waste generated by a lab EXCEPT waste covered in the other categories. It includes waste potentially contaminated with low level, non-hazardous trace amounts of chemicals from paper towels, disposable pipettes, plastic bottles, gloves, masks, etc. and uncontaminated material.

3.7.2 Biohazardous Waste

All biohazardous waste must be disposed of as determined by the local risk assessment for each approved biosafety permit. This waste must be handled in such a way as to minimize the risk of infection and to prevent contamination of the environment. This waste may be autoclaved, incinerated (on site or through a 3rd party service provider), or chemically decontaminated. Biohazardous waste includes contaminated sharps containers (glass/metal) and other waste from labs (contaminated paper towel, bench covers, disposable test tubes, media/plates, cell and microbial cultures, etc.). All material for autoclaving must be safely stored until transported to the appropriate autoclave facility (AVC Central Services and Duffy Science Centre).

3.7.2.1 Solid Biohazardous Waste

Solid biohazardous waste shall be disposed of by placing in **RED** biohazard bags or sharps containers labeled with the Biohazard symbol. These will be autoclaved or incinerated to render the waste non-infectious and non-contaminating. ***Note***: all bleached biohazardous materials must vent for at least 24 hours prior to autoclaving to ensure that the bleach has dissipated. Once the **RED** bag has been processed the autoclave staff will place the red bag inside an **ORANGE** bag which will be treated as General Lab Waste. Autoclaved metal sharps containers will be disposed of as metal waste. Autoclaved glass sharps will be treated as uncontaminated glass waste.

3.7.2.2 ***Liquid Biohazardous Waste***

Liquid biohazardous waste must be autoclaved or chemically decontaminated (e.g. bleaching) and then discarded down the sink.

3.7.3 Biomedical Waste (from VTH, Animal Resources and Junior Surgery ONLY)

Biomedical waste is material contaminated with **trace** amounts of blood, feces, urine, and other bodily fluids. This waste includes surgical masks, gloves, booties, plastic aprons, absorbents, surgery materials with trace amounts of animal blood, sample containers, test tubes, etc. This waste goes into a **YELLOW** bag and then placed in a Biomedical Waste box which is incinerated off site.

3.7.4 Metal Sharps

Metal sharps include needles, scalpel blades, razor blades, etc. Uncontaminated metal sharps must be packaged in a rigid, puncture resistant container. Biologically contaminated metal sharps must be placed in an APPROVED, LABELED, BIOHAZARDOUS SHARPS CONTAINER and then brought to the approved autoclaving facility.

3.7.5 Glass and Broken Glass

Chemical free glass and non-biohazardous broken glass will be disposed in a sturdy, puncture-resistant container such as plastic tubs or heavy cardboard boxes, sealed with tape. The containers must be clearly labeled, including the phrase **"CAUTION — GLASS FOR LANDFILL"** and the point of origin**.** These containers must be segregated from regular waste (cardboard boxes are not to be stored outside). Contact Facilities Management to co-ordinate pick-up and delivery for disposal.

Biologically contaminated glass containers, slides, glass pipettes, etc. must be autoclaved prior to being handled as the above.

3.7.6 Hazardous Chemicals and Containers for External Disposal

Certain chemicals cannot be discarded with regular refuse or flushed down a drain. UPEI has a process to collect and dispose of hazardous waste chemicals. The process is administered through the Health, Safety and Environment Department in consultation with appropriate departmental personnel.

Certain chemicals can be neutralized or recovered for re-use thus, reducing waste disposal costs. When there are no alternatives, hazardous chemicals must be appropriately packaged, labeled and safely stored until they can be picked up/shipped for external disposal. An up-to-date inventory of waste chemicals should be maintained according to site-specific procedures. Site specific procedures are those locally formulated by area, building or department. They should be reviewed during site specific training sessions for new and current workers in the areas of concern.

Each container label must be **WHMIS** compliant and the following labeling format should be used:

HAZARDOUS WASTE
Name(s) of the chemical(s) (avoid the use of abbreviations)
Estimate percentages, if applicable
Total mass or volume of the chemicals (for reactive include total mass of chemical and container)
Laboratory room number/generator's initials

e.g. HAZARDOUS WASTE
Chloroform/Phenol
40%/60%
4 litres
315S /J.S.

The inventory will include the above information, as well as the type and size of container.

Chemically contaminated material (gloves, absorbent pads, etc.) must be stored in a properly labeled and secure container until it can be sent for disposal.

Solvent waste may be blended with other compatible waste solvents. It should be collected separately as halogenated solvent waste and non-halogenated organic solvent waste, and held for disposal with the other chemical waste.

Hazardous waste chemical storage is subject to the same safety regulations as regular chemical storage regulated by the National Fire Code of Canada (http://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2015_national_fire_code.html. This may include restrictions on the total volume of chemicals. It may also limit the volume of individual containers to 25L for solvents. Further information about the procedure for storage of hazardous waste, particular to each building on-campus, will be given during site-specific safety training.

Empty Chemical Containers
Chemical containers (glass, metal, and plastic) that contain low hazard chemicals and can be sufficiently decontaminated may be recycled for use in the laboratory only, but must first be cleaned to remove chemical residues, and labels must be removed or defaced. Plastic and metal containers may be discarded in regular waste once this has been done. In the case of disposal, clean glass containers will be handled in the same fashion as uncontaminated glass (see section 3.7.5).

Containers for high hazard chemicals (e.g. ethidium bromide, trizol, etc.) must not be reused and must be disposed of as hazardous chemical waste.

3.7.7 Other Waste

3.7.7.1 Radioactive Waste

UPEI is licensed to handle radioisotopes by the Canadian Nuclear Safety Commission. Strict guidelines are in place with regard to disposal of radioactive waste. These guidelines can be found in the **UPEI Radiation Safety Manual** or by contacting the **UPEI Radiation Safety Officer** directly at 566-0835.

3.7.7.2 Anatomical Waste

Anatomical waste material which is grossly contaminated with blood, feces, urine, and other bodily fluids e.g. animal tissues, body parts, carcasses, bedding, saturated sponges, samples for diagnosis, surgery, treatment, etc. will be incinerated through Diagnostic Services, AVC. Contact Diagnostic Services for the appropriate containment and transport requirements. Properly packaged waste may be stored in specifically designated cold or freezer storage pending disposal/incineration.

3.7.7.3 Mixed Waste

Determine the disposal method prior to creating mixed waste. Mixed waste can be any combination of biological, chemical, and radioactive waste. Some biological waste cannot be autoclaved when it has been mixed with certain hazardous chemicals.

3.7.7.4 Toxins

Toxins can include things such as biotoxins, cytotoxins and genotoxins. Refer to site specific SOPs in the VTH for proper disposal methods or dispose of based on the method outlined within the specific biosafety permit.

3.7.7.5 Battery Disposal

Used batteries must not be disposed of in the general waste. Each department should identify the location for batteries to be stored until they can be dropped off at Facilities Management (or picked up by Facilities Management) for final disposal through the waste management system.

4. PROTECTIVE EQUIPMENT

The objective of personal protective equipment (PPE) is to protect workers from the risk of injury by creating a barrier against workplace hazards. PPE is not a substitute for effective engineering controls or administrative controls or safe operating procedures/practices, but should be used in conjunction with these controls to ensure the safety and health of workers. This section addresses various types of protection.

Scope

The use of PPE is applicable to all workers. Specific requirements will depend on hazard/risk analysis and safe operating procedures.

4.1 Responsibilities

Principal investigators/supervisors and all others in authority shall:

- Identify situations where PPE is required.
- Determine the types of PPE required for the specific hazard and implement site specific standard operating procedures (SOPs).
- Provide workers with appropriate PPE.
- Ensure workers wear appropriate PPE as prescribed in SOP from hazard/risk analysis (see **Appendix O** for a hazard/risk analysis template).
- Ensure that workers are informed about the proper use, care, and maintenance of PPE.
- Ensure that workers practice the safe donning/doffing of PPE as instructed (see **Appendix P**).

Lab users shall:

- Properly wear appropriate PPE as determined by the completion of a hazard/risk analysis and prescribed in the SOP.
- Maintain PPE in good condition.
- Report to their supervisors about any PPE concerns or defects.
- Adhere to proper donning and doffing procedures of PPE.

4.2 Cleaning and Maintenance

- All PPE must be kept clean, inspected, and properly maintained at regular intervals, as indicated in the SOP.
- Specific PPE (e.g. respirators) shall not be shared between lab users until properly cleaned and sanitized.
- PPE will be distributed for individual use whenever possible/practical.
- PPE contaminated with hazardous materials must follow applicable SOPs before cleaning and/or disposal.

4.3 Signage

Personal protective equipment requirements as prescribed by SOP shall be posted at the entry to labs or hazardous areas. All signage must be adhered to at all times by all lab users.

4.4 Hearing Protection

Hearing protective devices

Occupational noise-induced hearing loss may be prevented through the effective use of appropriate hearing protection. Appropriate hearing protection must protect against the level of noise hazard, provide a comfortable fit, and comply with CSA Standard Z94.2-M1984, *Hearing Protectors*.

A lab user is noise-exposed if they experience regular exposure to sound levels greater than an eight-hour time-weighted average (TWA) of 85 A-weighted decibels (dBA) or an equivalent noise exposure. For further details please review the UPEI Hearing Conservation Program at: http://www.upei.ca/vpaf/health-and-safety

Two general categories of hearing protection devices are:

1. Earmuffs
2. Earplugs

4.4.1 Earmuffs

Earmuffs are external hearing protection devices consisting of a headband and ear cups. The ear cups are cushioned and are intended to fit snugly (but not uncomfortably tight) over the ear.

To ensure optimal protection:

- The ear cup must completely surround the outer ear in order to provide a good

seal and thereby protect the noise sensitive inner ear.

- Earmuff fit must not be compromised by the use of other safety equipment such as hard hats, goggles, glasses, etc.

- The user must regularly inspect and maintain the earmuffs in good condition. For example, ear cup cushions which are cracked or hardened, or a headband with inadequate tension, must be replaced.

4.4.2 Earplugs

Earplugs are hearing-protection devices that are inserted into the ear canal. The most common earplugs are expandable foam or preformed plugs with flanges. Earplugs are either disposable (used only once) or reusable (with proper care, this type of earplug can be used for up to six months).

To ensure optimal protection:

- Earplugs must fit snugly and seal the ear canal to provide adequate noise attenuation and protect the noise-sensitive inner ear.

- Earplugs should be inserted using clean hands, by pulling back the ear with the opposite hand to straighten the ear canal.

- Reseat earplugs periodically since they can work loose through the day (from talking, etc.).

- Reusable earplugs must be regularly inspected and cleaned (washed in mild soap and allowed to dry in a clean environment).

Use of earphones:

- Recreational earphones used for music are <u>not</u> a replacement for properly fitted and appropriate hearing protection.

- Earphones can impede hearing during high-risk activities, emergency alarms, and are <u>not</u> allowed when acute attention is required.

4.4.3 Noise Reduction Rating (NRR)

This rating is on most hearing protection devices and means that when the hearing protection device is used it may reduce the decibels entering the ear by that rating. Due to many variables (e.g. fit, seal, movement of ear protection while working, etc.) the rule of thumb is that the NRR rating is reduced by 25% for earmuffs and 50% for earplugs. An NRR rating of 20 dBs on earplugs would reduce the noise level by 10 dBs (20 dBs X50%=10 dBs; 20dBs-10 dBs =10

dBs) reaching the ear. Earmuffs with a NRR of 20 dBs would reduce the noise level by 15 dBs reaching the ear (20 dBsX25%=5 dBs; 20 dBs-5 dBs =15 dBs). Both reduce noise levels reaching the ear but, earmuffs provide superior protection. If the worker was exposed to a noise level of 100 dBs in a work area for an 8 hour shift then, the earplugs with a NRR of 20 would not be effective because they would only reduce the noise level to 90 dBs and by OHS regulations 85 dBs is the maximum a worker can be exposed to for an 8 hour shift. The earmuffs with NRR of 20 dBs or an earplug with a greater NRR (e.g. 30) would be effective protection to meet the regulations reducing the noise exposure to 85dBs.

4.5 Eye and Face Protection

As of June 1, 2021, eye and face protection are mandatory in all UPEI laboratory settings. When any worker may be exposed to a hazard which could irritate or injure the eyes or face, the Lab Supervisor is responsible for completing a workplace hazard risk assessment. Should the activity be commonly occurring and more specific eye protection is required, Standard Operating Procedures must incorporate the specific eye protection. The type of protection used must be appropriate to the hazard and meets the standards and specifications of CSA Standard Z94.3-20, Eye and Face Protectors, or a standard offering equivalent protection. In many UPEI work processes the potential for flying particles, dusts, vapours, chemicals, or harmful rays to contact a person's eyes or face causing injury exists. Appropriate protective eyewear and face protection is outlined in the sections below to protect against the specific hazard present, provide a comfortable and secure fit, and comply with CSA Standard Z94.3-20, *Eye and Face Protectors*.

If a person requires prescription eyewear, under the Prince Edward Island Occupational Health and Safety Regulations Section 45.8 Obligations of the Employer "The employer shall ensure that a worker who has 20/200 vision in either eye, or is blind in either eye, wears eye protection as required by section 45.7." Please reach out to your Department Chair.

The general categories of protective eyewear and face protection include:

1. Safety glasses
2. Safety goggles
3. Face shields
4. Special filter lenses

4.5.1 Safety Glasses

Safety glasses have lenses that are impact-resistant and frames that are far stronger than those of regular eyeglasses. Safety glasses are to be worn when there is risk of injury to the eye from foreign debris/contaminants such as chemicals, particles, etc.

To ensure optimal protection:

- Regular eyeglasses must not be used in place of protective eyewear.
- Over-the-glasses safety glasses must be worn over regular eyeglasses.

- Non-prescription or prescription safety glasses (with attached/built-in side shields) must be marked as CSA approved.

- Please see Appendix Y for examples of CSA approved safety glasses that can be ordered through UPEI Procurement.

4.5.2 Safety Goggles

Safety goggles are contoured for full facial contact and are held in place by an elastic or strap; therefore, they offer greater eye protection than safety glasses. Safety goggles are used when there is potential of being exposed to airborne objects or particles, chemicals splashes or sprays, or when working near abrasive blasting. Safety goggles have impact resistance and may have direct or indirect ventilation to protect against fogging.

To ensure optimal protection:

- Goggles must be worn when there is potential for chemical or biological splashes or when working near abrasive blasting.

- Use goggles with indirect ventilation against splash hazards and flying particles.

- Please see Appendix Y for examples of CSA approved safety goggles that can be ordered through UPEI Procurement.

4.5.3 Face Shields

Face shields are designed to provide general protection to the face and front of the neck against flying particles and sprays of hazardous liquids. Contamination can result from chemical reactions, necropsy of infected animals, harvesting of tissues or fluids from infected animals, and manipulations of infectious materials, etc. Note that face shields do not fully enclose the eyes.

To ensure optimal eye protection:

- **Face shields are to be used in conjunction with safety glasses or goggles** (double eye protection) whenever procedures that have a high potential for creating flying particles are being performed (e.g. grinding metal).

4.5.4 Special Filter Lenses

To ensure optimal protection:

- Protective eyewear equipped with approved filter lenses must be used to protect against harmful light or other rays, e.g., infrared, ultraviolet, laser light.

- Laser protective eyewear must be clearly labeled with the optical density and the

wavelength for which protection is afforded.

NOTE: **Contact Lenses**
Current evidence indicates that the use of contact lenses in the workplace, on the whole, does not place the wearer at additional risk of eye injury. However, contact lenses are not protective devices, and must be used only in conjunction with appropriate protective eyewear.

Contact lenses may not be permitted in containment level 2 laboratories or may only be worn in conjunction with protective goggles. Refer to lab specific SOP. A hazard analysis of the work including the controlled products being used (e.g. review the chemical(s) safety data sheet(s) to determine if contact lenses are not permitted due to the potential to fuse the contact to the eye if an eye exposure occurs***) must be completed prior to commencing work with chemicals/hazardous materials.***

4.6 Protective Body Clothing: Lab Coats, Aprons, Overalls, etc.

All lab users must wear appropriate clothing when working in the lab. This includes full length pants, shirts, ankle length skirts, and full coverage foot wear. Additional personal protective clothing includes aprons, laboratory coats, scrubs, gowns, sleeve protectors, coveralls, and full-body suits, etc. Protective clothing material and design must protect against the specific hazards encountered in the workplace, cover and protect the areas of the body potentially exposed to the identified hazards, and provide a comfortable and secure fit.

Appropriate protective clothing must be worn in labs where chemical, biological, or other hazardous materials are used and stored to prevent skin from being exposed to splashes and other contact. ***Note***: no single material will protect against all hazards.

The general categories of protective clothing include:

1. Lab coats
2. Coveralls and overalls
3. Aprons, protective sleeves, etc.
4. Full body suits
5. Temperature-resistant clothing

4.6.1 Lab Coats

Lab coats are made of materials (e.g., cotton or cotton/polyester blend) suitable for the work environment, the materials handled, and the tasks performed.

To ensure optimal protection lab coats must:

- Fit properly, be fastened when worn, and provide appropriate flexibility to carry

out tasks.

- Be worn in order to protect against minor splashes or spills, and to minimize contamination of street clothing.
- Be regularly cleaned, maintained, and replaced when worn or exhibiting significant deterioration.
- Be decontaminated/sterilized prior to laundering when contaminated with hazardous materials.
- Be removed when leaving the laboratory working environment to reduce the potential for contamination of the external lab environment by chemicals or other hazardous agents.
- Not be worn in eating areas, in administrative office areas, or in public areas (e.g., washrooms, seminar rooms, public meeting places), except at AVC where specific, clean, colour coded lab coats are permitted in these areas as barriers for biocontainment practices.

4.6.2 Coveralls and Overalls

Coveralls and overalls are loose-fitting garments worn over regular clothes for protection. Coveralls provide more coverage, including the torso, arms, and legs, whereas overalls cover the legs and lower torso (from the chest down). Coveralls and overalls are used as protection against abrasion, small particles, greases, etc., which are common exposures in barns, post mortem, or during maintenance tasks, etc.

4.6.3 Aprons, Protective Sleeves, etc.

Aprons, protective sleeves, etc., may be used when a higher degree of protection is required. For example, plastic or rubber aprons should be used for greater splash protection when handling concentrated corrosive materials or working within an in vivo aquatic laboratory. Appropriate protective clothing must demonstrate low penetration, no significant degradation, and a low permeation rate.

4.6.4 Full Body Suits

Where potential exists for exposure to highly toxic dusts, or where the potential of skin contamination is high, wear appropriate full body suits that are resistant to retention or penetration of hazardous particles (e.g., disposable Tyvek™ suits). Disposable suits can be purchased with attached hoods and foot covers. After use, disposable suits must be discarded as hazardous waste.

4.6.5 Temperature-resistant Clothing

Heat: Where potential exists for exposure to heat, appropriate heat-resistant clothing must be worn. Depending on the source of heat, this may include apparel made of leather, aluminized fabric, or other heat-resistant material.

Cold: Where the potential exists for exposure to cold, such as work conducted in refrigerated environments or outdoors, or work with cryogenic materials, appropriate thermally insulated clothing (e.g., gloves, coats, vests, and aprons) must be worn.

4.7 Protective Gloves

Appropriate protective gloves must be worn in all situations where the hands are potentially exposed to hazards such as chemicals, infectious agents, cuts, lacerations, abrasions, punctures, burns, and harmful temperature extremes.

Appropriate protective gloves must protect against the specific hazards presented, and provide a comfortable and secure fit. The performance characteristics of a particular glove and its ability to protect against the specific hazards encountered are based on a number of factors, including the type of glove material, the manufacturing process, its thickness, design, and size.

Appendix Q outlines *Classification of Hazards and Recommended Glove Protection*

Chemical-resistant gloves
Chemical-resistant gloves provide an effective barrier against the specific chemicals and must be worn whenever hands are potentially exposed to chemicals.

Refer to **Appendix R** for the *Guide to Selection of a Chemical Resistant Glove.*

Disposable gloves

Disposable gloves are usually made of lightweight plastic or rubber materials, and offer greater sensitivity and dexterity to the user. Disposable gloves are generally intended to guard against mild chemicals or other materials, and provide little or no protection against many chemicals.

To ensure optimal protection:

- Be aware of the limitations of such gloves in protecting against chemical or physical hazards.

- Replace frequently and never reuse.

Selection requirements: The selection of the proper chemical-resistant glove begins with an evaluation of the job application.

Factors that influence this selection are the:

- type of chemicals to be handled, in terms of the degree of toxicity, the types of health effects, and the severity of the effects,
- frequency and duration of chemical contact,
- gloves that demonstrate no significant degradation upon contact with the specific chemicals, and have an appropriately high breakthrough time and a low permeation rate under the conditions of use,
- concentration of chemicals,
- temperature of chemicals,
- abrasion/resistance requirements,
- puncture, snag, tear, and cut resistance requirements,
- length to be protected (hand only, forearm, arm),
- dexterity requirements,
- grip requirements (dry grip, wet grip, oily),
- colour requirements (to show contamination),
- thermal protection (e.g., handling anhydrous ammonia),
- size and comfort requirements,
- price; and,
- specific process/use of glove.

Glove limitations

- No single glove material will protect against all chemicals.
- No glove material is totally impermeable.
- Glove performance can vary with product and manufacturer.

Reusable gloves

Of principal concern are cuts, tears, and punctures. Discolouration or stiffness may indicate non-uniformities in the rubber or plastic or chemical attack resulting from previous use.

To ensure optimal protection reusable gloves must be:

- Routinely inspected, as chemical-resistant gloves will break down after repeated chemical exposures.
- Thoroughly rinsed and allowed to air-dry.
- Replaced on a regular and frequent basis.
- Replaced immediately upon signs of degradation, and particularly after contact with toxic chemicals.

Latex allergies

The widespread use of latex gloves has resulted in an increase in irritant and allergic reactions to the glove material. Reactions may be due to exposure to the natural latex proteins or to the chemical additives added to the latex.

4.8 Protective Footwear

Appropriate protective footwear must be worn in all situations where foot hazards exist, such as chemicals, infectious agents, radioactive materials, harmful dusts, heavy or sharp objects, burns, and other hazards. ***Note:*** footwear must be chosen that will provide the needed level of protection. Different working environments may present different hazards and some environments contain multiple hazards.

This standard is based on the Canadian Standards Association (CSA) and Z195.1-02, *Guideline on Selection, Care, and use of Protective Footwear.* Contact the Health, Safety and Environment Department for further details on these standards.

Foot protection to be worn when exposed to specific hazards includes:

1. Protective footwear in chemical and biological laboratories
2. Rubber boots
3. Protective toe-cap and metatarsal protector impact resistant footwear
4. Protective sole puncture resistance
5. Static dissipative footwear

4.8.1 Protective Footwear in Chemical and Biological Laboratories

To ensure optimal protection:

- Do not wear perforated shoes, sandals, or similar-type shoes in labs.
- Appropriate footwear (closed toe, low heel and closed heel) must be worn to protect the entire foot.
- Shoe materials, including soles and uppers, must be compatible with the lab environment, the materials handled, and the tasks conducted.
- All foot hazards must be identified through a hazard analysis and SOP created for the specific lab, tasks and environment.

4.8.2 Rubber Boots

Rubber boots are required in areas such as barns where manure is present. Boots, shoe covers, or other protective footwear, and disinfectant footbaths, are required for biocontainment areas (e.g., Post Mortem, AVC).

To ensure optimal protection, rubber boots must be:

- Cleaned prior to leaving the designated areas.
- Removed immediately upon leaving the identified boot areas within the barn.

4.8.3 Protective Toe-cap And Metatarsal Protector Impact-Resistant Footwear

Such protective footwear is required when foot crush hazards exist such as heavy objects falling, rolling objects, sharp objects, hot objects, and saw cutting (e.g. Post Mortem). This includes workplaces where heavy materials are handled (e.g. large animals, furniture, boxes, etc.), heavy equipment is used, and on construction sites.

To ensure optimal protection:

- Safety footwear that protects feet from impact must be worn by those who are exposed to such hazards.

4.8.4 Protective Sole Puncture Resistance

Appropriate protective footwear is required to protect against penetration of sharp objects into the bottom of the foot (e.g., nails, glass) or hot objects, or saw-cutting.

4.8.5 Static Dissipative Footwear

The sole allows small charges of electricity to be dissipated into the walking surface, thus reducing the accumulation of static electricity.

To ensure optimal protection:

- Workers may be required (as per SOP established from hazard analysis) to wear static dissipative footwear in areas where flammable materials are present or where the buildup of static electricity must be minimized.

4.9 Respiratory Protection Program

The respiratory system provides the quickest and most direct route of entry for toxic materials. Although elimination or reduction of respiratory hazards through substitution or engineering controls is preferred, there may be instances in which UPEI lab users require the use of appropriate respiratory protection for work that has the potential for exposure to hazardous environments, such as airborne contaminants (dusts, fumes, mists, gases, vapours, aerosols). The use of a respirator is a last resort when other higher level of controls cannot adequately mitigate the risk.

Appropriate respiratory protection must protect against the specific hazard(s) present, provide a comfortable and secure fit, and comply with Canadian Standards Association (CSA) Standard Z94.4-02, "*Selection, Use and Care of Respirators*."

It is imperative that workers receive proper training prior to the initial use of respiratory protection devices (contact the UPEI Health, Safety and Environment Department for further details).

NOTE: Safety Data Sheets (SDS) for controlled products (e.g. chemicals) and the manufacturer's instructions for respiratory equipment must be referenced prior to selecting a respirator.

UPEI's Respiratory Protection Program includes:

- Responsibilities
- Training
- General categories of respirators
- Selection of respirators
- Cautions and limitations
- Care of respirators
- Health surveillance
- Fit testing

4.9.1 Responsibilities

Supervisors and all others in authority shall:

1. Identify situations where respirators are required;

2. Ensure that the proper type of respiratory protection required for the specific respiratory hazard(s) has been chosen;

3. Provide workers with appropriate respiratory protection;

4. Ensure that workers are able to use a respirator by completing the *UPEI Respirator User Screening Form* (**Appendix U)** and that training and fit testing is completed prior to assigning a task that requires a respirator;

5. Ensure that workers use the respirators in accordance with the instructions and the training received;

6. Ensure respirators are cleaned, sanitized, inspected, maintained, repaired, and stored in accordance with training and manufacturer's recommendations;

7. Enforce that respirator users must be clean-shaven and that there is nothing compromising the face-seal or operation of the respirator (e.g. safety glasses under full face respirator);

8. Be receptive to respirator users' concerns, identify changes in processes, equipment, or operating procedures that have impact on environmental conditions, and respiratory protection requirements;

9. Notify the Health, Safety and Environment Department of incidents where the use of a respirator may have prevented or contributed to an incident (Eg. hazardous respiratory exposure);

10. As necessary, provide details of the type of respirator selected and the anticipated working conditions to the health care professional conducting the medical assessment of a respirator user; and,

11. Ensure that workers wear appropriate respiratory protection when necessary.

UPEI Health, Safety and Environment Department shall:

1. Arrange annual fit testing and keep records of testing;

2. Keep records of respirator users;

3. Arrange initial group training and refresher training every 2 years; and,

4. Keep completed *UPEI Respirator User Screening Form* **(Appendix U)**.

Respirator Users shall:

1. Wear appropriate respiratory protection at all times when performing tasks or working in an area where respiratory hazards exist;

2. Attend training and refresher training every 2 years;

3. Complete respirator fit testing annually;

4. Complete *UPEI Respirator User Screening Form* **(Appendix U)** prior to fit testing and submit to Health, Safety and Environment Department after fit testing is completed;

5. Check that respirator is clean and in good operating condition prior to each use;

6. Perform negative and positive pressure check after each donning of a tight-fitting respirator;

7. Report any damage or malfunction of the respirator to their supervisor;

8. Report to their supervisor any condition or change that may impact on their ability to use a respirator safely (medical surveillance screening form will need to be updated);

9. When using a tight-fitting face-piece respirator, be clean shaven and refrain from having any object or material that would interfere with the seal or operation of the respirator; and,

10. Use the respirator in accordance with the manufacturer's instructions and training received.

4.9.2 Training

Training is required prior to the respirator user being fit tested and using a respirator. Training should include, as a minimum, information within this Respiratory Protection Program (section 4.9). Refresher training is required at least every 2 years.

4.9.3 General Categories of Respirators

Air Purifying Respirators

1. **Disposable Particulate Air Purifying Respirators**
   These respirators are made of light cotton and have a specific protection rating. For example, N95 indicates a 95% filter efficiency level against particulate aerosols free of oil. Disposable particulate respirators can provide protection against a variety of non-toxic dusts and mists, whose permissible exposure level are greater than 0.05 mg/m^3. Note that dust masks and surgical masks are not considered to be respirators.

   To ensure optimal protection:

   - Read the manufacturer's instructions before use to determine if the selection is suitable for the specific application.
   - Fit testing is required for this category of respirator.
   - **Do Not use for**: concentrations of contaminants which are unknown, or are immediately dangerous to life or health, gases, fumes, harmful levels of vapours and/or toxic dusts.

2. **Non-Disposable Air-Purifying Respirators (APR)**
   Air-purifying respirators can be used to protect against airborne contaminants such as dusts, mists, fumes, smokes, aerosols, gases and vapours. Since these respirators are air-purifying only, this type of respiratory protection must NEVER be used in oxygen-deficient atmospheres or situations which are immediately dangerous to life and health (IDLH).

   The general categories of air-purifying respirators are:
   - Dust, fume and mist (particulates)
   - Gas and vapour
   - Combination

   The air-purifying respirators are available in two modes of operation:

A) Non-powered

The non-powered respirators come in 2 designs:
a) Half-face APR: Only provides protection to the nose and mouth.
b) Full-face APR: As well as providing protection to the nose and mouth, a full-face APR provides protection against eye irritation. A full-face APR is used in the same atmosphere as the half-face. Full-face APRs are easier to fit than the half-face and provide a higher level of protection.

B) Powered

The powered respirators contain a blower and are equipped with a face-piece, helmet or hood. Selection of the most appropriate air-purifying respirator and cartridges/filters depends on factors such as the frequency of use, the type of contaminants and the anticipated concentration of those contaminants. Other considerations regarding the appropriate selection and use of air-purifying respirators are adequate warning properties of gases or vapours, whether the area is a confined space (as defined in the UPEI's Confined Space Procedure - contact Facilities Management), humidity levels and the potential presence of unknown contaminants.

Any worker who is required to use a respirator must be trained with respect to the limitations of that respirator, as well as: proper fit, inspection, maintenance, cleaning and storage.

Atmosphere Supplying Respirators

1. **Self-Contained Breathing Apparatus (SCBA)**

   SCBA's use a full face-piece connected to a source of air carried by the wearer. The SCBA provides respiratory protection in oxygen-deficient environments and in situations where high or unknown concentration of toxic gases, vapours or particulates are present. The SCBA can also provide protection in emergency situations. When using the SCBA, the user's respiratory system is isolated from the surrounding atmosphere because no outside air enters the mask (inside the mask is positively pressurized).

   SCBAs are the most complex respirators in use today so specific training in the proper use and maintenance of SCBAs is crucial, particularly given the conditions in which these units are used (contact the equipment supplier for further details).

2. **Supplied Air Breathing Apparatus (SABA)**

   The SABA system uses a supplied air line from a tank (or bank of tanks) or via a compressor that supplies breathable air from the natural environment (in a location that is a safe distance from the worker) to the worker's respirator. SABA is sometimes used for confined space entry if the duration in the hazardous environment exceeds the capacity of compressed air cylinder used with a SCBA. This process requires a trained person to be on watch to ensure the tank(s) don't run out of air (and to switch out tanks as required) or to ensure the compressor does not fail or an external contaminant (e.g. vehicle exhaust) does not enter the compressor and is passed through the worker's air-line. Other differences to evaluate using this process are the addition of the breathing line to the

worker including potential line breaks or pinches, entanglement of the air-line on objects in the work area and movement is limited due to the length of air-line/hose. A potential positive using this method is it increases the amount of air provided to the worker allowing the worker to spend more time in the area versus a SCBA that has limited time based on the capacity of the compressed air cylinder.

NOTE: If atmosphere supplying respirators, or respirators not mentioned within this document, are to be used at UPEI, then the applicable supervisor is responsible to ensure that a standard operating procedure (SOP) has been created for the specific respirator, workers receive the appropriate training and maintenance/inspection of all components meet the manufacturer's specifications. The supervisor must forward a copy of all documentation (SOP, training certificates, inspection logs, etc.) to the UPEI Health, Safety and Environment Department prior to commencement of the work.

4.9.4 Selection of Respirators

Air Purifying Respirators are assigned a **protection factor (PF).** The half-face PF is 10 times and the full-face PF is 50 times. This means that a person correctly wearing the respirator who has been properly fit-tested and using a canister/cartridge that will quantitatively remove the identified contaminant in the atmosphere, can expect to be inhaling one-tenth or less for the half-face (PF of 10) and one-fiftieth or less for the full-face (PF of 50) of the concentration of that contaminant in the environment. If the canister/cartridge fails, the seal is broken, or any other part of the respirator fails, the rated protection factor can no longer be expected.

To determine the concentration at which the respirator can be worn, the Threshold Limit Value (TLV) is multiplied by the PF (e.g. 100 ppm X 1/10 = 10 ppm of potential exposure when using a properly fitted half face respirator (with appropriate cartridges); and 100 ppm X 1/50 = 2 ppm of potential exposure when using a properly fitted full face respirator (with appropriate cartridges)). The TLV can be found on the Safety Data Sheet or through the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs®) for Chemical Substances and Physical Agents and the Biological Exposure Indices document. Canisters/cartridges are assigned a maximum use concentration of 1000 ppm and have a limited life service.

Replacing Cartridges

Canisters/cartridges are used up faster as the following rise:

1. Contaminant Concentration
2. Workplace Temperature
3. Relative Humidity
4. Breathing Rate

A cartridge change out schedule (see **Appendix S** for a template form and process steps) must be established and documented for the specific conditions present during respirator use. This change out schedule form documents usage time and imposes a maximum use time for all cartridges of 30 hours. The user can change out cartridges prior to the 30 hours if any of the following are identified: damage to cartridge or filter, leakage detected during pressure tests, difficulty

breathing when respirator is worn (cartridges filters are blocked), excess contamination, and detection of odour (smell, taste, etc.) while wearing the respirator in the work area. The supplier of safety equipment/services should be able to assist with this information.

Canisters/cartridges can be purchased for respiratory protection against specific gases. Some combination canisters/cartridges are available and are approved for acid gases and organic vapours. There are cartridges available that can protect against specific acids/vapours and particulates at the same time. The user must confirm that the appropriate cartridge is in place prior to use. An essential resource that may provide the type of respiratory protection required is the SDS.

An Occupational Hygienist or other qualified professional may need to be consulted to do a hazard assessment of the work area (as per Section 5 of the CSA standard) and assist with the selection of the proper respirator and cartridges as the following criteria listed below may not be available to base the selection on. These processes must be documented.

Four Factors of Respirator Selection

1. Results from atmospheric monitoring, contaminant monitoring, or sampling for 0_2 content and gas concentration to indicate levels present.

2. Accepted ACGIH, OSHA or NIOSH TLV's for the substance(s) present.

3. Maximum use Concentration (of a substance) for which a respirator can be used.

4. If the contaminant is unknown or the requirements for using APR's cannot be met, then a Supplied Air Respirator (SCBA) is required.

Situations When an APR Should be Worn

A flow chart is attached to aid in the selection of the proper Air Purifying Respirator. Please refer to **Appendix T**.

Note: For the organic chemicals that have a boiling point below 65°C (such as Acetone), you are required to dispose of your filter cartridges at the end of your work shift. During periods of storage or non-use, this type of contaminant has a tendency to migrate through the canisters/cartridges which can result in additional exposure to the worker that reuses the canisters/cartridges.

4.9.5 Cautions and Limitations

The following applies to **BOTH** Air Purifying Respirators and Disposable Particulate Respirators.

1. Do not use when the Odour Threshold is greater than the TLV (Threshold Limit Value). If the respirator fails, you may be unaware you are being exposed to contaminant levels

above the TLV. **Note**: Check Safety Data Sheet (SDS) for odour thresholds.

2. When the Protection Factor does not reduce contamination level below the TLV.

3. Not for use in atmospheres containing less than 19.5% oxygen.

4. Do not use if the identity and concentration of the contaminants are unknown.

5. Not for use in IDLH (Immediately Dangerous to Life and Health) atmospheres.

The following applies to Air Purifying Respirators only.

1. Organic canisters/cartridges can only be used for those organics that have adequate warning properties and do not generate high heat or react with the sorbent material in the cartridge.

2. Organic vapour canisters/cartridges are designed for a maximum exposure level of 1000 ppm.

3. Only use approved canisters/cartridges that are compatible to the respirator and designed for the contaminant and concentrations that are available.

4. Cartridges should be changed if any odour is detectable or when deemed necessary by the user.

5. Filters should be visually inspected every week. They should be discarded if dust is caked on or breathing becomes difficult.

6. It is recommended that the date the cartridges were opened is written on the cartridges.

The following applies to Disposable Particulate Respirators only.

1. Do not use if concentrations of particulates exceed the maximum use concentration or 10 times the OSHA Permissible Exposure Limit (PEL).

2. Do not use for gases, vapours, asbestos, paint spray, sandblasting or particulate materials which generate harmful vapours.

3. Use appropriate respirator (e.g. N95, P100 or R95). Oil has been found to ruin the filtering ability of some filter material. Oil coats the filter fibers preventing the electrostatic charge on the fibers from attracting and removing particulates. Therefore, to ensure a suitable filter is used particulate filters have an (N, R and P designation). N = Not resistant to oil; R = resistant to oil and respirator must be discarded after 8 hours or as deemed appropriate by worker; and P = Oil proof and you must follow the manufacturer's time use limitation if you want to reuse the respirator. The filter efficiencies (95, 99 and 100) are indicated on the respirator. The "95" designation means

that when subjected to careful testing, the respirator blocks at least 95% of very small (>= 0.3 micron) test particles; ‘99” designation means that when subjected to careful testing, the respirator blocks at least 99% of very small (>= 0.3 micron) test particles and “100” designation means that when subjected to careful testing, the respirator blocks at least 99.997% of very small (>= 0.3 micron) test particles.

4. Dispose of the respirator (as per the change out schedule outlined in the SOP) based on applicable hazard/risk analysis of the work and inherent hazards requiring respiratory protection.

5. Do not use respirators after the expiration date printed or stamped on the box.

An adequate seal between respirator and user’s face must exist in order to receive full benefits from any respirator. Each time a respirator is worn you must perform user seal checks (negative and positive). Follow the instructions for the user seal checks provided on the manufacturer’s instructions for the Disposable Particulate Respirators. For Air Purifying Respirators see the instructions below.

4.9.6 Care of Respirators

A commitment to properly clean and disinfect any respirator will ensure the greatest chance it will deliver the expected protection.

Disposable Particulate Respirators and Cartridges

Disposable Particulate Respirators should not be altered, modified or abused. When they get dirty, they should be disposed and replaced. Unused respirators should be stored in the manufacturer’s box in a non-contaminated area.

Non-disposable Air Purifying Respirators

Do not clean canisters/cartridges. Respirators should be kept in a sealed, plastic bag and stored in a convenient, non-contaminated, dry location. Cartridges that are stored in a contaminated environment can absorb the contaminants, thus unknowingly reducing the life of the cartridges. Disposal of contaminated cartridges must follow UPEI laboratory waste management plan. ***Note:*** If respirator shows sign of excessive wear or damage, replace immediately.

When to Clean

1. Any respirator which is used exclusively by one worker shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition. At a minimum the respirator must be cleaned at the end of each day of use.

2. Any respirator used by more than one worker shall be cleaned and disinfected before it is worn by another user and cleaned at the end of each day the respirator is used.

Procedures for Cleaning and Disinfecting Air Purifying Respirators

1. Remove filters and/or cartridges from connectors.

2. Inspect headbands for wear. Check all elastomer and rubber parts for pliability and signs of deterioration.

3. As applicable, remove the face piece breathing tubes, inhalation connectors, inhalation valves, headband assembly, exhalation valve guard, valve and seat from the face piece.

4. Remove the inhalation valves from inhalation connectors.

5. Prepare a solution of cleaner/sanitizer according to the manufacture's or cleaner/sanitizer instructions.

6. Wash the face piece and components in the cleaning solution.

7. Rinse components completely in clean warm water, then air dry in a clean area.

8. Visually inspect the exhalation valve for damage. If damage or wear is evident, inform your supervisor, dispose the respirator and replace.

9. Reassemble the face piece. Follow steps 2 through 4 above, in reverse order.

Note: Respirators may also be cleaned and sanitized according to the respirator manufacturer's instruction. However these procedures must be documented. Respirator cleaning wipes may be used as an interim method in the cleaning schedule.

4.9.7 Health Surveillance

Prior to fit testing and respirator use, documentation must be completed that confirms the individual is free from any physiological or psychological conditions that may preclude him or her from being assigned the use of the selected respirator. The *UPEI Respirator User Screening Form* (see **Appendix U**) will assist in identifying such conditions. The screening form must be submitted to the UPEI Health, Safety and Environment Department. This form will be kept in the worker's confidential health and safety file. ***Note:*** medical information is NOT to be offered on the form. This form will trigger whether an opinion is needed from a health care professional regarding the person's ability to use a respirator. If this opinion is required, then it shall be obtained prior to use of a respirator or if a change in condition(s) warrants this opinion. The written opinion shall indicate whether the user meets medical requirements, meets medical requirements with limitations (state limitations), or does not meet medical requirements to use the selected respirator. The health information will be maintained confidentially by the health care professional.

4.9.8 Fit Testing

A qualitative or quantitative fit test will determine the ability of a user to obtain a satisfactory fit and an effective seal when using a tight-fitting face piece. Respirator users must be trained prior to being fit tested for their respirator and they must pass the respiratory fit test prior to wearing a respirator. Respirator fit tests must be repeated annually and when a new respirator (with a different model or size) is purchased/used or if major facial alterations occur (eg. severe weight loss, jaw surgery, dentures, etc.).

Facial Hair: The fit test shall not be conducted if there is any hair growth between the skin and the face piece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

PPE: When other personal protective equipment (PPE), such as eye, face, head, and hearing protectors are required to be worn, they shall be worn during the respirator fit tests to ensure they are compatible with the respirator and do not break the facial seal.

Fit testing will be performed by an external agency. A copy of the fit test document must be kept by the UPEI Health, Safety and Environment Department.

Qualitative Fit Test: A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative Fit Test: Means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

User Seal Check Procedures – Face piece Positive and Negative Pressure Checks
The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. User seal checks are not substitutes for qualitative or quantitative fit tests.

Positive Pressure Check

Non-Disposable Respirators (Full and Half Face):
Close off the exhalation valve and exhale gently into the face piece. The face seal is considered to be a satisfactory fit if a slight positive pressure (out pouching) can be built up inside the face piece without any evidence of outward leakage of air at the seal. For some models of respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

Disposable Respirators (e.g. N95):
Cup hands over respirator. Blow out. A build-up of air should be felt with no air leaking out around where the face meets the respirator (respirator to face seal). Refer to the following link for an example of how to don/doff and complete pressure checks of a 3M respirator (N95): http://multimedia.3m.com/mws/media/894897O/health-care-respirator-1860-1860s-wearitrightposter-english.pdf

Negative Pressure Check

Non-disposable Respirators (Full and Half Face):
Close off the inlet opening of the canister(s)/cartridge(s) by covering with the palm of the hand(s), inhale gently so that the face piece collapses (in pouching) slightly and hold your breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the face piece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

Disposable Respirators (e.g. N95):
Cup hands over respirator without excessive pressure. Breathe in sharply. A light collapse of the respirator should be felt with no air leaking in around the seal between face and respirator. Refer to the following link for an example of how to don/doff and complete pressure checks of a 3M respirator (N95): http://multimedia.3m.com/mws/media/894897O/health-care-respirator-1860-1860s-wearitrightposter-english.pdf

REFERENCES:
American Conference of Governmental Industrial Hygienists: 2005 TLV's and BEL's, p.108.

Canadian Standards Association (CSA) Standards Z94.4-02, "Selection, Use and Care of Respirators."

OSHA: www.osha.gov

NIOSH: www.cdc.gov/niosh

4.10 Fume Hoods and Biological Safety Cabinets

In many laboratories, the fume hood is the single most important safety feature. In essence, they are ventilated boxes with a movable transparent "window" through which one can see what is happening in the hood. In some cases, you access the hood interior by raising the front window. In others, a transparent pane is slid to one side. As fires and explosions can happen in fume hoods, the window is made to withstand most fume hood incidents.

Fume hoods are vented to the outside where dilution reduces exhausted contaminant concentrations to acceptable levels.

Fume hoods must work properly in order to protect humans from exposure to chemicals. To pull air through the fume hood and force it out of the building, the fan must be mounted in the exhaust duct. The fan should be placed outside the building and near the end of the exhaust stack. This arrangement places the hood and the duct at reduced pressure so that if there is a leak, air

flows into, rather than out of, the exhaust duct.

A fume hood is supposed to efficiently exhaust airborne contaminants that are released in the hood. To exhaust these airborne contaminants fume hoods channel the air into the hood with a minimum of turbulence. Fume hoods achieve this smooth, turbulence-free flow by incorporating a contoured face on the side walls and a lower front edge that is shaped like an air foil. In a properly designed unit, air sweeps into the hood and across the working surface. Some of the air is expunged through openings in the rear baffle near the fume hood floor. The remaining air rises along the back wall to exhaust through baffle openings in the upper part of the hood. If there is an imbalance between the air flow through the lower and upper baffle openings, a vortex develops in the upper part of a hood. This vortex actually moves contaminated air toward the face of the hood. In the worst case, the vortex will propel contaminated air back into the lab.

The rate at which air flows into the fume hood is an important factor in determining the unit's effectiveness. As with many things, more is not necessarily better. When the window is fully open, air should flow into the fume hood at speeds of between 80 and 120 feet/minute (or 0.5m/sec). Higher air speeds create turbulent air flow that can cause contaminated air to spill out of the hood. As the window is closed the fume hood face opening decreases. Since most fume hood fans operate at constant volume, the velocity of the air flowing into the hood would increase when the window is lowered. To prevent the air velocity from increasing and turbulence developing, most hoods have a compensating baffle over the window that keeps the face area constant.

Persons walking in front of a hood, the opening of laboratory doors, and even the position and design of the diffuser that supplies fresh air to the laboratory, can cause air currents at the face of the fume hood. These currents can reduce fume hood performance.

Work practices can also dramatically affect hood performance. Fume hoods most effectively capture vapours created at least six inches into the fume hood. Placing sources of contaminants closer to the face of the hood can allow toxic materials to escape into the lab. Obstructions within the hood also influence air flow patterns and can impair performance. Placing bulky pieces of equipment or allowing excessive accumulation of stored materials in the hood can disrupt design airflow patterns. Shelves along the walls also interfere with air flow. They can all contribute to an escape of contaminants into the lab. When using a bulky piece of equipment in a fume hood, raise it about 1½ inches, using rubber stoppers or similar spacers. Raising the equipment in this way allows air to sweep the floor of the hood and minimizes the disruption in air flow.

Biosafety Cabinets

Fume hoods and biological safety cabinets (BSCs) are used for different purposes and are not interchangeable. Chemicals are rarely used in BSC’s and pathogens are never handled in fume hoods. BSCs are HEPA filtered containment devices used to protect the operator from infectious aerosols. For more information please refer to UPEI Biosafety Program Guide via the following link: http://www.upei.ca/vpaf/health-and-safety.

Fume hoods and biological safety cabinets on campus are certified annually, but site-

specific safety training will provide information on how to recognize failure that may be noted by either an audible alarm or visible gauge. A dated and signed certification sticker must be readily visible on each fume hood and BSC. All users must complete a pre-use inspection including checking the gauges to ensure they are within acceptable ranges and the inspection stickers to verify date of next inspection is not past due.

Refer to the Canadian Biosafety Handbook and Canadian Biosafety Standard for guidelines on the safe use of biological safety cabinets and laminar flow hoods. These documents can be found via the following links:

https://www.canada.ca/en/public-health/services/canadian-biosafety-standards-guidelines.html

https://www.canada.ca/en/public-health/services/canadian-biosafety-standards-guidelines/handbook-second-edition.html

For further reference

Laboratory Fume Hoods, G. T. Saunders, John Wiley and Sons, 1993.

4.11 Emergency Eyewash and Shower Stations

Introduction
The first 10-15 seconds after exposure to a hazardous substance, especially a corrosive substance, are critical. Delaying treatment, even for a few seconds, may cause serious injury. Chemical exposure incidents can still occur even with good engineering controls and safety precautions in place in laboratories or other areas where hazardous materials are used or stored. As a result, a strategically located, properly functioning emergency eyewash and shower are an essential backup to minimize the effects of accidental exposure.

The following recommendations are generally based on the US ANSI standard Z358.1-2004. The ANSI standard is the recognized Industry Standard. Adherence to this standard would be an indication of efforts to ensure due diligence at UPEI.

Policy
Suitable units for drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use where any person may be exposed to potentially injurious substances. These units shall not be a substitute for the use of appropriate personal protective equipment (e.g. goggles, gloves, lab coats, etc.).

Definitions
Emergency Shower: Referred to as either a drench or deluge shower, it is designed to have water cascade over the entire body. It should not be used to flush eyes because the high rate of water flow pressure could damage the eyes. Emergency showers are hands-free, as they remain activated until turned off, freeing the hands.

Eyewash or Eye/face wash station: Designed to flush the eyes and face only. Units used at the University can be plumbed, as they are connected to an uninterruptible water supply or unplumbed (e.g. eyewash bottles that would be used in the field). The plumbed units are hands-free, in that, once activated, they remain activated until turned off, freeing the hands.

Responsibility

- Each Departmental Chair or Primary Space Supervisor is responsible for assigning responsibility to maintain the emergency eyewash stations located in their laboratories or areas not maintained by Facilities Management.

- Individuals in each of the work areas designated responsible for the testing and inspection of eyewash stations must keep a written record of this maintenance, according to the manufacturer's specifications. It is strongly recommended that weekly tests are performed on eyewash stations and immediately after any disruption in water supply. Facilities Management must be notified immediately of any deficiencies observed by submitting an electronic work order.

- Facilities Management is responsible for maintaining the emergency shower stations on an annual basis.

- Facilities Management will perform annual preventive maintenance of both eyewash and shower stations to check for such problems as clogged openings and lines, and adequacy of the fluid volume. A record of these inspections must be kept. If an eyewash or shower is non-functional then, the workers in the area must be immediately informed and advised of the nearest functioning eyewash/drench shower system.

Training

- All individuals assigned maintenance tasks for emergency eyewash and shower units are to be trained.

- All individuals working in labs are to be trained on using the stations.

- Training should include instruction in contact lens removal.

- Training should include a "hands-on" drill.

- Document training.

Maintenance Procedure Performed by Facilities Management

- UPEI has adopted the requirement that as a minimum, eyewash stations be tested and verified monthly basis and shower stations annually. The testing/verifications will be signed, dated, and supplemented by a complete annual preventive maintenance inspection performed by Facilities Management and in accordance with the manufacturer's instructions.

- A regular check helps ensure that there is flushing fluid available, helps to clear the supply line of sediments and minimizes microbial contamination caused by ‘still’ or sitting water.

NOTES:
Hand-held drench hoses support shower and eyewash units, but shall not replace them.

Personal eyewash units (e.g. eyewash bottles) can be used as support to plumbed eyewash units or where there is no access to plumbing (e.g. field trips). The eyewash solution expiry date must be affixed to the bottle and the solution must be replaced prior to expiration.

Eyewash Station Monthly Maintenance
Eyewash stations should be inspected monthly and maintained according to the manufacturer’s instructions, which may include but are not limited to the following:

- Ensure access is unobstructed.
- Ensure unit is free from sharp projections in the operating area.
- Verify protective eyewash covers are properly positioned, clean, and intact.
- Check that the bowl and spouts are clean and free of trash.
- Place a pan or bucket under non-plumbed drainpipes to collect water during flushing.
- Check that flow is effective and continuous by activating the unit.
    - Verify that protective eyewash covers come off when the eyewash is activated, as applicable.
    - Check that water flows from both eyepieces.
    - Evaluate for adequate flow based on manufacturer’s instructions.
    - Verify that flow continues until deactivation or according to manufacturer’s instructions.
- Allow the water to run for at least 3 minutes.
- Ensure the flow of water is clear. If not, does the flow become clear after 2 minutes?
- Document the inspection and performance test. See Appendix V for a testing/maintenance record. It’s convenient to post this record on the wall in a plastic sleeve near the eyewash station.

NOTES:
Some eyewash stations are on alarm systems to UPEI Security, therefore arrangements may need to be made prior to doing maintenance.

Some useful items to have available during the monthly maintenance/inspection/testing are a

bucket, mop and wet floor sign.

Safety Shower Station Annual Maintenance
Safety shower stations must be inspected annually and maintained according to the manufacturer's instructions, which may include but, are not limited to the following:

- Ensure access is unobstructed.
- Ensure unit is free from sharp projections in the operating area.
- Place a bucket under non-plumbed drainpipes to collect water during flushing.
- Check that flow is effective and continuous by activating the unit (pull handle downward).
    - Evaluate for adequate flow based on manufacturer's instructions.
    - Verify that flow continues until deactivation.
- Allow the water to run at least 3 minutes.
- Ensure the flow of water is clear. If not, does the flow become clear after 2 minutes?
- Document the inspection and performance test. See **Appendix V** for a testing/maintenance record. It's convenient to post this record on the wall in a plastic sleeve near the shower unit.
- Report problems with safety showers to Facilities Management for follow-up via the online work order process.

NOTES:
Some shower stations are on alarm systems to UPEI Security therefore arrangements may need to be made prior to doing maintenance.

Some useful items to have nearby for maintenance are a curtain funnel, a bucket, mop and wet floor sign.

To use an emergency shower:

- Step under the shower. Pull the triangular handle to activate the shower.
- Remove contaminated clothing (there is a disposable fire blanket attached to the shower that can be used for privacy).
- Shower for at least 15 minutes.
- Seek medical assistance.

- Be prepared to provide the ambulance attendants with information on the chemical involved in the incident.

To use a portable eye wash bottle:

- Place the eye cup of the bottle over the affected eye and squeeze the bottle to flush the eye**.**
- Continue to flush the eye until you are able to reach a fountain eye wash station that has continual water flow.
- Continue to flush the eye for a full 15 minutes.
- Seek medical assistance.
- Be prepared to provide the ambulance attendants with information on the chemical involved in the incident.

To use a fountain eye wash station:

- Activate water supply.
- Adjust the proportion of hot and cold water to provide a comfortable temperature if possible.
- Hold your eye lids open, being careful not to introduce foreign material into the eyes.
- Flush eyes for a full 15 minutes.
- Seek medical assistance.
- Be prepared to provide the ambulance attendants with information on the chemical involved in the incident.

5. OTHER LABORATORY HAZARDS

5.1 Laser Safety

5.1.1. Laser Use at UPEI

Lasers present many safety risks. The most common damage is to the eyes. Other common laser concerns include skin damage, electrical hazards from high-energy power sources, and exposure to cryogenic materials used for cooling the laser during operation. Also, in the presence of high levels of oxygen, primarily used in surgical procedures, there is a potential hazard for fire and burn injuries as a result of the laser igniting the gas. This is most common when a patient is given oxygen during laser surgery and the gas trapped under surgical drapes ignites when in contact with the laser beam. One cannot use too much caution in these circumstances.

Users at UPEI must be trained in laser safety. Only trained users are authorized to operate class 3 and 4 lasers.

Information regarding upcoming sessions on campus is available through the Health, Safety and Environment Department, or check the UPEI Health, Safety and Environment website (http://www.upei.ca/vpaf/health-and-safety)**.**

Relevant standards: *American National Standard for the Safe use of Lasers;*ANSI Z136.1-2014 available through the Radiation Safety Office.

5.1.2. Laser Classification

Class 1: These lasers are incapable of producing damaging radiation levels during operation and maintenance and are exempt from control measures and other forms of surveillance (e.g., laser printers, CD players). ***Note:*** these lasers are labeled as Class 1 due to the housing of the instrument. The laser is not accessible under normal operating conditions. If housing is opened or damaged, it becomes a higher class of laser.

Class 2: These are low-power visible lasers (wavelengths between 0.4-0.7 μm). They pose a hazard only when viewed directly unprotected for extended periods of time. Eye protection is normally afforded by the aversion response, including the blink reflex. Examples include laser pointers and supermarket bar code scanners.

Class 3: These lasers may be hazardous under direct and reflected viewing conditions. Diffuse reflection is usually not a hazard. They are usually not a fire hazard. These lasers pose moderate risk and can cause injury. Class 3A lasers include higher-powered laser scanners, laser pointers, and laser surveying instruments. Most research lasers are class 3B.

Class 4: These are high-power, high-risk lasers, and are hazardous to view under

any conditions. They present a potential skin and fire hazard. These lasers include surgical, cutting, and welding lasers.

5.1.3. Potential Hazards

Despite precautions, serious eye and skin injuries from lasers are common. The most frequently occurring laser injuries to research investigators are to the interior tissues of the eyes, from the thermal effects of visible and near infrared wavelengths. These incidents often occur during beam alignment procedures. The most effective controls include a rigorous alignment protocol at low output power and total enclosure of the laser and all beam paths. When total enclosure is not possible, partial beam enclosure, restricting access to the beam paths, and laser protective goggles, specific to the wave length in use, may be necessary. Burns, fire, and electrical shock are other potential hazards associated with high-power laser systems used in research. Beam stops and protective enclosures are standard preventative measures.

5.1.4. Safety Guidelines for Using Lasers

- Before operating any Class 3 or 4 laser, a worker MUST be trained in laser safety. Training must be refreshed on a regular basis. Surgical lasers have additional safety protocols in place.
- All precautions specified by the supplier of the instrument must be studied and implemented before use of instrument.
- Eye protection, appropriate for the wavelength of laser in use, must be worn. This information is written on the goggles themselves. All goggles are not the same.
- Never look directly at the beam or pump source.
- Do not allow any objects that cause reflection to be present in or along the beam path. Even buttons or screw heads can be dangerous.
- Always display proper warning signs in laser areas. Proper shielding is also required.
- Surgical laser plumes are to be contained and not inhaled.

5.2 Ultraviolet Lamps

Investigators on campus must ensure that individuals under their supervision who will be using UV sources are adequately informed of the hazards related to these sources, and in the safe methods of using the equipment. This is especially true when UV-B and UV-C sources are used. Investigators must supply protective equipment to UV equipment users when such protective equipment is deemed necessary and appropriate.

Manuals supplied by the manufacturer of the UV-generating equipment should be consulted for

instructions concerning safe operation. These manuals provide specific safety-related information (such as the type of eye/skin protection needed, ventilation requirements, etc.) that must be completely understood prior to energizing the equipment.

5.2.1 Types of UV Radiation

The UV radiation portion of the electromagnetic spectrum lies approximately between 100 nm and 400 nm in wavelength. The UV spectrum has been subdivided into three distinct spectral bands:

1. UV-A radiation (315 nm to 400 nm)	Called “near UV” and "black light". Is the least photobiologically active, but exposure can produce tanning and some burning of the skin, and can lead to the formation of cataracts (opacities in the lens of the eye). It is efficiently transmitted by air and common glass. Tanning parlours generally expose patrons to UV-A radiation.
2. UV-B radiation (280 nm to 315 nm	Called “middle UV” and "erythemal UV". Causes skin tanning and “sunburn,” photokeratitis (inflammation of the cornea of the eye), photoconjuctivitis (inflammation of the mucus membrane which lines the inner surface of the eyelids), and cataracts. It is transmitted by air, but can be blocked with common glass.
3. UV-C radiation (100 nm to 280 nm	Called “far UV” and "germicidal UV". Also causes photokeratitis and photoconjunctivitis, with maximum effects occurring at 270 nm. It is blocked by common glass and by air (for wavelengths < 200 nm).

5.2.2 UV Protective Equipment

Operators of UV-generating equipment, for which the radiation is not totally enclosed and exposures are possible, must wear UV-filtering face shields, safety glasses, or safety goggles and protective clothing. Although these items may not completely eliminate the exposure to UV radiation, they substantially reduce the risk of a severe burn. Most UV-filtering face shields and glasses are made of *polycarbonate* plastic, which is capable of absorbing 99 per cent of UV radiation.

5.2.3 Safety guidelines for UV radiation

- Only authorized personnel familiar with the potential hazards and control measures may use such units. Serious and painful eye and skin injuries can result if UV lamps are used improperly.

- Appropriate personal protective equipment must be worn.

- Never view the UV lamp directly. Needless exposures should be avoided, even in cases in which the eyes and skin are covered. Take all necessary steps to reduce the exposure time to as short as is reasonably achievable, and use barriers/enclosures/shields to their maximum advantage.

- Use UV lamps only in designated areas with limited access, which afford protection to passers-by. Operation from within a closed, well-ventilated room or a draped area reduces the risks of exposure.

- Always display appropriate warning signs where UV lamps are in use.

5.3 Radiation Safety

5.3.1 Authority

The University has appointed a Radiation Safety Committee to carry the advisory responsibility for the overall operation of the radiation safety program. This program is directly administered by the Radiation Safety Officer. UPEI is governed by the guidelines outlined in the Radioisotope licenses issued by the Canadian Nuclear Safety Commission. Copies of the licenses are available through the Radiation Safety Office.

5.3.2 User Permits

All projects involving radioactive material must first seek approval from the Radiation Safety Committee. Applications for user permits can be obtained from the Radiation Safety Officer.

5.3.3. Radiation Safety Training

Radiation safety training is offered on-site several times per year. The University is obligated to ensure that all personnel, workers, students, and faculty who come in contact with radioactive materials through the course of their work attend radiation safety training. Anyone not trained will not be permitted to work in a radioisotope lab. Dates, times, and locations of upcoming sessions are available from the Radiation Safety Officer.

5.3.4 Radiation Safety Guidelines

- The handling of radioisotopes must be confined to areas designated for radioisotope use.

- Radioactive materials, the vessels in which they are used, and the work area must be clearly marked with the radiation warning symbol.

- Always know the properties of the isotopes used. This information is readily available from the Radiation Safety Officer.

- Always wear gloves, lab coats, and any other protective equipment deemed necessary by the radioisotope in use.

- Use proper shielding when storing and working with radioactive materials.

- Keep a copy of the UPEI Radiation Safety Manual in all labs using radioactive materials.

Note: Anyone using radioactive materials improperly will be prohibited from working with radioisotopes and from working in areas containing these materials.

For further reference:
Refer to the *University of PEI Radiation Safety Manual* for all guidelines outlining all aspects of radioisotope use on campus. This manual is available through the Radiation Safety Office, AVC 2337N, phone: 902-566-0835.

5.4 Electrical Hazards

5.4.1 Maintaining Electrical Equipment

Laboratories are full of complex equipment. If it is improperly maintained or worn out, this equipment can pose a safety hazard. Frayed wires, damaged plugs and overloaded outlets are examples of such hazards and should respectively be repaired, replaced or upgraded immediately.

Typical laboratory circuits carry 15 amps of current. Few people are aware that contact with as little as 0.1 amps can cause fatal electrocution. Therefore, even ordinary laboratory electrical equipment carries enough current to severely injure or even kill. Maintenance of all electrical equipment helps to reduce electrical incidents.

5.4.2 Electricity and Water

Most people are aware that water and electricity don't mix. Of particular concern is a ground fault, a defect that allows electrical current to leak to an exposed metallic surface of a tool or appliance. Touching this metal surface allows electricity to pass through a person on its way to the ground with serious and possibly fatal results. Ground faults are particularly dangerous if a person is around water. To prevent such incidents, Ground Fault Circuit Interrupters (GFCI) outlets must be used in areas close to sinks and other water sources. A GFCI is sensitive to leakage of very small amounts of current. When it detects leakage it quickly interrupts the flow of current, preventing harm to the individual. If you have any concerns about the electrical safety of your lab or any laboratory equipment, speak with your supervisor or contact facilities management. Refer to our provincial regulations.

5.4.3 Preventing Contact with Electricity

- Inspect electrical equipment regularly and prior to use. Remove damaged electrical equipment from service immediately, label as 'out of service' and report it to your supervisor.

- Report any equipment whose operation trips circuit breakers or blows a fuse to your immediate supervisor (e.g. Principle Investigator, Lab Manager or Chair).

- Do not use extension cords for anything other than very temporary installations. When it is necessary to use an extension cord or a power bar, always ensure that they are CSA/ULC approved and are rated for use on the piece of equipment you plan to use.

- Do not remove the third prong (ground) of an electrical plug.

- Ensure that all electrical equipment is approved by the Canadian Standards Association (CSA).

- Repairs to electrical equipment should ONLY be made by competent personnel. Facilities Management, Biomedical Engineering personnel or specialized service providers who are properly trained and/or licensed to perform such tasks.

5.5 Mechanical Hazards

5.5.1 Identifying Mechanical Hazards

Mechanical hazards are commonplace in most laboratories. Any equipment with moving parts could pose a risk to the safety of the operator and/or lab personnel. Rotating equipment, in particular, can entangle clothing, hair, or hands. An unguarded vacuum pump drive belt is an example of one such entanglement hazard. A centrifuge is another mechanical hazard. A high-speed centrifuge stores enormous amounts of mechanical energy in the rapidly turning rotor. If

these centrifuges are not operated, maintained, and cared for properly, the rotor can fracture and fragments can become lethal projectiles. No one may operate mechanical equipment in laboratories without proper training and authorization from, or on behalf of, their supervisor.

5.5.2 Safety Guidelines for Using Mechanical Equipment

- Develop and use standard operating procedures from the manufacturer's operation manual for all hazardous mechanical equipment, such as centrifuges, orbital shakers, and vacuum pumps.
- Lab equipment must only be used by properly trained personnel.
- Some equipment can be dangerous when operated alone. Take necessary precautions.
- Only operate equipment when all guards and safety devices are in place.
- Always use safety eye wear and other protective equipment as specified in the manufacturer's operating manual or as specified by standard operating procedures.
- Exercise extreme caution when work requires the use of saws or any equipment with rotating parts.

5.5.3 Using Pressurized Equipment

Pressure is another form of mechanical energy that can be released suddenly. Equipment that operates above or below atmospheric pressure can explode or implode with alarming results. Examples of such equipment include items such as compressors, vacuum apparatus, and some distillation equipment.

5.5.4 Avoiding Injuries from Pressurized Equipment

- Guard all laboratory equipment that operates at reduced or elevated pressure. In the event of a rupture, the guard will protect laboratory workers from flying debris.
- Never heat a closed system, e.g. distillation
- When heating materials NEVER use a tightly closed container (e.g. capped bottles, sealed flasks, etc.). Microwave ovens and hotplates are especially hazardous in these instances.

5.6 Extremes in Temperature

5.6.1 *Extreme High Temperatures*

Many operations and many pieces of equipment found in laboratories operate at a high temperature, presenting risk of both burns and fire. Planning work in advance, having appropriate PPE, and paying attention to work in progress are normally sufficient to prevent incidents. Ensuring that insulation is undamaged and that equipment is maintained are important parts of a burn prevention program.

Some laboratory activity involves the use of very high temperatures or equipment that can become very hot under normal operating conditions. Plasma research and high-temperature pyrolysis are examples of high temperature activities. Laboratories involved in such activity should carefully review their practices to ensure they do not place individuals at risk.

5.6.2 *Extreme Low Temperatures*

Very low temperature experiments are common in some laboratories. Direct skin contact with very cold surfaces or coolant can burn the skin in a fashion quite like heat. The potential for harm increases with decreasing temperature. Many freezers in UPEI labs operate at temperatures well below an average household freezer. Many maintain temperatures as low as -80 degrees Celsius (See Appendix W for the SOP for -80 Freezers). Always wear protective gloves when retrieving or adding items to these freezers. Quite often, regular lab gloves will not offer enough protection and heavier cryo-gloves should be worn. **Avoid direct skin contact**. For further information about working with cryogens such as liquid nitrogen, liquid helium, or dry ice, see Section 3.5.

5.7 Biological Hazards

A biological hazard or biohazard is an organism, or substance derived from an organism, that poses a threat to health. This can include medical waste, samples of a microorganism, virus or toxin (from a biological source) that can impact human health. It can also include substances harmful to animals. The term and its associated symbol are generally used as a warning, so that those potentially exposed to the substances will know to take precautions.

Resources

- For information on the UPEI Biosafety Policy or the UPEI biosafety forms, please visit: http://www.upei.ca/vpaf/biosafety or http://www.upei.ca/research/biosafety.

- Laboratory Biosafety Guidelines: https://www.canada.ca/en/public-health/services/laboratory-biosafety-biosecurity.html

- Canadian Biosafety Standard (Second edition): https://www.canada.ca/en/public-health/services/canadian-biosafety-standards-guidelines/second-edition.html

- Canadian Biosafety Handbook: https://www.canada.ca/en/public-health/services/canadian-biosafety-standards-guidelines/handbook-second-edition.html

- Canadian Food Inspection Agency: http://www.inspection.gc.ca/eng/1297964599443/1297965645317

5.8 Nanoparticle Safety Guidelines

Nanoparticles have always been present in the natural environment. Recently nanoparticles have been intentionally created to determine potential benefits in medical treatment. Nanotechnology, utilizes nanoparticles which have the potential to be harmful to humans and the environment. Currently, there is very little toxicological data available to determine Occupational Exposure Limits, Threshold Limit Values, etc. to utilize for protection of workers. Until scientific research has been accepted and specific Federal/Provincial Occupational Health, Safety and Environmental legislation is developed and passed in Canada, UPEI will demonstrate due diligence to ensure the reasonable protection of those that handle, use, store, or dispose of nanoparticles and to prevent any releases into the environment. To achieve this UPEI has established these safety guidelines from the most current information available.

5.8.1 Definition of Nanoparticle

The American Society for Testing and Materials (ASTM) defines a nanoparticle as: a particle with lengths in two or three dimensions between 1 and 100 nanometers ((nm) or (10^{-9}m)). Nanoparticles come in different shapes such as spheres, tubes, rods, and other geometric shapes.

5.8.2 Purpose of Guidelines

The purpose of these guidelines is to ensure all reasonable precautions are identified and utilized by any person working with nanoparticles on the UPEI campus. These guidelines must be reviewed by the principal investigators/supervisors and used to establish written standard operating procedures and/or safe work practices, develop training and determine what equipment is required or what modifications to systems are necessary to ensure worker safety while handling, using, storing or disposing of nanoparticles.

5.8.3 Responsibilities

Health, Safety and Environment Department (HSE): Responsible for the development and review of these guidelines to ensure the content is current. As UPEI's usage of nanoparticles changes these guidelines will be updated to ensure that any new hazards/risks are identified, assessed and controlled to protect the health and safety of people and to maintain environmental stewardship (e.g. research with nanoparticles including experiments with animals). HSE will ensure that adequate controls for nanotechnology research are compliant with legislation, regulations, standards, and best practices.

Departments (Deans/Chairs): Responsible to ensure that those in charge of research activities (e.g. Principle Investigators) utilize these guidelines to establish specific written procedures for

handling, using, storing, and disposing of nanoparticles in their areas and to ensure that workers receive adequate training on how to work with nanoparticles safely. The specific departments will ensure that the necessary equipment (or modifications to equipment) and systems are complete prior to working with nanoparticles.

Supervisors: Responsible for writing specific protocols that must be followed by anyone working with nanoparticles in their laboratories. They must provide all safety training to anyone in their laboratory that may be exposed to nanoparticles as it is their ‘right to know’ under the OHS Act of PEI.

Workers/Students: Must comply with the standard operating procedures, safe work practices and training provided on working with nanoparticles. Workers/students must immediately report any hazardous conditions or situations to their supervisor to ensure an immediate response occurs to mitigate the hazard/risk. Workers/students must attend the safety training and wear all the mandatory PPE as described in the standard operating procedures or safe work practices developed for working with nanoparticles.

5.8.4 Routes of Exposure

There are 4 possible routes of exposure depending on the processes being used when working with nanoparticles.

Inhalation	Due to the size, nanoparticles can enter the respiratory system and end up in the trachea, bronchioles or alveoli of the lungs. Because of their tiny size they can end up deep within the lungs and may move to other body organs. Thus, nanoparticles must be handled in forms that do not generate airborne particulate whenever possible (e.g. solution). If there is a potential for airborne particulate to be generated engineering controls must be utilized (e.g. biological safety cabinet (BSC), fume hood (HEPA filtered), or glove box). When cleaning up work areas (e.g. benches, inside BSC, Fume Hood, etc.) or responding to a spill release it is mandatory to utilize a respirator with P100 cartridge.
Ingestion	This is possible if those that handle, use, store, or dispose of nanoparticles do not follow good hygiene practices. It is possible that nanoparticles may be ingested and moved throughout the body via the circulatory system. To reduce the potential for ingestion it is imperative that anyone who works with nanoparticles wash their hands frequently and prior to leaving the laboratory. Contaminated clothing (gloves, lab coats, safety glasses, etc.) must be removed and cleaned in a safe area. There must be no eating or drinking in any laboratory on campus.
Absorption	It is possible that nanoparticles may be able to penetrate through intact skin and be circulated in the body. Skin contact can occur when working with a liquid or powder that contains nanoparticles. Double gloving is recommended for anyone handling nanoparticles in a form that could contact the skin. The outer glove should be removed inside the fume hood or biological safety cabinet (HEPA filtered) to reduce the potential for particulate to migrate to other parts of the laboratory or onto other laboratory equipment/materials. The outer gloves should be placed in a sealed bag and disposed of as hazardous waste.
Injection	There is always the potential for contaminants entering the body by way of a skin puncture when using sharps, glassware, etc. in the laboratory setting or when working with animals (bites/scratches). To prevent accidental exposure via this route it is recommended that double gloves and a lab coat be worn at all times and that standard operating procedures and/or safe work practices are followed when working with sharps (e.g. needles).

5.8.5 Hierarchy of Exposure Controls

The hierarchy of controls for nanoparticles is no different than for any hazard. The following table/list explains the controls from most effective to least effective. A thorough hazard analysis must be completed prior to commencing work with nanoparticles to identify, assess, and control all the hazards inherent in the specific job/task being performed using nanoparticles.

Elimination/Substitution	Eliminate the hazard by effectively changing the experimental design (e.g. automated process to remove worker from hazard or use a product that poses less of a hazard (e.g. chemical or larger particle size or different formulation).
Engineering	Reduce the potential for exposure by removing the hazard at the source (e.g. using local exhaust ventilation such as an externally vented biological safety cabinet or fume hood with HEPA filters to remove the nanoparticles prior to reaching the worker).
Administrative	Ensure adequate procedures, training, signage, preventative maintenance schedules, etc. are in place to reduce the potential for exposure to nanoparticles while being used, handled, stored, or disposed of by workers (e.g. restricted access, transport dry nanoparticles in sealed containers, clean work area daily using a HEPA vacuum or wet wiping method).
Personal Protective Equipment	Utilizing standard laboratory PPE for working with nanoparticles or any hazardous chemical to ensure a protective barrier is between the worker and the hazard [e.g. wear latex or nitrile gloves (double glove) with gauntlets (to protect forearm) when handling nanoparticle materials, wear chemical splash goggles when working with nanoparticle material in suspension or dry powder forms, wear disposable lab coats, boot covers and appropriate respiratory protection (minimum half face elastomeric respirator with P100 cartridges if there is inadequate ventilation or the potential for airborne particles exists (e.g. during spill clean-up)]. When possible use disposable PPE to reduce the potential for exposure to nanoparticles.

5.8.6 Spill/Release Clean-Up

The laboratory that will work with nanoparticles should create a specific spill kit in the event of a release/spill. The spill kit should contain:

1. disposable PPE (Tyvek suits and boot covers,);
2. nitrile gloves (gauntlet);
3. deionized water in spray bottle to mist down any particulate/powder prior to removal;
4. sealable bags and container;
5. absorbent material;
6. wipes; and
7. barricade tape.

The laboratory should have access to a HEPA filter vacuum to assist in spill clean-up. Any spill or release of nanoparticles must be reported to your supervisor and cleaned up immediately. A UPEI incident report must be completed immediately after clean-up is completed. Follow the laboratory spill clean-up procedures outlined in Section 6. The unique difference with nanoparticles is to prevent them from becoming airborne particulate matter. If the spill is outside the biological safety cabinet or fume hood then, everyone should be removed from the laboratory. Those that will clean up the spill must wear appropriate respiratory protection with P100 cartridges and disposable Tyvek PPE (lab coat and boot covers). A tack mat should be placed at the access/egress point(s) to prevent nanoparticle migration on feet. To clean up effectively while reducing the potential for generating airborne particles utilize a HEPA vacuum and/or a wet wiping method to minimize the amount of dust generated during clean up. All PPE should be removed in a non-contaminated area of the laboratory with respiratory protection being the last piece of PPE to remove. All contaminated waste (and disposable PPE) must be placed in a sealed container, labeled properly, and disposed of as hazardous waste.

If the spill/release is too large (highly unlikely in a laboratory setting) then, everyone evacuates the laboratory and contact campus security to advise of the hazards (nanoparticles and any other controlled products e.g. solvents), the quantity, location and precautions to take as per safety data sheet. UPEI Security Services will contact the Health, Safety and Environment Department and members of the Emergency Operations Centre Team to initiate spill clean-up response by an external agency.

5.8.7 Disposal of Nanoparticle Waste

All nanoparticle waste must be considered hazardous waste including all materials, etc., that were in contact with the nanoparticle material and have become heavily contaminated with nanoparticles such as PPE, disposable items, etc. All waste must be placed in a sealed container and labeled appropriately. The label should include percentages of all hazardous components within the container and wording such as “Trace Nanoparticles” to ensure those workers that will handle the waste and dispose of it know what hazards are within the container. If nanoparticles are mixed with biological hazardous materials then, the waste must be placed in an appropriately labeled container and disposed of through an external waste provider.

Refer to *Hazardous Chemicals and Containers for External Disposal* in section 3.7.6.

5.8.8 References

- National Institute of Environmental Health and Safety
  http://www.niehs.nih.gov/health/topics/agents/sya-nano/

- Concordia University: Nanomaterials Safety Guidelines
  https://www.concordia.ca/content/dam/concordia/services/safety/docs/EHS-DOC-035_NanomaterialsSafetyGuidelines.pdf

- The University of Texas; Health Science Center at Houston: Nanoparticles Safety Guide
  https://www.uth.edu/dotAsset/f4cda4eb-dee9-498a-8b6b-598df7af6783.pdf

- Purdue University: Nanoparticle Safety and Health Guidelines
  https://www.purdue.edu/ehps/rem/home/booklets/nanopolicy.pdf

5.9 Cytotoxic Drugs Safety Guidelines

Cytotoxic drugs are toxic therapeutic agents, used for cancer treatment, that destroy cells during cell reproduction. Currently there are no established occupational exposure limits for cytotoxic drugs. Veterinary practitioners involved in handling cytotoxic drugs are at risk for exposures during preparation, administration, and clean-up of waste that contain cytotoxic drugs. To demonstrate due diligence UPEI will ensure that reasonable measures are in place to reduce the potential for exposure to those that may be subjected to low level doses through the course of their employment (e.g. chronic exposure). Exposure can occur by inhalation of aerosols and/or particulate, absorption through the skin, ingestion and needle stick injuries while preparing cytotoxic drugs, administering cytotoxic drugs to patients or cleaning up waste containing cytotoxic drugs. Some other ways exposures can occur are: during transport of cytotoxic drugs, contact with contaminated surfaces, and handling, transportation, and disposal of animal wastes (e.g. urine and fecal matter).

There is still very little known about the long term effects of exposure to cytotoxic drugs but, there is evidence that indicates potential adverse effects due to occupational exposure. Possible effects include: contact dermatitis, allergic reaction, alteration to normal blood cell counts, excretion of the drugs or metabolites in the urine in exposed personnel. Although chronic occupational exposure effects are inconclusive, UPEI will ensure that every reasonable precaution is taken for the protection of everyone working with cytotoxic drugs.

5.9.1 Definition of Cytotoxic Drugs

Cytotoxic Drugs: Toxic to cells. These drugs destroy rapidly growing cancer cells and have been found to be mutagenic, carcinogenic and/or teratogenic. Cytotoxic drugs are commonly used in chemotherapy to inhibit the proliferation of cancerous cells.

5.9.2 Purpose of Guidelines

The purpose of these guidelines is to provide information and advice to eliminate, or at minimum, reduce the potential for exposure to anyone working with cytotoxic drugs or waste containing cytotoxic drugs. These guidelines provide safety information to assist staff, faculty, students and clients that handle, use, store, dispose, or administer cytotoxic drugs (or handle waste containing cytotoxic drugs) in preventing unnecessary exposure. Anyone involved with cytotoxic drugs and its waste must be aware of the inherent hazards and risks. The applicable UPEI supervisors will ensure that protocols are in place to safely work with these hazardous materials.

5.9.3 Responsibilities

It is a legislated Occupational Health and Safety responsibility for all workplace parties to do everything reasonable, under the circumstances, to protect themselves and others from injury/illness.
The supervisor (e.g. Veterinarian) in charge of a procedure involving the use of cytotoxic drugs has the responsibility to ensure that:

- an SOP is in place,
- workers have been trained on the SOP,
- workers adhere to the SOP to prevent an exposure to cytotoxic drugs; and,
- all the necessary tools, equipment, devices, and other resources to complete the work are readily available and in good working condition.

Any deviation from the SOP must be documented and approved by the VTH Hospital Administrator (Director).

Workers that prepare and administer cytotoxic drugs must be qualified by knowledge, training, certification and experience to complete these tasks and must demonstrate competency to their supervisor prior to working with these hazardous products without supervision.

The employer and supervisors have the responsibility to ensure that:

- anyone working with cytotoxic drugs is sufficiently trained in the procedures to complete the work safely. This would include workers that handle (e.g. shipping/receiving), prepare, administer, transport, store or disposes of cytotoxic drugs.
- all the necessary personal protective equipment is readily available and workers have been trained to effectively respond to an emergency (e.g. spill, exposure).

All workplace parties are responsible to immediately report any incident involving cytotoxic

drugs to their supervisor and submit a completed incident report form to the Health, Safety and Environment Office (3rd floor Kelley Building) or via email to incident@upei.ca . This ensures that appropriate corrective actions are implemented to prevent a recurrence. The original incident report form and investigation paperwork must be submitted to the Health, Safety and Environment Office within 3 business days.

5.9.4 Routes of Exposure

There are 4 possible routes of exposure depending on the procedures involving cytotoxic drugs.

Inhalation	This is the main route of exposure when preparing, handling, administering, storing or disposing of cytotoxic drugs. Depending on the state of the cytotoxic drug (i.e. liquid or solid) there is a potential to inhale drug particles or aerosols while preparing or administering to the patient. When preparing cytotoxic drugs engineering controls must be utilized (the Pharmacy Suite has a Class II Type C1 biological safety cabinet (BSC) that HEPA filters the air within the BSC and directly exhausts out of the building). When cleaning up cytotoxic spills outside the BSC a N95 respirator should be used by the responders if there is an inhalation hazards. All other people must be evacuated from the immediate area of spill until the spill has been effectively cleaned up.
Ingestion	This is possible if those that handle, use, store, or dispose cytotoxic drugs do not wear all the necessary PPE and do not follow good hand hygiene practices. It is possible that cytotoxic drugs may be ingested and moved throughout the body via the circulatory system. To reduce the potential for ingestion it is imperative that anyone who works with cytotoxic drugs washes their hands frequently and immediately after the task (e.g. prior to leaving the laboratory, after administering or after cleaning BSC/kennel/cage). It is strongly recommended that all PPE used when working with cytotoxic drugs are single-use/disposable. E**ating, drinking and storage of food** are prohibited in all laboratories on campus and in specific areas within the VTH (e.g. treatment rooms).
Absorption	Cytotoxic drugs can be absorbed through intact skin (or mucous membranes) and will be circulated throughout the body. Skin contact can occur when preparing or administering cytotoxic drugs in a liquid or powder form, when handling cytotoxic wastes, and transporting materials containing cytotoxic drugs. All workers must ensure that a protective barrier such as gloves and lab coats are worn to reduce the

	potential for absorption through the skin. Cytotoxic drugs can also irritate mucous membranes (e.g. eyes). Anyone who works with cytotoxic drugs, or waste containing cytotoxic drugs, must ensure that appropriate safety eyewear is worn. Adherence to applicable SOPs is mandatory to protect the worker from exposure to cytotoxic drugs.
Injection	There is always the potential for contaminants entering the body by way of a skin puncture when using syringes, scalpels, glassware, etc. or if there are cuts or abrasions on the skin. If this type of exposure occurs it must be immediately treated, reported to your supervisor. and observed for any potential problems. If necessary, medical attention should be sought depending on the wound and all potential contaminants (e.g. type/dose of cytotoxic drug and potential infectious hazards from source, blood or bodily fluids from animal being treated). All necessary safe work practices must be followed when working with sharps including the required use of closed system transfer devices (needless system) to prevent accidental exposure via needle stick.

All cytotoxic waste must be labeled and disposed of as per SOP. Adverse effects to exposure depend on many factors including, but not limited to, dosage and exposure time. Those workers that provide chemotherapy care to animals, prepare, and administer cytotoxic drugs have the highest potential for chronic exposure. These workers must be diligent with adhering to all safety protocols to prevent unnecessary exposure. Some effects of exposure include irritation of the skin or mucous membranes, potential allergies, nausea, dizziness, and headaches. Anyone exposed to cytotoxic drugs must receive medical attention or advice. Phone the poison control center at: 1-800-565-8161. The SDS must be consulted if there has been an exposure and must be taken with the 'exposed' person to the hospital or medical center/clinic.

5.9.5 Hierarchy of Controls

UPEI cannot eliminate the hazards inherent with working with cytotoxic drugs. To demonstrate due diligence UPEI will follow the hierarchy of controls, to assess and control the hazard(s). The initial process must:

1. Identify the people at risk of exposure;
2. Explain the hazards to those at risk of exposure;
3. Provide required training and PPE to those at risk of exposure; and,
4. Educate those working with cytotoxic drugs on the signs and symptoms of exposure.

Elimination/ Substitution	Eliminating cytotoxic drugs is not an option at the current time as they are an effective means of treating different types of cancer; however, whenever possible UPEI will substitute cytotoxic drugs (or forms e.g. liquid/pill) for another option that is as effective at treating the patients while reducing the health hazards to those that have to work with the

	drugs.
Engineering	These engineering controls will be used when preparing cytotoxic medications: 1. A minimum of a Class II Type C1 biological safety cabinet (BSC) with HEPA filter exhaust system that does not allow air to be circulated back into the room (direct exhaust out of the building). 2. Closed system transfer devices. Required to be used during preparation and administration of cytotoxic drugs to prevent aerosolization. 3. Medications will be secured and only accessible to those people properly trained and approved to have access to the storage location. 4. Containers for safe disposal of needles, syringes, vials and glassware must be CSA approved, labeled (cytotoxic), and puncture proof. 5. Preparation areas must be under negative pressure to prevent any spilled cytotoxic drugs from migrating out of the preparation room. 6. Safety engineered medical devices such as luer lock syringes.
Administrative	Ensure adequate procedures, training, signage, preventative maintenance schedules, etc. are in place to reduce the potential for exposure while preparing, administrating, or transporting cytotoxic drugs or while handling or storing any waste containing cytotoxic drugs. Appropriate labels must be visible on packaging to ensure those handling cytotoxic materials are aware of the contents. Special controls are required for workers regarding the potential hazards involved in handling materials that may be contaminated with biological fluids contaminated with cytotoxic drugs (e.g. feces, urine, animal bedding, etc.). SOPs and/or safe work practices for handling these materials must be developed and all affected staff trained to prevent unnecessary exposures including the mandatory use of closed system storage device (CSTD). SOPs should consider using chemo mats under the animal to absorb any cytotoxic drug that may leak from the IV system. Proper signage informing all workplace parties of the presence of cytotoxic drugs and their hazards must be developed and displayed in highly visible locations. Eating, drinking, and the storage of food are prohibited in the cytotoxic preparation area. Students are not to be involved in the actual administration of cytotoxic medications.  (example of a label)
Personal Protective	Those handling cytotoxic drugs must use: 1. Chemotherapy protective gloves that comply with ASTM

Equipment	standard D-6978-(05)-13 and be powder free when administering cytotoxic drugs. The preparation of cytotoxic drugs must be done in a sterile environment thus, the dispensary staff will double glove using sterile surgical gloves. Gloves should be changed frequently, or immediately if punctured, cut, or torn. It is also recommended that two pairs of gloves are worn at a time for additional protection. Vinyl gloves should not be used. 2. A moisture resistant, long sleeved, back closing gown with elastic cuffs. 3. Eye protection (e.g. chemical splash goggles) and face shields when there is a possibility of a splash to the face or eyes. 4. Protective booties when administering or cleaning cages/kennels to protect against a spill or splash. 5. At minimum a N95 respirator and if necessary the appropriate elastomeric respirator and appropriate cartridge if there is a chance of exposure to aerosolized drugs, such as when cleaning up a liquid spill, unpacking, or mixing drugs. To prevent environmental contamination of cytotoxic medication protective clothing should not be worn outside of the preparation area. Utilizing standard laboratory PPE for working with cytotoxic drugs will ensure a protective barrier is between the person and the hazard. Wearing appropriate respiratory protection (minimum N95 respirator) will reduce the potential for exposure when cleaning up a cytotoxic drug spill. It is strongly recommended that whenever possible disposable lab coats and other PPE are utilized to reduce the potential for exposure. Other non-disposable PPE (e.g. safety glasses/goggles/face shields, respirators, etc.) must be thoroughly washed using soap and water after use.

Safety while caring for patients
Those individuals that could be exposed to biological fluid from a patient who has received cytotoxic drugs within the previous 48 hours, and those people handling potentially contaminated waste (or bedding) must wear protective gloves and disposable gowns that are discarded after use. It is the responsibility of the supervisor to ensure appropriate signage is posted in conspicuous areas to inform everyone (students, staff, faculty, facilities management, etc.) of the presence of cytotoxic drugs in the specific area(s) so appropriate safety precautions are taken.

Waste disposal
All cytotoxic waste will be placed in approved, labeled bins provided by the external waste provider. If plastic bags are used they must be labeled as cytotoxic waste. All sharps must be placed in puncture proof containers (labeled as 'cytotoxic waste') at point of use. The supervisor must ensure that waste materials containing cytotoxic drugs are segregated (i.e. separate from other non-cytotoxic wastes), placed in the approved containment , labeled as cytotoxic waste, and kept in a secured area until picked up by the waste provider.

Anyone handling materials that may contain cytotoxic waste must wear gloves. Cytotoxic waste must be handled differently than regular garbage and must be prepared for disposal as per UPEI's outside service provider (i.e. waste management contractor).

5.9.6 Storage of Cytotoxic Drugs

Cytotoxic drugs will be ordered, received, and stored by a competent person (e.g. AVC Pharmacist). The VTH Administrator/Director must ensure that everyone involved with ordering, receiving, and storing of these medications is competent to complete their work safety.
The refrigerator and any other storage areas/cabinets that contain cytotoxic drugs must be labeled appropriately and the SDS must be readily available and in close proximity to the storage locations. All cytotoxic drugs must be in a designated and secured location (e.g. locked dispensary with controlled access). Each container (e.g. bottle or sealed bag) holding the drug must be clearly labeled "Cytotoxic" and must be stored in the original container.

5.9.7 Spill/Release Clean-up

It is imperative that cytotoxic drug spills are cleaned up immediately. It is strongly recommend that specific chemotherapy spill kits are purchased and are readily available in areas where cytotoxic drugs are prepared, stored, or administered to patients. The VTH Administrator/Director must assign competent workers as spill responders (e.g. RVT/ATH). Spill response provisions should include:

1. disposable nitrile gloves
2. disposable gown
3. disposable booties
4. chemical splash goggles
5. fitted N95 respirators
6. absorbent plastic backed pads (2)

7. disposable towels for cleaning and absorbing chemical spills
8. strong alkaline detergent (or approved wipes)
9. approved sharps container (labeled as cytotoxic)
10. cytotoxic plastic bags (2)
11. warning signage: chemical spill
12. caution tape to cordon off area of spill
13. disposable dust pan
14. plastic scraper
15. cytotoxic labeled, plastic puncture-proof, leak-proof container (can be used to hold all the provisions)
16. plastic tweezers (to pick up debris, broken glass, etc. within the spill)

The responsible AVC supervisor for cytotoxic drug preparation and delivery to the patient must develop a SOP on how to effectively clean up a spill in the biological safety cabinet, in the storage room, on a floor during transport, and when administering the drug to the patient. All people handling, using, storing, or disposing cytotoxic drugs must be trained on the spill response procedures and contents of the cytotoxic/chemotherapy spill kit. The education should be documented to demonstrate the supervisor's due diligence.

Any chemical spill should be cleaned up from the outer perimeter gradually working towards the center. A cytotoxic spill procedure should include immediately donning the necessary personal protective equipment, removing anyone in close proximity, and cordoning off the area of spill prior to beginning spill clean-up. Initial action is to utilize absorbent pads/towels to remove the majority of the spilled material. Once the majority of the cytotoxic material has been absorbed the area of spill should be washed down using an appropriately diluted strongly alkaline detergent, rinsed thoroughly with sterile water, and then wiped down with sterile isopropyl alcohol (70%) or other suitable agent. If using an approved cytotoxic spill kit then, follow the instructions to utilize the wipes, etc. within to effectively clean the spill. All contaminated materials must be placed in the labeled cytotoxic bag/container for appropriate disposal through the UPEI approved waste contractor.

Main steps to clean up a cytotoxic spill contained within a BSC:

1. Obtain cytotoxic spill kit.
2. Identify the area where the cytotoxic material was spilled.
3. Absorb the liquid with the absorbent material (towel or pad).
4. Clean contaminated area as per the cytotoxic spill kit instructions.
5. Dispose of contaminated material in labeled, cytotoxic bag/container for proper disposal.

Main steps to clean up a cytotoxic spill on a floor or in area where the drug was administered:

1. Obtain cytotoxic spill kit.
2. Don all PPE (N95 respirator, double glove, gowns, booties, chemical splash goggles, etc.).
3. Evacuate immediate area then cordon off area with caution tape. Place spill signage

outside caution tape. If the spill is large and assistance is needed to restrict asses to the area please contact Security Services ext. 0384 (UPEI phone) or 902-566-0384 (cell phone). Call your supervisor if relocating animals nearby is required due to the size of the spill.

4. Prevent spill from spreading by absorbing cytotoxic spill from outer perimeter towards the center with absorbent pads. Keep applying absorbent pads until the majority of the spill is removed. Clean up any debris (e.g. broken glass, sharps, etc.) with plastic tweezers and place in the cytotoxic labeled waste container. If it is a powder spill, wet the absorbent pads and carefully place over the spilled powder to prevent migration of powder.
5. When majority of spill is absorbed by pads place pads in labeled cytotoxic waste container.
6. Clean area as per cytotoxic spill kit instructions.
7. When done cleaning area, remove outer gloves and discard all disposable waste (PPE, tools, etc.) in the labeled cytotoxic waste bag or container already used for other contaminated material (absorbent pads). Seal the first bag or container and place into a second cytotoxic labeled waste bag. Remove inside gloves and dispose of in second bag then, seal second bag.
8. Wash your hands thoroughly with soap and water.
9. Contact Facilities Management to thoroughly clean the area of spill.
10. Remove signage and caution tape to open up area again. Dispose of caution tape.
11. Arrange for proper disposal of the cytotoxic waste through the approved UPEI waste contractor.
12. Inform your supervisor, complete and submit the UPEI incident report form via email at incident@upei.ca .

5.9.8 Cleaning of Facilities, Equipment Used by Treated Animals

This section is to reduce the potential for exposure to those people that provide support to any patient that is receiving cytotoxic drugs as part of their treatment plan. The workers that clean cages, floors, etc. where cytotoxic drugs are prepared, administered, or where animals being treated with cytotoxic drugs are housed have a right to know about the potential exposure hazard and how to protect themselves while completing their work.

Any area where cytotoxic drugs are prepared or administered, as well as animal holding areas (e.g. kennels, transfer cages, etc.) where patients being treated with cytotoxic drugs are housed must be considered a contaminated area. The workers involved with cleaning these areas must receive training and education on the health risks associated with cytotoxic drugs and the consequences of ineffective cleaning. The appropriate PPE must be worn by those assigned cleaning duties in potentially contaminated areas. All contaminated disposable items used to clean these areas must be disposed of as cytotoxic waste.

Here is a list of the equipment required to clean a cage/kennel:

1. disposable gown
2. protective eyewear (chemical splash goggles or face shield if splashes are possible)

3. chemotherapy gloves (rubber or nitrile)-DOUBLE GLOVE
4. rubber Boots
5. waste provider approved container (bin, plastic bag) with cytotoxic label for waste materials.
6. absorbent towels/pads
7. multi-purpose disinfectant

Cleaning procedure for cage/kennel:

1. Every effort should be made to eliminate producing airborne particulate or aerosols when cleaning cage/kennel contaminated with animal waste (e.g. feces, urine) or blood and bodily fluids (e.g. saliva).
2. All appropriate PPE must be worn to complete these cleaning tasks.
3. All bedding used by animals treated with cytotoxic drugs must be disposed of to prevent cross contamination to other materials or contaminated linen can be sent out to an external laundry facility to be processed safely.
4. All contaminated disposable materials must be placed in an approved, container (e.g. bin or bag) with a cytotoxic label and disposed of appropriately through the approved UPEI waste contractor.
5. Absorbent pads or paper towels can be used to remove the majority of liquid/wet waste and place in the approved container (e.g. bin or plastic bag) with a cytotoxic label.
6. Wash the cage with diluted strongly alkaline detergent (> 10 pH) prior to applying the multipurpose disinfectant.
7. Use the multipurpose disinfectant to rinse the area, repeat several times.
8. Allow the cages/kennels to air dry or dry the area with towel/pads and place in cytotoxic waste bag.
9. Complete the final clean using water and bleach (2.4% solution). All disposable materials must be placed in the cytotoxic waste bag (e.g. paper towel, etc.)
10. Remove outer gloves and place in cytotoxic waste bag then, seal the bag and place in a second cytotoxic waste bag along with other disposable materials (e.g. gown). Do not overfill the bag.
12. Remove inside gloves, dispose of in second waste bag and seal the bag.
13. Wash your hands with soap and water.
14. Place the bag in a rigid plastic, leak-proof container (or bin) to prevent leakage during transport to the appropriate area for disposal via the approved UPEI waste contractor.

5.9.9 Disposal of Cytotoxic Drugs and Contaminated PPE

All waste containing potential cytotoxic drugs generated from preparation, administering, cleaning, etc. must be placed in a sealed, purple cytotoxic bag and all sharps contaminated with cytotoxic drugs must be deposited in a purple cytotoxic puncture/leak proof container and disposed of through the approved UPEI external waste contractor as described in the SOP. This hazardous cytotoxic waste must be separated from all other waste.

5.9.10 Tips for Owners of Pets that are Receiving Cytotoxic Drugs

If cytotoxic drugs (pills) are to be administered at home by the owner then, they must be labeled and packaged appropriately (as per the PEI VMA rules) including: Veterinarian's name, DIN, owner's name, patient's name, drug name, administration route, schedule and dosage. Clear verbal and written instructions must be provided to the owner of the animal that will administer the cytotoxic drugs at home. Home care givers must be informed in writing of all special precautions to take to administer the cytotoxic drug and to clean up animal waste during the specified treatment period to prevent exposure to themselves and other animals in close proximity.

The home care giver should have these materials on hand during the home treatment plan using cytotoxic drugs (pill form):

1. Disposable nitrile/latex gloves (dispose of after each use).
2. Flushable paper towel for cleaning up animal wastes.
3. Detergent to wash down area after clean up.
4. Owners should identify the area that the animal urinates outdoors to ensure copious amounts of water can be poured over the area to dilute the cytotoxic drugs within the urine. They must be advised to prevent splashing and to wear appropriate PPE (e.g. safety goggles or face shields) when applying water that has potential for splashes.
5. Animals undergoing cytotoxic treatment should not be permitted in public places (eliminate waste including urine and feces from contaminating public areas) until advised by the veterinarian in charge.
6. Scoop up feces on a shovel and flush down a toilet.
7. Waste (e.g. diarrhea, vomit, or urine) that cannot be picked up should be diluted using copious amounts of water.
8. Animal bedding and care-giver clothing that has been contaminated should be laundered immediately and separated from other non-contaminated materials. Wash and rinse on longest cycle at least twice.
9. Wash your hands with soap and water thoroughly after cleaning up waste or handling any materials that may be contaminated with cytotoxic material.

5.9.11 References

- Massey University, Kate Hill and Andrew Scuffham 2007; Reviewed by Els Acke, Jon Bray, and Steve Crow, Health and Safety Strategy 'Guide for handling cytotoxic drugs and related waste'. http://www.massey.ac.nz/massey/fms/Colleges/College%20of%20Sciences/IVABS/vetschool/IVMA%20/3_%20SOP%20CYtotoxic%20Drugs.pdf

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of-Hazardous-Drugs-in-Healthcare.pdf

- Current Oncology, Safe handling of cytotoxics: guideline recommendations; 2015 Feb: 22(1) e27-e37; PMCID: PMC4324350 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4324350/

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- Veterinary Clinics of North America: Small Animal Practice Volume 44, Issue 5, September 2014, pages 941-963 Chemotherapy Safety on Clinical Veterinary Oncology http://www.sciencedirect.com/science/article/pii/S0195561614000874#bib6

- ASTM International. ASTM D6978-05(2013) Standard Practice for Assessment of Resistance of Medical Gloves to Permeation by Chemotherapy Drugs. West Conshohocken, PA: ASTM International; 2013

6. RESPONDING TO EMERGENCIES

UPEI requires that laboratory workers shall be trained and able to respond effectively to incidents that are reasonably foreseeable.

Where the laboratory activities warrant, site-specific safety training must ensure that workers have ready access to and are trained in the use of: fire extinguishers, first aid supplies**,** eye wash fountains, emergency showers**,** chemical spill kits, emergency equipment, and personal protective equipment**.**

6.1 Responding to a Fire

If you suspect a fire (e.g. smell smoke) call UPEI Security Services at ext. 0384 or 902-566-0384

If you discover a fire, **RACE** for safety:
R - Rescue anyone in immediate danger,
A - Activate the Fire alarm (and/or Call 9-911 for emergency services),
C - Contain the Fire (Close the door if possible) and,
E - Extinguish the fire (if you are trained to use a fire extinguisher and if the fire is small) otherwise, **Evacuate** the building.

For further information, refer to the UPEI Evacuation Procedures and UPEI Building Emergency Plans.

6.1.2 Choosing the right extinguisher

Fire Extinguisher Ratings

Class A: Will put out fires of ordinary combustibles, such as wood and paper. The numerical rating for this class of fire extinguisher refers to the amount of water the fire extinguisher holds and the amount of fire it will extinguish.

Class B: Should be used on fires involving flammable liquids, such as grease, gasoline, oil, etc. The numerical rating for this class of fire extinguisher states the approximate number of square feet of a flammable liquid fire that a non-expert person can expect to extinguish.

Class C: Suitable for use on electrically energized fires. This class of fire extinguishers does not have a numerical rating. The presence of the letter “C” indicates that the extinguishing agent is non-conductive.

Class D: Designed for use on flammable metals and are often specific to the type of metal in question. There is no picture designator for Class D extinguishers. These extinguishers generally have no rating nor are they given a multi-purpose rating for use on other types of fires.

A		Ordinary Combustibles	Wood, Paper, Cloth, Etc.
B		Flammable Liquids	Grease, Oil, Paint, Solvents
C		Live Electrical Equipment	Electrical Panel, Motor, Wiring, Etc.
D		Combustible Metal	Magnesium, Aluminum, Etc.
K		Commercial Cooking Equipment	Cooking Oils, Animal Fats, Vegetable Oils

Carbon dioxide extinguishers: Effective in extinguishing both flammable liquid and electrical fires. Carbon dioxide extinguishers are red with a large-diameter black nozzle. Using a CO_2 extinguisher releases very cold carbon dioxide which cools the extinguisher's black horn. Touching either the horn or the CO_2 "snow" can cause serious skin injury.

Multi-purpose extinguishers: Some UPEI laboratories are equipped with dry chemical extinguishers that may be used on fires involving ordinary combustibles, flammable liquids, or energized electrical equipment. Dry chemical extinguishers are orange or red resembling CO_2 extinguishers but with a simple black hose instead of the large black plastic horn of a CO_2 extinguisher. Discharging a dry chemical extinguisher releases lots of fine, fire-retardant powder that effectively extinguishes many fires. However, the powder may present a significant clean-up problem, particularly if it gets into sensitive electronic equipment. CO_2 extinguishers are strategically located throughout UPEI to reduce the potential for damage on sensitive/expensive equipment while still effectively extinguishing a fire in close proximity to the equipment.

At UPEI, **all silver-coloured extinguishers contain pressurized water for use on ordinary combustible fires.**

Warning: Using water on burning solvents, oils, fats, or other flammable liquids might spread the fire and ignite other, nearby materials. Similarly, water should not be used to fight fire in electrically energized equipment. As a water stream can conduct electricity, someone using water on a fire in energized electrical equipment could be electrocuted.

6.1.3 Using a Portable Extinguisher

Choose the correct extinguisher for the type of material that is burning and ensure that you have a safe escape route. Remember the acronym **PASS**.

P - PULL the pin to release the handle.
A - AIM the nozzle at the base of the fire.
S - SQUEEZE the handles together.
S - SWEEP the nozzle back and forth over the base of the fire to extinguish.

To prevent harming others, never unnecessarily discharge an extinguisher in the direction of any person. Evacuate immediately if you cannot completely extinguish the fire with one extinguisher.

For further reference: Hanford Fire Dept., *All You Ever Wanted to Know about Fire Extinguishers*
Retrieved August 11, 2005, from www.hanford.gov/fire/safety/extingrs.htm

6.2 Dealing with Chemical Spills/Releases

Remember the acronym **SPILL:**

S – Secure the scene of spill and safely evacuate all persons from vicinity.
P – Prevent the spread of materials/vapours/fumes by stopping the source of the release, if safe to do so. Prevent material from entering waterways.
I – Initiate the call to your supervisor and inform of specifics of spill/release. Initiate spill clean-up procedure and incident report completion.
L – Leave all electrical equipment alone. Do not turn anything on or off, including light switches.
L – Locate the SDS for the chemical. Use this information to ensure the hazards are understood and the necessary personal protective equipment is worn (respirators, gloves, goggles, body coverings, etc.).

Spill response requires knowledge of the physical, chemical, and toxicological properties of spilled chemicals. Always consult a chemical's SDS prior to chemical use to determine the materials required for a spill clean-up. Planning ahead and ensuring the laboratory has the required equipment usually results in a quick, safe, and effective response.

Laboratories with chemical hazards are required to have appropriate spill kits which contain absorbent and protective equipment for use in responding to chemical spills. Information on the location of these spill kits and a list of the contents will be given during the site-specific safety training (See **Appendix X** for a *Sample Department Safety Training Checklist* that can be used to document supervisor due diligence that adequate safety training has been provided to laboratory workers). Spill kits should be readily available and tailored to meet the specific spill control needs of each laboratory. A safety supply catalogue may assist with the standard types of spill materials that are currently available.

When a spill occurs, laboratory occupants must immediately assess the situation to see if the spill has created a serious or even life-threatening situation requiring an immediate building evacuation. A spill of a few milliliters of a solvent may not present a major hazard. A spill of an appreciable volume of a flammable liquid might call for a building evacuation. For example, a spill of 4L of a volatile, flammable liquid in a small room might produce vapour levels in the flammable range. A spark, a flame, or even a hot surface could cause a fire that might engulf the room. A total evacuation might also be required in the event of a leak of an appreciable quantity of a flammable or toxic gas.

Spill kit supplies may include, but are not limited to:

- signs/hazard tape to indicate a spill has occurred (e.g., "Caution: Spill — Please keep out")
- brush and scoop for mixing and cleanup (consider non-sparking tools)
- heavy-duty plastic bags
- paper towels or absorbent pads
- tongs to pick up broken glass/sharps and appropriate leak- and puncture-proof containers for safe removal of such materials
- absorbent materials
- appropriate personal protective equipment (e.g., face shield, goggles, lab coat, gloves, etc.)

For large chemical spills:

Complete the following if the chemical spill is IDLH (immediately dangerous to life or health):

- Notify individuals in the immediate area.
- Close the door(s) and contact Security Services (ext. 0384 or 902-566-0384).
- If spill is IDLH to other occupants within the building activate the fire alarm and exit the building. Move to designated emergency assembly point.
- When safe to do so, consult the SDS or applicable SOP.
- Brief emergency response workers or appropriate personnel (chief building warden) on the nature of the situation.
- Do not re-enter the building until instructed by Security Services or emergency responders.

For small chemical spills:

- Consult SDS or applicable SOP.

- Follow the spill clean-up procedures: don appropriate PPE, obtain spill kit, contain the spill, and use spill kit provisions to
- If uncertain about hazard, call Security Services at ext. 0384 or 902-566-0384.
- Begin clean-up wearing appropriate protective equipment

Small spills of oxidizers (e.g., peroxides, nitrites, nitrates, chlorates, chlorites, etc.) may be treated by first removing any readily oxidizable materials from the spill area, then destroying the oxidizer by cautiously adding sodium bisulfite solution. **Be sure to consult the SDS before attempting this procedure.**

Mercury spills should be cleaned up using a commercially available mercury spill kit and/or following the site-specific SOP. Even small mercury spills should be considered hazardous as mercury is toxic and has significant chronic impacts on human health. Mercury thermometers are not to be used in UPEI laboratories unless absolutely necessary. Any mercury thermometers being disposed of must be submitted as hazardous chemical waste.

To dispose of waste from spill clean-up:

- Refer to your area's site-specific protocol for the appropriate hazardous waste disposal method.

APPENDIX A

ADDITIONAL SOURCES OF INFORMATION

LINKS TO PEI LEGISLATION, UPEI HEALTH, SAFETY AND ENVIRONMENT INFORMATION AND REFERENCES

1. Occupational Noise Levels:
   Occupational Health and Safety Act: general regulations, part 8
   http://www.wcb.pe.ca/Workplace/OHSActAndRegulations

2. First Aid
   Occupational Health and Safety Act: general regulations, part 9
   http://www.wcb.pe.ca/Workplace/OHSActAndRegulations

3. Radiation Protection
   Occupational Health and Safety Act: general regulations, part 10 (non-ionizing radiation)
   http://www.wcb.pe.ca/Workplace/OHSActAndRegulations
   Public Health Act: Radiation Safety Regulations
   https://www.princeedwardisland.ca/sites/default/files/legislation/p30-1-06.pdf

4. Ventilation
   Occupational Health and Safety Act: general regulations, part 11
   http://www.wcb.pe.ca/Workplace/OHSActAndRegulations
5. Environmental Protection Act: Air Quality Regulations
   https://www.princeedwardisland.ca/sites/default/files/legislation/e09-02.pdf
   https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=CC0DE5E2-1

6. Fire Control
   Occupational Health and Safety Act: general regulations, part 25
   https://www.princeedwardisland.ca/sites/default/files/legislation/o1-01g.pdf
   Fire Prevention Act
   https://www.princeedwardisland.ca/sites/default/files/legislation/f-11.pdf
   Codes & Standards Order Regulations
   https://www.princeedwardisland.ca/en/legislation/fire-prevention-act/codes-and-standards-order-regulations

7. Electrical Safety
   Occupational Health and Safety Act: General regulations, part 36
   https://www.princeedwardisland.ca/sites/default/files/legislation/o1-01g.pdf
   Electrical Inspection Act: Canadian Electrical Code Regulations
   https://www.princeedwardisland.ca/sites/default/files/legislation/e-03.pdf

https://www.princeedwardisland.ca/sites/default/files/legislation/e03-1_0.pdf

8. Eye, Skin and Face Protection
   Occupational Health and Safety Act: General regulations, S.43.31 and Part45
   http://www.wcb.pe.ca/Workplace/OHSActAndRegulations

9. Chemical Storage
   Occupational Health and Safety Act: General Regulations, S.43.9 - 43.31
   https://www.princeedwardisland.ca/sites/default/files/legislation/o1-01g.pdf

10. Chemical Handling
    Occupational Health and Safety Act: General Regulations, S.43.9 - 43.31
    https://www.princeedwardisland.ca/sites/default/files/legislation/o1-01g.pdf

11. Chemical Disposal
    Environmental Protection Act: Waste Resource Management Regulations
    https://www.princeedwardisland.ca/sites/default/files/legislation/e09-15.pdf

12. UPEI Health and Safety Policies/Information
    http://www.upei.ca/vpaf/health-and-safety

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5. Sax N. I., Dangerous Properties of Industrial Materials, 8th ed., Van Nostrand Reinhold, Litton Publishing, New York, 1993.

6. Sittig M., Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2nd ed., Noyes Publications, New Jersey, 1985.

7. Bretherick L., Hazards In the Chemical Laboratory, 4th ed. Royal Chemical Society, London, 1986

8. Prudent Practices in the Laboratory, National Research Council, National Academy Press, Washington, DC, 1995

9. Laboratory Health and Safety Guidelines, 4th ed., Chemical Institute of Canada, Ottawa, ON, 2003

10. Safety in Academic Laboratories, 7th ed., American Chemical Society, Washington, DC, 2003

11. Furr A.K., Handbook of Laboratory Safety, 3rd ed. CRC Press, Cleveland, OH,1990

APPENDIX B

UNATTENDED OPERATIONS NOTICE

An example of a notice that can be cut to fit a 5" X 7" plastic frame follows.

<table>
<tr><th colspan="3">PLEASE LEAVE ON</th></tr>
<tr><td>Name:</td><td colspan="2">phone #</td></tr>
<tr><td>Permission from supervisor</td><td>Yes</td><td>No</td></tr>
<tr><td>Supervisor’s name:</td><td colspan="2">phone #</td></tr>
<tr><td>Alternate contact:</td><td colspan="2">phone #</td></tr>
<tr><td colspan="3">Start time: _____(am/pm); End time: _____(am/pm)
Date:_____; Date:_____</td></tr>
<tr><td colspan="3">Contents of reaction vessel include:</td></tr>
<tr><td colspan="3">Procedure requires (Circle):
Stirring Heating Water cooling Vacuum Nitrogen</td></tr>
<tr><td colspan="3">Instrument to be left ON :</td></tr>
</table>

APPENDIX C **UPEI Laboratory/Barn/S&R Inspection Report**

Ap

Inspection Date		**Area(s) Inspected**		Local H & S Working Group	
Inspectors				Area Guide	

Hazard Rating (hazards to personal injury, property or the environment): A - Serious hazard B - High hazard C - Moderate hazard. D - Low hazard.
* Item previously noted.

*#	Y	N	NA	Item (Y = Satisfactory, N = Needs Improvement NA = Not Applicable)	Description	Hazard Rating	Corrective Action	Person Responsible	Target Date	Completion Date
General Housekeeping										
1				Workplace clean and orderly						
2				Exits clear of obstructions and accessible						
3				Floor free of tripping hazards: loose obstacles (e.g. boxes, hoses, chemicals)						
4				Stored materials secured and limited in height to prevent collapse						
5				Materials in cabinets/shelves stored safely						
6				Books/items reachable from the ground or approved step stool available						
7				Free standing shelves are stable/safe loads						
8				Drawers/cupboard doors are shut when not in use						
Chemical Handling										
9				All chemicals are properly stored & cabinets labeled with separate acids, bases and flammables storage. Glass bottles should not be stored on the floor.						
10				Nitric acids must be stored separately from all other chemicals						
11				Chemicals should be stored at lower elevations (below eye level) that are						

*#	Y	N	NA	Item (Y = Satisfactory, N = Needs Improvement NA = Not Applicable)	Description	Hazard Rating	Corrective Action	Person Responsible	Target Date	Completion Date
				easily reached or in appropriate cabinets						
12				Face shield & insulated gloves must be available & used with liquid nitrogen/frozen gases						
13				Hazardous materials inventoried within the last year						
14				Current MSDS available for hazardous materials (within 3 yrs old)						
15				Hazardous waste procedure followed						
16				Adequate spill containment, clean-up & procedures available						
17				Procedure in place & used for safe transport of hazardous materials between work areas						
Equipment Maintenance										
18				Eyewash & safety shower stations: clearly marked, training and monthly maintenance done & documented. Access unobstructed.						
19				Fire extinguishers fully charged and currently filled						
20				all sprinkler heads free of obstruction						
21				Fume and biocontainment hoods maintained (not used for chemicals storage) and regularly inspected						
22				Lab ventilation adequate						
23				Gas cylinders properly labeled; secured when stored or moved; caps in place						
24				No frayed electrical cords						
25				No overloaded sockets						

*#	Y	N	NA	Item (Y = Satisfactory, N = Needs Improvement NA = Not Applicable)	Description	Hazard Rating	Corrective Action	Person Responsible	Target Date	Completion Date
26				Equipment properly maintained & safety guards in place						
27				Suitable warning signs & labels (radiation, laser, UV, PPE, biohazards, no food/drink)						
28				Animal restraint devices available & used						
29				Fridges/freezers must be labeled as whether or not they are approved as suitable for storing flammables						
Safety rules, training and documentation										
30				No food or drink in labs						
31				Appropriate body cover and no open shoes						
32				PPE available and personnel trained in the selection, care & use of PPE						
33				Personal hygiene & decontamination procedures in place & followed						
34				SOP's and appropriate manuals available (e.g. UPEI Lab Safety Manual, Laboratory Biosafety Guidelines- Health Canada, Containment Standard for Veterinary Facilities, etc.)						
35				WHMIS training current for all employees						
36				First Aid/CPR trained individuals known						
37				Staff inoculated against appropriate infectious materials						
38				Site specific training & immediate area orientation done & documented						
39				Incident report forms readily available, completed, and submitted to HR as required						

*#	Y	N	NA	Item (Y = Satisfactory, N = Needs Improvement NA = Not Applicable)	Description	Hazard Rating	Corrective Action	Person Responsible	Target Date	Completion Date
40				Additional training requested by workers						
Emergency Response										
41				Emergency telephone #'s posted/accessible. Ensure safety placard is posted on lab doors with current emergency contact info.						
42				Emergency exit signs available, visible & working. Emergency exits unobstructed						
43				Fire alarm pull stations, fire blanket, fire hose stations, and portable fire extinguishers visible and unobstructed						
44				Stairway doors/self closing doors closed (unless close automatically during alarms)						
45				Rags/paper towels used to clean up flammable/combustible materials must be stored in metal cans with lids to prevent spontaneous combustion						
46				Emergency evacuation plan & drills in place; exit routes, pull stations & fire extinguisher locations known						
47				Electrical outlets near sinks/water must contain ground fault circuit interrupters (GFCI's)						
48				Discontinue the use of extension cords and power bars for extended use. Permanent electrical outlets must be installed where necessary.						

Additional Comments:

_____
_____
_____
_____

Inspection

Lead Inspector (print name):_____(signature):_____ Date: _____

Area Leader (print name):_____ (signature):_____ Date: _____

Copies to: Area Leader (original), Laboratory Supervisor, others identified for action: _____

☐ When actions & form are completed, return original to the Lead Inspector (noted above).

Overall Target Date:

Completion of Actions

Area Leader's signature: _____Date: _____

APPENDIX D

QUICK GUIDE TO RISK ASSESSMENT FOR HAZARDOUS CHEMICALS

1. **Identify chemicals to be used and circumstances of use**. Identify the chemicals involved in the proposed experiment and determine the amounts that will be used. Is the experiment to be done once, or will the chemicals be handled repeatedly? Will the experiment be conducted in an open laboratory, in an enclosed apparatus, or in a fume hood? Is it possible that new or unknown substances will be generated? Are any of the workers involved in the experiment pregnant or likely to become pregnant? Do they have any known sensitivities to specific chemicals?

2. **Consult sources of information**. Consult an up-to-date MSDS for each chemical involved in the planned experiment. In cases where substances with significant or unusual potential hazards are involved, it may also be advisable to consult more detailed references. Depending on the worker's level of experience and the degree of potential hazard associated with the proposed experiment, it may also be necessary to obtain the assistance of experts in the field, supervisors and safety professionals before proceeding with risk assessment.

3. **Evaluate the types of toxicity and other dangers**. Are any of the chemicals to be used toxic, corrosive, irritants or sensitizers? Will any carcinogens be encountered? How about flammability and environmental toxicity? Are any chemicals involved in the proposed experiment suspected to be reproductive or developmental toxins or neurotoxins? Examine all possible types of toxicity and other danger.

4. **Consider possible routes of exposure**. Determine the potential routes of exposure for each chemical. Are the chemicals gases, or are they volatile enough to present a significant risk of exposure through inhalation? If liquid, can the substances be absorbed through the skin? Is it possible that dusts or aerosols will be formed in the experiment? Does the experiment involve a significant risk of inadvertent ingestion or injection of chemicals? Will there be environmental impacts?

5. **Evaluate quantitative information on toxicity**. Consult the information sources to determine the LD50 for each chemical via the relevant routes of exposure. Determine the acute toxicity hazard level for each substance, classifying each chemical as highly toxic, moderately toxic, slightly toxic and so forth. For substances that pose inhalation hazards, take note of the threshold limit value time-weighted average (TLV-TWA), short-term exposure limit (STEL) and odour threshold.

6. **Select appropriate procedures to minimize exposure**. Use Good Laboratory Practices for all work with chemicals in the laboratory. In addition, determine whether any of the chemicals to be handled in the planned experiment are extremely hazardous, i.e. deserve a

‘3' or ‘4' rating under any of the NFPA categories. If so, pay special attention to the control of these compounds. Consider the total amount of the substance that will be used, the expected frequency of use, the chemical’s routes of entry, and the circumstances of its use in the proposed experiment.

7. **Prepare for contingencies**. Note the signs and symptoms of exposure to the chemicals to be used in the proposed experiment. Note appropriate measures to be taken in the event of exposure, accidental release or other unplanned situations involving any of the chemicals. Be sure to get the appropriate spill clean-up supplies for the chemicals in use and keep them on hand.

Reference: *University of Saskatchewan Lab Safety Manual*, June 2003. As adapted from: Committee on Prudent Practices for Handling, Storage and Disposal of Chemicals in Laboratories. *Prudent Practices in the Laboratory Handling and Disposal of Chemicals, Washington*: National Academy Press, 1995. Page 47

APPENDIX E

VACATING A LAB FORM: FOR LABORATORY EMPLOYEES

This form is to be filled out and signed when faculty, staff, graduate and/or research students who have made use of laboratory facilities at UPEI, are planning to vacate their lab at UPEI for any reason.

PLEASE PRINT

VACATEE: _____

POSITION: _____

DEPARTMENT:_____

BUILDING/LABORATORY(S): _____

1. Have you made an inventory list of the Chemicals, Radioactive Materials, Infectious Agents, Gas Cylinders and Equipment that you have been responsible for?

   □ YES □ NO

2. Have you consulted with your supervisor/chairman to decide which of the above is to be disposed of, removed from the University or taken over by another party?

   □ YES □ NO

3. Have you made arrangements to ensure the proper handling of the above items on your inventory list?

   □ YES □ NO

If NO, who will be responsible for these items after you leave:_____

Have the work areas that you have used been cleaned and left in a tidy state and disinfected if necessary?

□ YES □ NO

Vacatee Name: _____ (please print)

Signature: _____ Date: _____

Supervisor/Chairman Name: _____ (please print)

Signature: _____ Date: _____

APPENDIX F

UNIVERSITY of Prince Edward ISLAND

Containment Level 2 Laboratory Decommissioning Check List

The purpose for decommissioning a laboratory is to ensure that hazardous chemicals, radioactive materials, infectious agents, gas cylinders, and laboratory equipment are either safely disposed of or are assigned to a responsible person, who will be subsequently responsible for their safe handling.

The goal of this process is to make the laboratory as safe as possible for future users of the space. This document is not intended to cover radiological decommissioning of laboratories. For information on this process, please contact the Radiation Safety Officer (http://research.upei.ca/wheretostart) for assistance. The laboratory must be free from contamination, have no inventory of biological substances, have all biological waste removed, and be inspected and approved through the Biosafety Committee.

The following checklist is a general guideline only. Special circumstances may require additional procedures. Perform the following steps as they relate to your laboratory. When completed, sign the form and have it reviewed and signed by your Department Chair. Inform the Biosafety Officer that you have completed the work, and an inspection will be arranged. No new research or construction can occur in the laboratory until the decommissioning has been inspected and approved through the Biosafety Committee

Laboratory Room No.		
Principal Investigator		
Department		
Chemicals – all must be safety removed from the room	**Date Completed**	**N/A**
Check that all chemicals intended for transfer or waste disposal have WHMIS labels		
Special consideration must be taken for the handling of any potentially toxic, explosive, or unstable chemicals in the laboratory		
Transfer surplus chemicals to responsible investigators. Compile a list of chemicals with the approximate quantities and record name(s) of recipient(s) and date(s) transferred.		
Dispose of waste chemicals according to University Policy.		
Update the chemical inventory to reflect the above changes		
Gas Cylinders	**Date Completed**	**N/A**
Gas cylinders must be removed from laboratory and returned to supplier if possible		
Radioisotopes	**Date Completed**	**N/A**
In form Radiation Safety Officer (RSO) of your intention to discontinue working with radioisotopes		
Coordinate the removal of radioactive material from the laboratory and the subsequent testing of the laboratory for radioactive contamination with the RSO		

All radioactive signs in the laboratory to be removed by the RSO after testing shows there is no evidence of radioactivity.		
Biological Agents	**Date Completed**	**N/A**
Inform the Biosafety Officer of your intention to decommission the laboratory		
Indicate if current biosafety permit(s) are to be terminated or amended to reflect a new location		
Dispose of all biohazardous materials (BHM) by the appropriate method, according to University policy or transfer the BHM to a colleague. All activities must be documented in the inventory database.		
Ensure that all BHM have been removed from fridges, freezers, incubators, cryocans, etc.		
Biological Safety Cabinets (BSC): all accessible (external) surfaces must be disinfected. If it is to be moved, you must arrange for formaldehyde decontamination, to be completed before it can be relocated.		
All laboratory equipment that may have been contaminated must be surface decontaminated using a disinfectant effective against the BHM worked with in the lab. Remove hazard signage.		
Sharps	**Date Completed**	**N/A**
Ensure all sharps are disposed of in appropriate containers according to University policy		
Check all drawers, crevasses, shelves, etc. for stray sharps		
All sharps containers have been decontaminated and disposed of through Central Services		
Equipment and General Laboratory Cleaning	**Date Completed**	**N/A**
Fume hoods – all items in the fume hood must be removed and all accessible surfaces cleaned and disinfected		
Centrifuge, blender, sonicator, etch – all equipment cleaned and disinfected		
BSC – disinfected as described above		
Clean benches, laminar flow units etc. – disinfect surfaces with appropriate disinfectant		
Refrigerators and freezers and incubators in the lab must be cleaned and all accessible surfaces disinfected.		
Glassware to be removed from the lab. All commonly owned glassware to be returned to Central Services		
Unused, open glass pipettes can be returned to Central Services, plastic pipettes to be discarded appropriately		
Lab furnishings, cupboards, shelves, sink, etc. to be cleaned and decontaminated.		
For any equipment that is leaving a CL2 lab, a decommissioning tag must be attached to indicate it has been appropriately decontaminated.		
Once decontaminated, any biohazard symbols are to be removed.		
All waste to be disposed of according to University policy. Ensure NO waste remains in the lab.		
Consult with Department Chair regarding the placement of any		

specialized equipment you may have used in your laboratory		
Biosecurity Issues		
The list of individuals with authorised access to the labs has been revoked		
Keys have been returned		

Notes:_____
_____
_____
_____
_____
_____

Decommissioning completed by_____**(print)**

_____**(signature)**

_____ **Date**

Reviewed by Department Chair_____**(print)**

_____**(signature)**

_____ **Date**

For Biosafety Committee Use:	
Laboratory Decommissioning inspected by:	Date
Decommissioning approved by the Biosafety Committe	

APPENDIX G

SOME KNOWN, PROBABLE AND POTENTIAL CARCINOGENIC CHEMICALS

EVALUATED BY IARC (Note: this list is not complete.)

Group 1 Chemicals which are Carcinogenic to Humans	
4-Aminobiphenyl	Arsenic and some arsenic compounds
Benzene	Benzidene
Beryllium and some beryllium compounds	Bis(chloromethyl) ether
Chloromethyl methyl ether	Cadmium and some cadmium compounds
Chromium VI compounds	Ethylene oxide
2-Naphthylamine Nickel compounds	Formaldehyde
Vinyl chloride	
Group 2a Chemicals which are Probably Carcinogenic to Humans	
Acrylamide	Acrylonitrile
Benzidine-based dyes	Benzo(alpha)pyrene
1,3-Butadiene	Diethyl sulfate
Dimethyl sulfate	Ethylene dibromide
Formaldehyde Tetrachloroethylene	
Trichloroethylene	
Group 2b Chemicals which are Possibly Carcinogenic to Humans	
Acetaldehyde	Acetamide
o-Anisidine	Antimony trioxide
Beta-Butyrolactone	Carbon tetrachloride
Chloroform	Cobalt and some cobalt compounds
1,2-Dichloroethane	Dichlormethane
2,6- Dimethylaniline	1,1-Dimethylhydrazine
1,2-Dimethylhydrazine	2,4-Dinitrotoluene
2,6-Dinitrotoluene	1,4-Dioxane
Ethyl acrylate	Furan
Hydrazine	Methyl methanesulfonate
Nickel	2-Nitroanisole
Nitrobenzene	Phenyl glycidyl ether
Potassium bromate	Beta-Propiolactone
Propylene oxide	Styrene
Thiourea	Toluene diisocyanates
o-Toluidine	Vinyl acetate

For further information from the International Agency for Research on Cancer (IARC) go to: http://monographs.iarc.fr/ENG/Classification/

APPENDIX H

FIRE PROPERTIES OF SOME COMMON LABORATORY LIQUIDS AND VOLATILE SOLIDS

	Boiling Point (C)	Flash Point (C)	Flammable Limits lower (%)	upper (%)	Autoignition Temp (C)
Acetic Acid	118	39	4.0	19.9	463
Acetone	56	-20	2.5	12.8	465
Acetonitrile	82	6	3.0	16.0	524
Acrylonitrile	77	0	3.0	17.0	481
Benzene	80	-11	1.2	7.8	498
1-Butanol	117	37	1.4	11.2	343
tert-Butanol	83	11	2.4	8.0	478
Chlorobenzene	132	28	1.3	9.6	593
Cyclohexane	82	-20	1.3	8.0	245
Cyclohexene	83	-7	0.8	2.8	244
Dibutyl Ether	141	25	1.5	7.6	194
1,2-Dichloroethane	84	13	6.2	16.0	413
Diethyl Ether	35	-45	1.9	36	180
p-Dioxane	101	12	2.0	22.0	180
Ethanol	78	13	3.3	19.0	363
Ethylamine	17	-18	3.5	14.0	385
Ethyl Mercaptan	35	-18	2.8	18.0	300
Furfural	161	60	2.1	19.3	316
Gasoline	40-200	-43	1.4	7.6	280
Hexane	69	-22	1.1	7.6	225
Isoamyl Alcohol	132	43	1.2	9.0	350
Isopropyl Alcohol	83	12	2.0	12.7	399
Isopropyl Ether	69	-28	1.4	7.9	443
Methanol	64	11	6.0	36.0	464
Methylene Chloride	40	none	13.0	23.0	556
Methylethyl Ketone	80	-9	1.4	11.4	404
Nitromethane	101	35	7.3		418
Phenol	181	79	1.8	8.6	715
1-Propanol	97	23	2.2	13.7	412
Tetrahydrofuran	66	-14	2.0	11.8	321
Toluene	111	4	1.1	7.1	480
Trichloroethane	74	none	7.5	12.5	
p-Xylene	138	27	1.1	7.0	528

APPENDIX I

FIRE PROPERTIES OF SOME COMMON LABORATORY GASES

Gases	Boiling Point (^{o}C)	Flammable Limits		Autoignition Temperature (^{o}C)
		Lower (%)	Upper (%)	
Acetylene	-83	2.5	100	305
Ammonia	-33	15.0	28.0	651
1,3-Butadiene	-4	2.0	12.0	420
Carbon Monoxide	-192	12.5	74.0	609
Dimethylamine	7	2.8	14.4	400
Ethane	-89	3.0	12.5	472
Ethylene	-104	2.5	36.0	450
Hydrogen	-252	4.0	75.0	500
Hydrogen Sulphide	-60	4.0	44.0	260
Methylamine	-6	4.9	20.7	430
Propane	-42	2.1	9.5	450

APPENDIX J

SOME INCOMPATIBLE CHEMICAL COMBINATIONS

Uncontrolled reactions between chemicals listed on the left and chemicals or chemical families on the right can result in fires, explosions or in the release of otherwise dangerous substances. If you are unsure of the chemistry, refer to the SDS and seek help from your supervisor.

Chemicals	Chemicals or Chemical Families
Acetic acid	Strong oxidizing agents, strong bases
Acetic anhydride and acid halides	Alcohols, amines, strong bases, strong oxidizing agents, water
Acetone	Acids, bases, strong oxidizing agents
Alkali metals (Li, Na, K)	Acids, alcohols, carbon dioxide, oxidizing agents, water
Alkali metal hydroxides	Halogen and nitro-substituted organics, strong acids
Ammonia or ammonium hydroxide	Acids, certain heavy metals such as silver and mercury, halogens, strong oxidizing agents
Ammonium nitrate	Metal powders, strong reducing agents
Azide salts	Acids, carbon disulfide, heavy metal salts
Charcoal (finely divided)	Strong oxidizing agents
Chlorates	Acids, reducing agents
Chromic acid (chromium trioxide, chromates and dichromates)	Strong reducing agents
Hydrazine	Strong oxidizing agents
Hydrogen peroxide	Reducing agents
Metals (powdered) : in air some are spontaneously combustible)	Oxidizing agents
Nitric acid	Chromic acid, strong bases, strong reducing agents
Oxalic acid	Mercury and silver and their salts
Perchloric acid	Certain heavy metal salts, reducing agents, strong acids salts and bases
Perchlorate salts	
Peroxides (some peroxides are shock sensitive)	Reducing agents
Phosphorus pentoxide	Alcohols, bases and water
Sulfuric acid	Alcohols, bases, chlorates, perchlorates, permanganates, water

APPENDIX K

PEROXIDE-FORMING CHEMICALS

Tetrahydrofuran and diethyl ether are two of a number of laboratory ethers that readily auto-oxidize forming peroxides. The resulting peroxides are quite unstable and can be detonated by even a relatively minor shock. Chemical suppliers often stabilize the parent ethers with inhibitors which retard the formation of peroxides. But because the inhibitors interfere with some applications, many suppliers also sell peroxide-forming chemicals without the inhibitors. Some laboratories distill ethers to produce high purity solvents. These redistilled solvents also lack the inhibitor.

Exposing an uninhibited peroxide-former to air allows the peroxide to form. The rate of peroxide formation depends upon a number of factors, but with some ethers, dangerous amounts of peroxide can form within days. When the peroxide is insoluble in the parent ether, the risk of a shock-initiated explosion can be extreme. When the peroxide is more soluble in the parent ether, the explosion risk increases as the parent solvent evaporates. Again, the result can be a disastrous explosion.

Many common peroxide-forming materials are highly volatile. So, in addition to the peroxide problem, they often present a serious fire hazard.

To Reduce the Chances of Peroxide Accidents:

- Avoid using peroxide-forming chemicals when possible.
- Buy only inhibited ethers when possible.
- Buy peroxide-forming chemicals in the smallest quantities possible to limit the volumes exposed to air.
- Store in a cool location and protect from exposure to light or air.
- Record the date that the containers were opened.
- Use peroxide-forming chemicals with regard for their reactivity, toxicity and flammability.
- Work in a fume hood with the sash lowered as far as practical.
- Use laboratory techniques that prevent exposing inhibitor free peroxide-formers to air.
- Consider using and explosion shield.

- Wear eye protection at all times while in the laboratory.
- Test* containers for peroxides at least monthly and record the date and result of the test. If the test shows the presence of significant amounts of peroxide then, remove the peroxide and dispose of properly.
- Treat any peroxide-forming chemical as an extreme shock sensitive explosion hazard unless you are sure it is free of peroxides.
- Do not move the container if crystalline deposits or viscous liquids form in peroxide-forming chemicals. Do not handle, alert supervisor immediately.

***TEST FOR PEROXIDES IN ETHER**

- Use commercial peroxide test strips, or
- Add 9 mL of ether to 1mL of a saturated solution of KI. Mix carefully. A yellow colour indicates the presence of peroxides.

Some Common Peroxide-Forming Chemicals:

acetal	cyclohexene
dibutyl ether	diethyl ether
1,4-dioxane	ethylene glycol dimethyl ether
isopropyl ether	tetrahydrofuran

Some Less Common Peroxide-Forming Chemicals:

decahydronaphthalene	diacetylene
dicyclopentadiene	divinyl acetylene
methyl acetylene	sodium amide
tetrahydronaphthalene	vinyl acetate
vinyl ether	vinylidene chloride

APPENDIX L

HAZARDS OF COMMON LABORATORY GASES OBTAINED IN HIGH PRESSURE CYLINDERS (* Liquefied gas)

GAS	Decompression	Flammability	Asphyxiation	Toxicity	Cryohazard
Acetylene	Yes	Yes	Yes	No	No
Air	Yes	No	Yes	No	No
Argon	Yes	No	Yes	No	Yes*
Carbon Dioxide	Yes	No	Yes	Yes	Yes*
Helium	Yes	No	Yes	No	Yes*
Hydrogen	Yes	Yes	Yes	No	Yes*
Nitrogen	Yes	No	Yes	No	Yes*
Oxygen	Yes	Yes	No	No	Yes*
Propane	Yes	Yes	Yes	No	No

APPENDIX M

COMPRESSED GAS ASSOCIATION FITTING DESIGNATIONS:

GAS	CGA DESIGNATION
Acetylene	CGA-510
Air	CGA-590
Argon	CGA-580
Carbon Dioxide	CGA-320
Helium	CGA-580
Hydrogen	CGA-350
Nitrogen	CGA-580
Oxygen	CGA-540*
Propane	CGA-510

* Ensure that the regulator does not contain aluminum

APPENDIX O

JOB HAZARD ANALYSIS

Date
Department/unit:
Supervisor:
Job:
Assisted By:
All Workers Advised (yes/no):

TASK	IDENTIFIED HAZARD	IMMEDIATE AND ROOT CAUSES	CORRECTIVE ACTION AND/OR PREVENTATIVE MEASURE TAKEN

EXISTING SAFE WORK PRACTICES TO UPDATE:
NEW PROCEDURES TO DEVELOP:

APPENDIX P

Safe Doffing of Personal Protective Equipment (PPE)

Doffing of Disposable Gloves: Glove to glove/skin to skin:

1. Pinch the inside wrist area of one glove with the index finger and thumb of the other gloved hand.
2. With the index finger and thumb pull the glove downwards and away from the wrist and over the hand and fingers until the glove comes off your hand.
3. While holding the inside-out glove slide your finger(s) of the ungloved hand under the wrist of the gloved hand. Don't touch the outside of the glove with your hand as it is contaminated.
4. Pull down the wrist of the glove (inside out) until it completely covers the other glove.
5. This has both gloves inside-out keeping the potentially contaminated outside of the gloves enclosed.
6. Grasp the inside out gloves and discard in the proper waste receptacle.
7. Wash your hands effectively using soap and water: remember to clean under and around nails.

Removing Chemical Splash Goggles/Safety Glasses: When gloves are removed only touch the head bands/ear pieces to remove goggles and place in appropriate place for cleaning. Wash your hands effectively using soap and water: remember to clean under and around nails.

Doffing of Lab Coats/Gowns: Once gloves are removed then, proceed to remove lab coat/gown. Always remember that the outside will be most contaminated (especially sleeves and front) so, remove like you are peeling a banana inside-out as to capture contaminants and to allow a safe area to hold the gown/lab coat. Dispose of in the correct area for laundry of soiled linens or in the appropriate waste receptacle for disposable gowns. Wash your hands effectively using soap and water: remember to clean under and around nails.

Doffing of Respirator(s):

1. Once gloves, eye protection and lab coat are removed and placed in the appropriate receptacles then, remove the respirator following the steps below.
2. The front of the disposable respirator i.e. N95 (or cartridges and front of the mask of the ½ or full face elastomeric) are contaminated so, don't touch with bare hands.
3. When in a safe area away from the respiratory hazard tilt your head slightly downwards and use a hand to pull the head band (of the N95 mask) that is at the base of your neck up and over your head and in front of your mask, then remove the head band from the top of your head slowly allowing the N95 mask to fall away from your face and dangle by the head band. For the elastomeric respirator loosen the head band straps fully while keeping your face slightly tipped forward until the mask is loose and away from your face. Using a disposable paper towel in one hand hold the front of the respirator while removing the head bands up and over your head to the front of the respirator with the other hand. Place the respirator in the dirty area to be cleaned and discard the paper towel in the appropriate waste receptacle.
4. Discard disposable N95 mask in the appropriate waste receptacle.
5. Wash your hands effectively using soap and water: remember to clean under and around nails.

Order of Donning: In Safe Area: 1) if necessary foot protection, 2) wash hands, 3) Gown, 4) respirator, 5) goggles, and 6) gloves.
Order of doffing: In Safe Area: 1) Foot protection, 2) gloves, 3) goggles, 4) gown, 5) respiratory protection then, 6) wash hands.

APPENDIX Q

CLASSIFICATION OF HAZARDS AND RECOMMENDED GLOVE PROTECTION

NATURE OF HAZARD	DEGREE OF HAZARD	PROTECTIVE MATERIAL
Chemicals and Fluids	Refer to Appendix M, product MSDS, or glove manufacturer data	Dependant upon specific chemical hazards: natural rubber, neoprene, butyl rubber, polyvinyl chloride, etc.
Cold	-	Leather, insulated plastic or rubber, wool, cotton, cold resistant specialty fabrics. Loose fitting gloves for liquid nitrogen or carbon dioxide.
Heat	High temperatures (>350°C)	Heat resistant specialty fabrics
	Medium temperatures (100-350°C)	Heat resistance leather with linings, Nomex, Kevlar, Zetex
	Less warm temperatures (up to 100°C)	Chrome-tanned leather, terry cloth
Abrasion	Moderate	Rubber, plastic, leather, polyester, nylon, cotton
Sharp Edges	-	Leather, terry cloth, polyester, cotton, nylon, Kevlar®
General Duty	Low risk duties	Cotton, terry cloth, leather, rubber, plastic

* (Adapted from Safety Infogram produced by the Canadian Centre for Occupational Health and Safety.)

APPENDIX R

GUIDE TO SELECTION OF A CHEMICAL RESISTANT GLOVE

The following table is intended to be used as a general guideline during glove selection. Adapted from the ACGIH Guidelines for the Selection of Chemical Protective Clothing.

GLOVE MATERIAL	CHEMICAL RESISTANCE PROPERTIES		PHYSICAL PROPERTIES E=EXCELLENT; G=GOOD; F=FAIR; P=POOR				
	RECOMMENDED FOR USE WITH	NOT RECOMMENDED FOR USE WITH	Cut Resistance	Flexibility	Heat Resistance	Puncture Resistance	Tear Resistance
Natural rubber latex	Acids, bases, alcohols, aqueous solutions.	Oils, greases, organics.	E	E	F	E	E
Butyl rubber	Aldehydes, ketones, esters, glycol ethers, polar organic solvents.	Hydrocarbons, chlorinated solvents.	G	G	E	G	G
Neoprene	Oxidizing acids, caustics, alcohols, oils, fats, aniline, phenol, glycol ethers.	Chlorinated hydrocarbons.	E	G	G	G	G
Nitrile	Oils, greases, acids, caustics, aliphatic chemicals	Aromatics, many ketones, esters, many chlorinated solvents.	E	E	G	E	G
Polyvinyl alcohol (PVA)	Aliphatics, aromatics, chlorinated solvents, ketones (except acetone), esters, ethers.	Acids, alcohols, bases.	F	P	G	F	G
Polyvinyl chloride (PVC)	Strong acids and bases, salts, other aqueous solutions, alcohols, glycol ethers.	Aromatics, hydrocarbons, chlorinated solvents, aldehydes, ketones, nitrocompounds.	P	F	P	G	G

APPENDIX S

RESPIRATOR CARTRIDGES: CHANGE-OUT SCHEDULE

Each worker must complete a separate form to document their cumulative time of use of specific cartridges. If the worker uses different cartridges for different areas/chemicals then, they must have separate change out schedule forms for each set of cartridges.

The respirator cartridges must be discarded after 30 hours of use (or at the discretion of the user) according to the waste management protocol for the specific contaminant (biological, chemical, etc.).

The user may change out the cartridges before 30 hours has elapsed based on several factors such as: damage, leakage detected during pressure tests, difficulty breathing when respirator is worn (cartridges filters are blocked), excess contamination, and detection of odour (smell, taste, etc.) while wearing the respirator in the work area.

Worker Name: _____

Supervisor Name: _____

Respirator Info: _____ **(Make, Model, Size and Type)**

Cartridges Details: _____ **(Make, Model and Type)**

Cartridge Identifier: _____ **(place same identifier on cartridge storage bag).**

DATE USED	START TIME	END TIME	AMOUNT OF TIME CARTRIDGES USED (MINS)	TOTAL (CUMULATIVE) TIME CARTRIDGES HAVE BEEN USED	AREA/ROOM/LAB WHERE CARTRIDGES HAVE BEEN USED	HAZARDOUS MATERIALS OR CHEMICALS USED

See next page for process steps to complete this form and an example.

APPENDIX S

Process steps to complete the change out schedule form:

1. Each time the same cartridges are used complete a new row in the table above.
2. Prior to use record the date and start time in columns 1 and 2 respectively. Use the same identifier on the storage bag for the cartridges as indicated on the change out schedule form.
3. After every use of the cartridges record the end time in column 3.
4. Calculate the amount of time the cartridges were used in minutes (using column 2 and 3) and record that time in 4th column.
5. Add the minutes used from the 4th column to the Total (cumulative) minutes in the row directly above and insert the new usage time (in minutes) in the Total (Cumulative) column for that date/time.
6. Repeat steps 1-5 for each time the specific cartridges are used.
7. Cartridges should not be shared.
8. Respirators must be cleaned/disinfected after every use.
9. Cartridges must be stored in a sealed bag that is labeled (with the date of first use, workers name, area used in and chemicals/hazards used to protect against.)
10. All used cartridges must have a corresponding change out schedule form or they must be disposed of immediately.

REPLACE THE CARTRIDGE AFTER A MAXIMUM OF 30 HOURS (1800 minutes) OF USE.

Example:
Worker Name: **John Doe**
Supervisor Name: **Jane Somebody**
Respirator Info: **3M 6900, Large, Full Face Respirator (Make, Model, Size and Type)**
Cartridges Details: **3M 6005, Formaldehyde/Organic Vapour (Make, Model, Type)**
Cartridge Identifier: Anatomy JD 01 (place same identifier on cartridge storage bag)

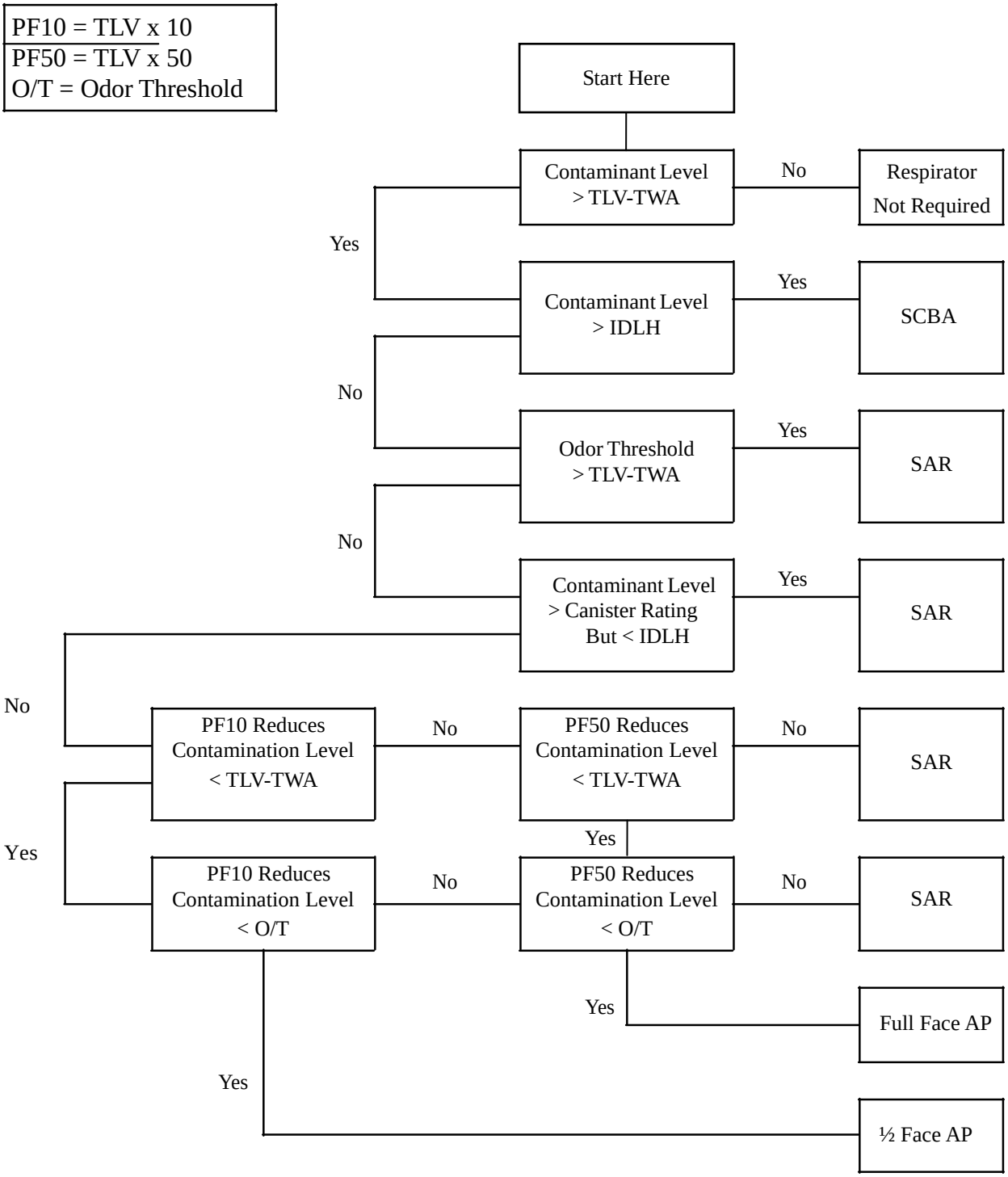
DATE USED	START TIME	END TIME	AMOUNT OF TIME CARTRIDGES USED (MINS)	TOTAL (CUMULATIVE) TIME CARTRIDGES HAVE BEEN USED	AREA/ROOM/LAB WHERE CARTRIDGES HAVE BEEN USED	HAZARDOUS MATERIALS OR CHEMICALS USED
Oct 15, 2017	10:00 a.m.	11:50 a.m.	110	110	AVC 1022N Anatomy Lab	Formalin
Oct 16, 2017	1:00 p.m.	1:47 p.m.	47	157	AVC 1022N Anatomy Lab	Formalin
Oct 22, 2017	2:00 p.m.	3:02 p.m.	62	219	AVC 1022N Anatomy Lab	Formalin
Nov 6, 2017	11:00 a.m.	12:21 p.m.	81	300	AVC 1022N Anatomy Lab	Formalin

To date these cartridges have been used for 5 hours:
Total Hours = Total Cumulative minutes X 1 hour/60 minutes
Total Hours = 300 mins X 1hour/60 mins) = 5 hours. Therefore: 25 Hours of use remain before disposal via appropriate waste management stream (hazardous Chemicals).

APPENDIX T

GUIDE TO RESPIRATOR SELECTION

RESPIRATOR SELECTION LOGIC TREE



Appendix U

UPEI Respirator User Screening Form

(For initial and periodic screening of respirator users in conjunction with CSA Standard Z94.4, Clause 11.)

Part 1: Employer Information

University of Prince Edward Island
550 University Avenue, Charlottetown
PE C1A 4P3

Supervisor Name: _____
Telephone: _____
Fax: _____

Part 2: Respirator User Information

Name: _____ Date: _____
Employee #: _____ Telephone: _____
Title/Occupation: _____ Fax: _____

Part 3: Conditions of Use

Activities requiring respirator use (please list):

Frequency of respirator use:
❑ daily ❑ weekly ❑ monthly ❑ yearly ❑ uncertain

Exertion level during use:
❑ light ❑ moderate ❑ heavy ❑ other

Duration of use per shift:
❑ <½ hr ❑ ~ 1 hr ❑ >2 hr ❑ variable ❑ unknown

Temperature during use:
❑ <0℃ ❑ 0-25℃ ❑ >25℃

Atmospheric pressure during use:
❑ reduced ❑ normal/ambient ❑ increased

Special Work Conditions

Uncontrolled/hostile Environment

❑ Emergency escape ❑ Rescue operations ❑ Oxygen deficiency
❑ IDLH ❑ Confined spaces ❑ Riot/Police activity ❑ Fire fighting
❑ Hazardous materials (emergency) ❑Other: _____

Other Personal Protective Equipment (PPE):
Additional types of PPE required, specify: _____
Weight of tools/equipment carried during respirator use (estimate): Maximum: ___ Average: ___

Part 4: Types of Respirators Used (check all that apply):
❑ Tight-fitting (forms a seal)
❑ Non-tight-fitting (eg. hood)
❑ Air-purifying, powered
❑ Air-purifying, non-powered
❑ SCBA
❑ Other - specify: _____

Part 5: Respirator User's Health Conditions (check YES or NO box only. Do not specify)
a) Some conditions can seriously affect your ability to safely use a respirator.

Do you have or do you experience any of the following, or another condition that may affect respirator use? ❑ YES ❑ NO

Shortness of breath	Lung disease	Color blindness
Vision impairment	Hypertension	Reduced sense of smell
Back/neck problems	Neuromuscular disease	Claustrophobia/fear of heights
Breathing difficulties	Temperature susceptibility	Facial features/skin conditions
Chest pain or exertion	Panic attacks	Dizziness/nausea
Cardiovascular disease	Asthma	Hearing impairment
Fainting spells	Reduced sense of taste	Diabetes
Heart problems	Emphysema	Dentures
Thyroid problems	Allergies	Chronic bronchitis
Prescription medicine to control a condition	Pacemaker	Seizures

b) Have you had previous difficulty while using a respirator? ❑ YES ❑ NO ❑ N/A

c) Do you have any concerns about your future ability to use a respirator safely? ❑ YES ❑ NO

If you answered "YES" to "a", "b" or "c" part 6 of this form must be completed as this indicates further assessment by a health care professional is required prior to respirator use. NOTE: **Medical information is NOT to be offered on this form.**

Signature of Respirator User: _____ Supervisor's Initials: _____
Date: _____

Part 6: Health Care Professional Primary Assessment (if required)

Assessment date: _____
Respirator use permitted? ❑ YES ❑ NO ❑ Uncertain
Referred to Medical Assessment: ❑ YES ❑ NO
Comments:_____
_____

Name of Health Care Professional: _____ Signature of HCP:_____
Title: _____ Reassessment date: _____

Part 7: Medical Assessment (if required)
Assessment date: _____
❑ Class 1. NO restrictions
❑ Class 2. Some specific restrictions apply: _____
❑ Class 3. Respirator use is NOT permitted.

Name of Physician: _____ Signature of Physician: _____

❑ Return this form to: UPEI Health, Safety and Environment
550 University Ave, Charlottetown PE, C1A

APPENDIX V

Record of Testing & Maintenance of Emergency Eyewash and Shower Stations

Instructions: Place the date and the signature of inspector/tester beside the appropriate month or at the Annual Maintenance, indicating that the emergency eyewash was inspected and tested; one form per eyewash unit.

Location: _____

Year: _____

Month	Inspector	Date
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
Annual Maintenance		

APPENDIX W

STANDARD OPERATING PROCEDURE FOR -80 FREEZERS

1. Once a -80 freezer is purchased, the Principal Investigator (PI) is responsible to ensure it is connected to an emergency electrical outlet as well as assume the cost to connect it to the central security system.

2. Once connected and alarmed, the freezer must have all required labels (i.e. biohazard label) with hazard symbols and emergency contact information that must include the technical staff and PI.

3. Security must be contacted with this updated emergency contact information immediately.

4. If a staff member is the emergency contact, this SOP must be shared with them as well as any freezer-specific training that is required. The staff member must also be knowledgeable about the nature of the samples stored and how sensitive to changes in temperature they are.

5. When storing RG2 materials the PI must identify a "back-up" freezer and ensure staff know its location in case the materials must be transferred due to an emergency failure.

6. Staff responsible for freezer(s) agrees to disclose their home phone number in case of emergency after-hours. Note that the after-hours number does not need to be posted on the freezer. The number on the freezer could be the Security Dispatch desk number, but they must be informed of the individual's after-hours number(s) and this must be kept up to date.

7. If staff notice a freezer is not holding temperature or is contacted by security during working hours, they must **inform their supervisor immediately** and in consultation with their supervisor, determine what action to be taken next (ie. move samples to a previously determined back-up freezer; call biomedical engineering to assist in repair of freezer; call technical support for freezer, etc). When biohazardous materials need to be temporarily moved, this information must be sent to the Biosafety Officer.

8. Security/Dispatch is responsible to call the identified contact person when they are notified of a freezer alarm. Staff who are contacted by Security after-hours are responsible for asking security to identify which freezer is alarming and whose name is on it. The designated staff member is responsible for coming in and moving the samples to the back-up freezer (over-time rates apply). If no freezer space is available, **then PI must be contacted immediately**.

9. The next day, the supervisor must be informed immediately (if not already contacted) and the cause of the failure followed up and investigated by both faculty and staff (for example, if building issue, then facilities is contacted, if freezer issue, then biomedical engineering or technical support connected).

Note: Risk Group 2 biohazardous materials which need to be stored in a freezer/back-up freezer must be kept in a locked freezer if the laboratory or room is not kept locked.

Revised: January 2018

APPENDIX X

UPEI Sample Departmental Safety Training Checklist/Acknowledgement Form

I, _____, have completed WHMS training and site safety orientation for the _____ department and know:

Check those that apply.

- ☐ The location of and how to use the Safety Data Sheets (SDS's) for the lab.
- ☐ The chemical inventory and SDS update procedure for the lab.
- ☐ The proper labeling and storage procedure for any products developed and kept in the lab, the safe handling, storage, use and disposal procedures for:
- ☐ Chemicals
- ☐ Biohazards
- ☐ Sharps and broken glassware
- ☐ Gases
- ☐ Cryogens
- ☐ Other: _____
- ☐ Individuals who transport, offer for transport, pack or unpack chemicals may be required to be trained on Transportation of Dangerous Goods (TDG) if and when the chemicals are classed as dangerous goods under the TDG regulations.

If applicable, the safe use of radiation including

- o Ultraviolet
- o Laser
- o X-ray

The personal protective equipment (PPE) for the lab including:

- ☐ The compulsory use of lab coats, closed toe and heel footwear and safety glasses
- ☐ The availability and proper use of various protective gloves

The location of and how to properly use:

- ☐ Face shields
- ☐ Respirators
- ☐ Fume hoods
- ☐ Biological Safety Cabinets
- ☐ Eyewashes, emergency showers and deluge hoses
- ☐ First aid kits and Automatic External Defibrillators (AED's)
- ☐ Nearest fire alarm
- ☐ Fire extinguishers

The precautions to follow when leaving reactions unattended including:

- Informing my supervisor and getting approval
- Properly labeling the reaction with the approved department form
- Properly securing the apparatus, including the heat source
- Using appropriate tubing for water cooling and securely clamping it to the equipment
- Where to locate the electrical panels for labs and instrument rooms
- Where to locate the UPEI Emergency Procedures Guide
- The emergency evacuation procedure for this building
- The procedure for reporting and incident to the immediate supervisor, to incident@upei.ca email, to UPEI security and , in an emergency to 9-911
- That only people who are authorized by the supervisor are allowed to be in the lab

I also acknowledge that general safe laboratory practice also includes:

- Safety glasses and lab coats must be worn in all areas where hazardous chemicals are stored and used.
- Food or drinks are not allowed in the lab.
- Working alone in the laboratory is not permitted when working with hazardous chemicals or equipment and doing other activities as noted in the specific lab working alone policy.
- After hours work is permitted only with proper authorization.
- Fume hoods, benchtops and sinks must be kept clear of clutter.
- Volume of radios/music must be kept low to enable hearing of sounds of trouble and avoid disturbing others.
- Lab coats and gloves must not be worn outside of the lab area.
- Door handles, phones, computers and other common surfaces must not be touched with gloves.
- Hands must be washed prior to leaving the lab.
- Loose clothing is not to be worn in the lab and long hair must be tied back.
- Shorts are not permitted in labs.
- Safe handling procedures for all glassware and equipment must be known and practiced at all times.
- Caution must be used when working around equipment emitting high voltages.
- Equipment having frayed electrical cords must never be used. They must be marked as damaged and replaced or repaired immediately.

Worker Name (print):_____ Signature:_____ Date:_____

Supervisor Name (print):_____ Signature:_____ Date:_____

APPENDIX Y - CSA Approved Safety Eyewear

Brand	Model	Approved Vendor	Catalogue Number	Price*	Features	Picture
Pyramex	Venture II	UPEI Bookstore		$10.00	Scratch resistant, ultraviolet protection, various lens colours	
		Fisher Scientific	19-051-446	$3.99	Temples adjust to four sizes	
				$47.88/case of 12		
Lincoln Electric Cover 2	K2968-1	Home Depot	1000752736	$10.49	Ratcheting adjustable-length temple	
					Impact resistant	
Pyramex	OTS	UPEI Bookstore		$10.00	Fits over Perscription Eyewear	
		Fisher Scientific	19-130-3504	$3.87	Scratch resistant, lightweight	
Uvex Stealth® Goggles, Honeywell Safety		VWR	CA33000-751	$38.73	Fits over Perscription Eyewear	
					Antifog, antiscratch, antistatic, and ultraviolet protection	
VWR Vistor Specs		VWR	89187-988	$68.37/ case of 12	Fits over Perscription Eyewear	
					Impact Resistant, scratch resistant	
3M	OX	VWR	CA47744-941	$88.31/ case of 12	Fits over Perscription Eyewear	
					Wide profile, seamless lens with built -in sideshields	

There is also a websits that offers prescription eyewear at a reasonable price that has been recommeded by JOHSC Members: Zenni - https://ca.zennioptical.com/search?keyphrase=safety%20glassess.

*Please note: Availability and prices are subject to change

This Appendix is only intended to assist in the purchase of safety eyewear. Any CSA approved eyewear may be purchased.