Washington Clean Energy Testbeds

Chemical Hygiene Plan (CHP) – Laboratory-Specific Information

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This CHP covers the laboratory spaces in the Washington Clean Energy Testbeds. The specific rooms addressed in this CHP are Rooms 110, 111, 112, and 113.
Introduction

Washington Administrative Code (WAC) 296-828 requires that laboratories document their safety procedures in a “Chemical Hygiene Plan” or CHP. For UW chemical laboratories, the laboratory’s chemical hygiene plan is created by combining laboratory-specific information and safety requirements with the generic UW Laboratory Safety Manual.

The Washington Clean Energy Testbeds (WCET) CHP is electronic, but a hard copy is available in Room 112. The WCET CHP encompasses the UW Laboratory Safety Manual, which can be found at the following web address: [http://www.ehs.washington.edu/manuals/lsm/lsm.pdf](http://www.ehs.washington.edu/manuals/lsm/lsm.pdf)

This CHP, consisting of the UW Laboratory Safety Manual and our laboratory-specific information, was reviewed and updated:

Date: March 27, 2017
By: Michael Pomfret, Managing Director

The items listed below identify our laboratory-specific information that is attached (or filed in its noted location), and that applies to our laboratory:

- Laboratory-specific information cover sheet
- Laboratory floor plan
- General laboratory safety rules, applicable at all times in our laboratory
- Designations of individuals performing particular tasks (e.g., checking first aid supplies, maintaining chemical inventories, weekly eyewash check, etc.)
- Authorizations for individuals to use specific hazardous/controlled substances
- Instructions for receiving and storing hazardous materials
- Contents of chemical spill kits
- Instructions for labeling containers
- Training records location (filed separately from this Plan)
- Standard Operating Procedures (SOPs, separate documents filed with this plan)
- MyChem Chemical Inventory Report location
- Locations of MSDSs, equipment maintenance manuals, building evacuation plan, health and safety plan, filed separately from this CHP.

Location of Chemicals in WCET

All of the chemicals housed in WCET are found in the Characterization and Scale-Up Testbed, located in Rooms 110-113 (See Chemicals Classes and Storage section below for precise locations). A complete, up-to-date inventory can be found in Room 112. It is the users’ responsibility to notify WCET management when new chemicals are brought into the lab and when chemical containers are empty. In addition to UW standard laboratory policies that apply to all campus laboratories, each of the four rooms has specific rules for contamination control and safety. Users must be trained on conditions of access and specific, relevant instrumentation to enter the Characterization and Scale-Up Testbed Facilities.
Key: EW-eye wash, ES-emergency shower, FE-fire extinguishers, FA-fire alarm pull stations, 1A-first aid kit, P#-emergency phone number signs, →-direction of exit, SK-spill kit, EB-electrical boxes.

General Laboratory Policies and Procedures

DRESS CODE

The WCET dress code applies to all laboratory areas. It is based on industry-wide best practices for working in areas containing hazardous materials and preventing undue dust production from human sources. You will be denied access to laboratory spaces if you are not dressed according to the following rules.

HYGIENE

You and your clothing should be clean (i.e. free of dust or dirt) before entering lab spaces. Avoid clothing that sheds fibers such as wool, fur, fake fur, mohair, etc. Dirty or shedding clothes contaminate everyone's work. Make-up and cosmetics are not allowed in lab spaces.

SHOES

You must wear shoes that completely enclose the heel, toes, and top of your feet. Socks or stockings are required. Sandals, open-weave shoes, or shoes that expose the top of the foot are not allowed. High heels and deep-treaded shoes that hold mud or dirt are also not allowed. Despite the substantial wet weather in the Pacific Northwest, your shoes should be clean and dry before entering the labs. It is preferable that you bring a clean, dry change of dedicated lab shoes that you do not wear outside.

PANTS

You must wear long pants that run from your shirt to your ankles. Shorts, short pants, capris, skirts and dresses are not allowed. During warmer weather, you may bring with you a pair of lightweight hospital-scrub style pants to wear over your shorts.

SHIRTS
Your shirt must cover your shoulders and reach from the top of your arms to your pants. Tank tops, halter-tops, and spaghetti strap tops are not acceptable.

SAFETY GLASSES

Safety glasses must be worn at all times in all labs. The WCET provides safety glasses, or you may choose to purchase your own glasses, provided that they meet ANSI Z87.1-2003 standards. You are allowed to remove your safety glasses when using optical microscopes, but remember to put them back on when you step away from the microscope. Safety glasses are not acceptable for chemical protection; face shields must be worn during chemical use. Please refer to the Personal Protective Equipment (PPE) section for details in chemical protection protocols.

CONTACT LENSES

Consistent with recent recommendations from the American Chemical Society, contact lenses are allowed in WCET laboratories, provided that safety glasses are also worn at all times. In the case of an eye exposure emergency, rinse at the emergency eyewash station with contacts in place, and remove them while flushing.

More specific and detailed information about Personal Protective Equipment (PPE) are provided during the initial Lab Orientation and listed below.

Working with Chemicals

UNIVERSITY OF WASHINGTON LABORATORY SAFETY MANUAL

WCET is a laboratory space controlled by the University of Washington. As such, we must follow rules outlined in the University of Washington Laboratory Safety Manual put together by Environmental Health and Safety (EH&S). The manual is part of this CHP and can be found at:


You are responsible for understanding this laboratory safety manual and abiding by its rules.

UNDERSTANDING HAZARDS

It is the responsibility of all users to understand the hazards associated with the chemicals involved in their processes. All users must complete the required safety training and must be aware of the hazards associated with their processes. All process Standard Operating Procedures must be submitted to and approved by WCET management prior to the use of that process in WCET lab space. Users are permitted to handle hazardous substances, once approved by WCET management. Visitors may not handle any hazardous substance. Do not use or handle any chemical until you read and understand its label and safety datasheet (SDS). Understand the hazards, handling, storage, disposal, and emergency procedures for every chemical you use. SDSs are located on the User Information Computer Station in Room 112 and are also available through CORAL. You also need to know evacuation routes and locations of eyewashes, and shower stations. Lab-specific safety concerns are discussed during orientation and lab user meetings. Discussions related to chemical safety and attendees are documented in the Chemical Safety Training Log, which is located in the Managing Director’s Office.
Employee Safety Training Checklist is maintained for all WCET employees and is located in the Managing Director’s office.

GENERAL SAFE PRACTICES

- Do not taste, touch, or smell any chemicals
- Do not mix, heat, dispose, or otherwise use chemicals in an unauthorized manner
- Work with chemicals in an exhausted fume hood or wet bench
- Use chemicals only in wet benches where they are approved
- Never mix acids and solvents
- Never dispose of solvents down water drains
- Change your gloves if they might be contaminated
- Label your chemicals
- Do not place or store chemicals above the level of the wet bench surface
- Never remove chemicals from the lab without permission
- Use chemicals and wipes sparingly
- Do not interrupt users working with chemicals
- If you are unsure of handling or safety procedures, ask questions

BUDDY SYSTEM

Most chemicals used for cleaning substrates, preparing inks and samples are very dangerous, so it is required that another authorized WCET user accompany you while you are working at the wet benches. All dry processes are permitted without a buddy; however, it is recommended that you coordinate lab activities to ensure that at least one other person is in the vicinity. You may not assume that someone is your buddy if they happen to be in the lab. You must explicitly notify them that you need a buddy, and they must accept that responsibility. Your buddy may not leave until chemical operations are completed and you have cleaned up.

CHEMICAL CLASSES AND STORAGE

Acids – Acids are substances that donate protons when dissolved in water. Acids are used for etching metal and cleaning wafers, are generally corrosive, and can be toxic or water reactive (e.g. sulfuric acid). Acids are stored in the appropriate blue corrosives cabinet.

Bases – Bases accept protons, and can increase the hydroxide ion concentration when dissolved in water. Bases are stored in the appropriate blue corrosives cabinet.

Oxidizers – Oxidizers are agents that are easily reduced, and generally supply oxygen to chemical reactions. Oxidizers can react violently with organic chemicals. Oxidizers are stored in the appropriate blue corrosives cabinet.

Solvents – Although the term “solvent” refers to any liquid used to dissolve another material, at WCET “solvents” are typically organic liquids that are flammable or combustible. We use acetone, isopropyl
alcohol, methanol, n-methyl pyrrolidone, dimethyl sulfoxide, and a variety of others. Solvents are stored in the yellow flammables cabinets near the Room 112 entry vestibule.

There are 5 cabinets in Room 112 for storing chemicals in the Scale-Up & Characterization Testbed:

Cabinet 1 – Flammables
Cabinet 2 – Acids
Cabinet 3 – Bases
Cabinet 4 – Peroxidizables, oxidizers and nitrated
Cabinet 5 (black, with doors) – General chemicals

*See section D page 2-9 of the Laboratory Safety Manual (LSM) for detailed information on chemical storage

NEW MATERIALS REQUESTS

Only WCET laboratory staff can accept new chemicals and materials into the WCET labs. Before bringing a new chemical into the cleanroom, you must send an SDS, and a Standard Operating Procedure to WCET staff at wcet@uw.edu. The lab manager and the lab safety manager will review the documents prior to approval. NO UNAPPROVED CHEMICALS ARE ALLOWED IN WCET LABS. We do not permit long-term storage of any personal chemicals in the facility without explicit permission.

CHEMISTRY BENCH TYPES

There are 3 types of working spaces: lab benches, glove boxes, and fume hoods. Organic solvents such as acetone, isopropanol, and SU-8 developer are not allowed on the plastic surfaces without protection because they will dissolve the working surfaces. Acids and bases are not allowed on metal surfaces. You are responsible for understanding the specific requirements and chemical restrictions for each bench type.

AVOIDING FUMES

Fume hoods are designed to limit your exposure to chemical fumes. Check the status panel of the hood to make sure it is functioning properly. Many fumes in the lab are toxic, corrosive, or carcinogenic, so it is important to only work under the sash for very brief periods of time and only when absolutely necessary.

PERSONAL PROTECTIVE EQUIPMENT
You are required to use additional personal protective equipment (PPE) when working in the Scale-Up & Characterization Testbed and Environment Controlled Room. Rooms 110-113 require booties, gloves, and eye protection. A lab coat is required when using chemicals. In addition, hair nets and a cleanroom suit are required in the Environment Controlled Room.

- Specifics:
  - disposable non-woven lab coats provided by the lab are preferred, but personal, clean cotton lab coats are acceptable
  - safety glasses must be worn at all times. Regular glasses may be sufficient when not working with chemicals. Use face shields for high volumes (> 100 mL) of solvents
  - latex and/or nitrile gloves are provided, but proper chemical compatible gloves for your chemicals must be listed in your process standard operating procedure (SOP), and must be brought by you, if not available

DONNING PPE

Check all items for damage before use. Look for cracks or pinholes in gloves, tears or holes in coats and suits, and scratches or cracks in eye protection. If any gear is damaged (e.g. ripped apron or gloves), discard it and use another item. Rinse damaged items with DI and dry before disposing.

WEARING PPE

Do not touch anything unnecessarily with the chemical gloves and treat them as though they were contaminated. Do not leave the Scale-Up & Characterization Testbed while wearing chemical gloves. Wearing PPE is not an excuse to act in an unsafe manner. Do not ever put your hands or fingers into a chemical bath, and always avoid splashing or spilling chemicals. Also, PPE provided by the WCET is only for temporary protection. It will not protect you from a spill, splash, or mist for a prolonged period of time.

DOFFING PPE

Gloves, booties and hair nets should be disposed of in lab waste containers. Lab coats, suits, and safety glasses should be returned to the dressing location in the Room 112 vestibule.

LABELING

Prior to filling, all chemical containers must be properly labeled even if you do not intend to walk away. You must include your name, the chemical name, and the date. If you plan to leave chemicals out after leaving the room, a phone number or email and an expected time of disposal must also be provided. Water must be labeled. If the chemical is not regularly used in the laboratory (e.g. it was brought in after approval from the lab staff), list all hazards.
POURING CHEMICALS

Assume that all chemical bottles are contaminated. Use a bottle carrier when transferring chemicals to and from storage locations. Immediately before pouring, always recheck the chemical label and make sure the chemical container you intend to use is set flat on the bench surface. Do not try to pour small volumes from gallon jugs; instead, transfer chemicals from gallon jugs to graduated cylinders or beakers, and then pour again from this secondary container. Use good judgment and do not overfill containers (i.e. do not fill them so close to the top that moving the container or disposing the chemical is unsafe). Never return poured chemicals to their original container.

Use containers that are compatible with your chemicals. For example, some chemicals or solutions, such as piranha (a mixture of sulfuric acid and hydrogen peroxide), cannot be stored in closed containers even for brief periods of time because it outgases and could cause an explosion. Also, hydrofluoric acid cannot be used with glassware because it will dissolve the container.

CHEMICAL BOTTLE CLEAN-UP

Use chemicals in partially used bottles before opening new bottles. Properly clean empty chemical bottles before disposal. Leave empty solvent bottles open in a fume hood to evaporate. After the solvent residue has evaporated, fill the bottle half full with DI water and dump down a water drain. Repeat this process three times. Acid and base bottles must also be rinsed by filling the bottle half full with DI water, emptying the bottle into a water drain, and repeating at least three times. After rinsing, dry the outside of the bottle with wipes, use a black marker to cross out the label, and then write “Rinsed 3x” in at least two different locations on the bottle. Set the empty, rinsed, dry, and labeled bottle on the top shelf of the blue waste cabinet.

DISPOSING SOLVENTS

To dispose of used solvent, empty it into an appropriate waste container. Clean the chemical container with an acetone soaked wipe, and then wipe thoroughly with isopropanol (IPA). Remove the label with acetone or IPA (do not bring a solvent squirt bottle into a plastic bench), rinse with DI water and return the container to the drying rack.

DISPOSING ACIDS AND BASES

To dispose of used acids and bases, empty them into an appropriate waste container. Rinse the container three times with water, then rinse with DI water. Take the chemical container to a fume hood and remove the label with acetone or IPA on a wipe and then return it to the drying rack.
HANDLING SMALL SPILLS

Attempt only to clean small spills for which your training and experience are appropriate, provided you can do so safely without taking unnecessary risks. Large spills or spills outside of wet benches should be treated as emergencies. Refer to the Chemical Emergencies section of this manual.

Clean small solvent spills with lint-free wipes and dispose them in the laboratory waste can. Then use acetone and IPA with wipes to clean the surface(s). Clean acid or base spills by thoroughly rinsing the surface with DI water. Do not wipe up chemicals directly with wipes without first rinsing and diluting the spill thoroughly. Once you are sure that there is only water left on the surface, dry the remaining drops of water with a wipe to leave a clean, dry surface.

Spill kits available for cleaning general solvent spills. These kits contain: spill pads, baking soda, dust pan and broom, hazmat waste bags, splash goggles, impervious gloves, lightweight gloves, EH&S chemical collection request forms and hazardous waste labels.

HOTPLATE SAFETY

Do not touch hotplate surfaces. Use extreme care when hotplates are used in proximity to flammable solvents or other liquids. Do not spill on hotplates or spray water on hotplates, and do not heat high vapor pressure solvents. For example, do not heat up acetone or isopropanol. It is acceptable to remove hotplates from a wet bench if you need more room or if you feel more comfortable working without one in the hood. If you need to heat an organic solvent or material in a bottle, heat the container in a water bath, not directly on a hotplate.

LEAVING WORKSPACES

After using a bench or other workspace, clean up all chemicals, chemical containers, wipes, and other materials (samples, tape, markers, notes, personal effects, etc.). Always leave wet bench surfaces clean and dry within comfortable arms reach, and as organized as possible.

Chemical Emergencies

Spill Response – In order to become an onsite user, you are required to complete the UW EH&S Managing Laboratory Chemicals online training course. This training outlines chemical handling and emergency procedures. If you cause or encounter a chemical spill, respond accordingly based on the following scenarios.

- Risk of fire or spills that could spread out of the room: Pull the nearest fire alarm. This alerts the local fire and police departments that there is an emergency at your location and sounds the alarm in the building for everyone to evacuate. Leave the building, helping others as necessary. Then, if possible, call 9-1-1. Tell them what happened. Stay on the scene to help personnel respond to the emergency. Do not fight any fires yourself.
- No risk of fire, spill and vapor contained in the room, but someone is injured or exposed: Call 9-1-1 only. If someone has been exposed to a chemical, begin decontamination and/or first aid as soon as possible. Evacuate the room and wait for emergency personnel to arrive.

- Everyone is safe, but there is a large chemical spill: Contact the lab staff or call the EH&S Spill Advice Line during normal hours at 206-543-0467. Call 9-1-1 after normal business hours and ask for EH&S chemical spill advice. EH&S will advise you on how to clean up your spill or will call the UW's spill cleanup contractor to clean up the spill for you at the lab's expense.

Only attempt to clean small spills for which your training and experience are appropriate. If you feel comfortable and are properly trained, there a spill kit is located Room 112 for any chemical spill that is not considered a HAZMAT emergency. Personal protective equipment includes nitrile and neoprene gloves, aprons, and face shields. Additionally HAZMAT Level B suits are available on the spill cart for staff use only. Contact staff for large spills (>100 mL) or spills outside of a wet bench. Do not clean spills that occur outside of the fume hood that may require specialized respiratory protection (e.g. large acid or solvent spills, including any HF spills).

Regardless of the size of spill, contact the staff and report the spill details and if/how it was cleaned. Once the spill is handled properly and everyone is okay, the events need to be reported and discussed to improve spill prevention and evaluate the response as a laboratory group. Also, if you are involved in a spill, you must fill out an Online Accident Reporting System (OARS) accident report on the EH&S website. State and federal law requires that all accidents and near-misses be reported. The University of Washington also has committees that track accidents on campus in order to assess and improve campus safety.

Chemical exposures – Working with chemicals is dangerous. Even common mistakes like dropping a container or leaving a reaction unattended for "just a minute" can have serious consequences when chemicals are involved. Work carefully and deliberately; keep in mind what to do if things go wrong. Read the SDS for all chemicals you plan to use to ensure you are aware of hazards and emergency procedures. Avoid exposures by following the rules below:

- Don’t work with chemicals when you’re too tired to think clearly.
- Keep your workspaces clean and organized.
- Wear personal protective equipment

If you are exposed to a chemical (other than hydrofluoric acid, discussed in the next section), do the following:

- Stay calm. Move out of the contaminated area.
- Get the chemical off. Fast dilution is key. If the chemical is on skin or soaking through your clothing, go to the safety shower. Pull the handle on the safety shower, and do not worry about getting the floor wet. Stay in the shower for a minimum of 15 minutes, taking off all clothing necessary to minimize exposure to the chemical. Do not be modest, as your life may depend on removing soiled garments! Get coworkers to help shield you or cover you up. If the chemical is in your eyes, use the eyewash, holding your eyes open in the water for 15 minutes.
- Get a coworker to call 9-1-1 as soon as possible. Have them explain the situation to emergency personnel.
If possible, obtain an SDS to give to emergency personnel.

You must inform WCET staff if you have had an exposure to a dangerous chemical. If a hospital visit is needed, it is always valuable to take the SDS for the chemical to the hospital because the proper medical care can be better determined with the SDS.

**Hydrofluoric acid exposure** – Hydrofluoric acid (HF) is among the most dangerous chemicals in WCET, and the medical treatment for exposure is specialized and differs from that of most other chemicals. HF exposure is very serious, as it can cause severe burns, metabolic imbalances, pulmonary edema, and cardiac arrhythmias. As little as 100 mL is potentially lethal if untreated. HF and Buffered Oxide Etch (BOE) will not necessarily cause an immediate burning sensation, so respond quickly if you have had an exposure even if you do not feel any immediate pain.

- In the event of skin contact: remove clothing and flush the affected area for a maximum of 5 minutes. While rinsing, have someone call 9-1-1. Put on double nitrile gloves and then apply calcium gluconate gel, located on the HF wet benches, to the contaminated skin. This will help to neutralize fluorine ions.
- In the event of eye contact: use the eyewash for 15 minutes. Do not use calcium gluconate in your eyes! Call 9-1-1. Emergency personnel will treat eyes with a solution of calcium gluconate mixed with saline.
- In the event of inhalation: Call 9-1-1. Move to fresh air and wait for medical assistance.

If you are aiding someone experiencing HF exposure, wear black, neoprene gloves that offer the highest protection from HF, or double nitrile gloves if those are not available. The University of Washington EH&S provides details on HF hazards, exposures, spill cleanup, storage, etc. in a document that can be found at:

http://www.ehs.washington.edu/manuals/focus/hf.pdf

A much more thorough examination of HF and of first aid and medical procedures can be found at:


**Important Contacts**

WCET has a designated Chemical Hygiene Officer (CHO) who is knowledgeable about the laboratory’s procedures, is actively involved and observant of those procedures being performed, and has the authority to enforce correct procedures. The CHO ensures that laboratory-specific information is documented in the CHP and ensures that activities conducted within the laboratory are consistent with the CHP. Additional information and documents, including SDSs, building evacuation plan, and the health and safety plan can be found at the user information station in room 112. Equipment manuals are stored with or near the instruments.

The CHO for WCET is the Managing Director, Michael Pomfret. WCET staff members (Michael Pomfret and Felippe Pavinatto) are responsible for checking first aid supplies, maintaining chemical inventories, and weekly eyewash checks. Other important contacts for chemical management at WCET are given below.
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<th>Facility</th>
<th>Room</th>
<th>Zone</th>
<th>Department</th>
<th>Contacts</th>
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