

The Hong Kong University of Science and Technology

Nanosystem Fabrication Facility (CWB)

NFF (CWB)

HEALTH AND SAFETY MANUAL



**NANOSYSTEM
FABRICATION FACILITY
(CWB)**

Website: <http://www.nff.ust.hk>

1/7/2017

Prepared By: Mr. Wing Leong CHUNG, email: mfechung@ust.hk, Tel.: 2358 7211

General Enquiry: Ms. Maggie YAU, email: mfcmyau@ust.hk, Tel.: 2358 7221

CONTENT

Health and Safety Policy

Objective

1. General

- A. Safety Organization
- B. General Responsibilities
- C. Equipment Operational Procedures
- D. The Cardinal Rule
- E. Safety Awareness
- F. Restrictions
- G. Available Safety Equipment
- H. Casualty Control
- I. Evacuation Routes
- J. Personnel Protective Equipment
- K. Toxic Gas Alarm System
- L. Emergency Alarm Buttons
- M. MSDS

2. NFF (CWB) Laboratory Safety Rules and Procedures

- A. Introduction
- B. General Cleanroom Safety Precautions
- C. Equipment Operation Safety
- D. Operation Guideline inside NFF (CWB) Phase 2 Basement
- E. DG Store Operation Procedures
- F. Chemical Spill Control
- G. Disposal of Hazardous Materials
 - i. Disposal of broken glassware and broken wafer
 - ii. Disposal of broken thermometer
 - iii. Disposal of chemical
 - iv. Disposal of contamination paper or cleaning residues
- H. Electrical Hazards
 - i. Principle cause of electrical shock or electrocution
 - ii. First Aid for shock or electrocution
 - iii. Effect of low frequency current on human body
 - iv. Effect of high frequency current on human body

- v. Hot work precaution
 - vi. Safe practices for RF current and high voltage
 - vii. Safety for electronic component
- I. Lock Out/Tag Out
- J. Chemical Control
 - i. General
 - ii. Standard and Special items
 - iii. Bringing-in chemicals
 - iv. Taking-away of Chemical
 - v. Table of standard items
- 3. Special Guideline on HF Safety
 - A. Description
 - B. Toxicity and the Effects in Man
 - C. Symptoms
 - D. First Aid Treatment
 - i. Inhalation
 - ii. For Skin contact
 - iii. For eyes contact
 - E. Prevention
- 4. Emergency Procedures
 - A. Reporting Procedures
 - i. Office hours
 - ii. Non-office hours
 - B. Immediate Treatment
 - C. Emergency Response Plan
 - D. Evacuation Procedures
 - E. Evacuation Routes
- 5. Appendix
 - A. Emergency Escape Routes of NFF (CWB) Phase 2 Cleanroom
 - B. Emergency Escape Routes of NFF (CWB) Phase 2 Basement
 - C. Emergency Escape Routes of NFF (CWB)-EC
 - D. Emergency Escape Routes of NFF (CWB)-DRIE Center
 - E. Emergency Escape Routes of NFF (CWB)-NDL
 - F. Emergency Response Plan

Health and Safety Policy

It is the policy of NFF (CWB) that a safe and environmentally sound laboratory provided for all NFF (CWB) users and staff, and that all users and staff and the laboratory in which we work will fully comply with all regulations and prudent operating practices.

Objective

It is the objective of NFF (CWB) to have an outstanding Health and Safety program and to reduce the number of accidents to an absolute zero. This can only happen if we all work together and express our concern to each other about our own safety and the safety of other NFF (CWB) users.

1. General

A. Safety Organization

| | | |
|---------------------------|---|------------------------------|
| Department Safety Officer | : | Mr. Wing Leong CHUNG (SO) |
| Deputy Safety Officer | : | Mr. Man Wai LEE (DSO) |
| Emergency Response Team | : | All NFF Technical Staff |
| Safety Committee: | | Mr. Wing Leong CHUNG (Chair) |
| | | Mr. Man Wai LEE |
| | | Mr. CK WONG |
| | | Mr. Chun Fai YEUNG, Henry |
| | | Mr. Ho LI |
| | | Mr. Peter PUN |

24 hours on campus emergency responders:

| | |
|----------------|-------------|
| Mr. CK WONG | (9753 1662) |
| Mr. Peter PUN | (9789 9508) |
| Mr. Boris CHOI | (9492 1482) |
| Mr. Brial KWOK | (6622 3455) |

B. General Responsibilities

The NFF (CWB) Safety Officer is responsible for enforcing the Health and Safety program and for coordinating all emergency response. The DSO or

his/her deputy is always on-call and can reach via mobile phone (9621 7708) or telephone (2358 7900).

Safety Committee will organize a regular meeting to review all safety related issues periodically to ensure that the safety program execute efficiently.

C. Equipment Operational Procedures

Equipment operation procedures are posted nearby the equipment. **Do not operate the equipment if you are not a qualified user of that equipment.** Detailed qualification procedures please refer to NFF (CWB) website. If you do not familiar with the equipment operation, please consult the staff in charge of the equipment training (Mr. Ho LI).

NFF (CWB)'s staff should:

1. Provide training with proper procedures to users;
2. Give necessary instruction;
3. Enforce safety rules;
4. Allow adequate time, resources and personnel to perform the work;
5. Provide adequate facilities and housekeeping;
6. Provide adequate safety gear and proper tools;
7. Monitor Job progress.

Persons performing the work should:

1. Follow instructions and safety rules;
2. Use safety equipment provided;
3. Use proper tool;
4. Concentrate on the work;
5. Report any incident/machine malfunction to NFF (CWB) staff;

Things you should not do:

1. Take shortcuts because of haste or laziness;
2. Bypass interlocks for convenience;
3. Work when impaired by fatigue, illness, or other causes;

D. The Cardinal Rule

NEVER WORK ALONE. This rule is absolute and non-negotiable. All NFF (CWB) users must follow buddy system all the time. Check the computer system at the main entrance to find out if others are working in the lab. Once you have ascertained that there is lab user working in the lab, you can enter and gown up. Locate one of the lab users and tell them where you will be working. Check up each other frequently. If no one else is present, you should stop working until you find another lab user. It is a good idea to plan if you want to work in the evening. No lab-user ever permits to work alone.

It is NFF (CWB) policy that no one is allowed to work after lab operation hours.

| | | |
|--|---|---------------------------------------|
| NFF (CWB) phase 2 | : | 9:00 a.m. to 23:59 (Monday to Friday) |
| NFF (CWB)-EC | : | 24 hours operation (Monday to Friday) |
| NFF (CWB)-DRIE Center (Rm 2223) | : | 9:00 a.m. to 17:00 (Monday to Friday) |
| NFF (CWB)-TSV Process Lab.: (Rm 2227) | : | 9:00 a.m. to 23:59 (Monday to Friday) |
| NFF (CWB)-NDL (Rm 3114) | : | 9:00 a.m. to 17:30 (Monday to Friday) |

E. Safety Awareness

Please report any unsafe act or unsafe condition that you encounter. Imminent hazardous conditions must report directly to NFF (CWB) staff immediately.

F. Restrictions

Open shoes, sandals and shorts are not permitted. Wearing contact lenses in the lab is discouraged due to the hazard of trapping chemicals in or under your lenses. Soft or hydrated contact lenses may contain up to 50% water by weight and can become irritating, if they absorb chemical vapors. If you choose to wear contact lenses in the lab, you can do so at your own risk.

Safety glasses must be wore all the time. Splash goggles use for corrosive liquid. Laser or UV sources may require further specialized eyewear. Please contact NFF (CWB) staff if you anticipate this need.

No ear/head phones are allowed to use in the cleanroom area. Using an ear/head phones are danger in case of any alarm signal triggered, and user may not alert to the alarm signal in the cleanroom environment. Please consult NFF (CWB) staff if you have any enquiry.

G. Available Safety Equipment

The primary fitted fire service installation included the following:

- * Toxic Gas Leakage Alarm System;
- * Water Sprinkler;
- * Fire Damper;
- * Fire extinguishers;
- * Heat Detector;
- * Smoke Detector;
- * Fire Alarm System;
- * Exhaust Failure Alarm.
- * Emergency Alarm Button.

Other Safety Equipment:

- * Eye washer and Safety Shower;
- * First Aid Kit (include calcium gluconate for HF exposures);
- * Chemical Spill Kit;
- * Emergency Telephone Directory (posted beyond the phone);
- * Evacuation Route;
- * Emergency Lighting;
- * Personal Protective Equipment;
- * Right-To-Know Center (MSDS)
- * Emergency Safety Equipment.
- * Fire blankets;

Before working inside the lab, please make sure that you are familiar with the location of the safety equipment, such as, location of fire extinguisher, first

aid kit, location of eye washer and safety shower, and fire escape routes and assembly point.

H. Casualty Control

First, lab users should notify the accident to the Security Control Center (x8999). All injuries or casualties will give first aid as necessary. For minor injuries, such as minor burns and cuts treatment with the first aid kit to be acceptable or call campus clinic. For injuries beyond the scope of campus resources, ambulance service will be called and the following procedures must follow:

- * While waiting for the ambulance, remove victim from hazardous area if safe to do so
- * Injured person will be placed in the care of qualified medical personnel.
- * information regarding injury-causing agents will be provided to the ambulance service, including material safety data sheets (MSDS) where chemical exposure are involved
- * The next of kin of injured person will notify.

I. Evacuation Route

The evacuation route map posted by the telephone. Please familiarize yourself with all the emergency exits.

J. Personnel Protective Equipment

PPE is a personal protective equipment designed to protect of lab users and staff. Appropriated PPE are located next to the equipment with potential hazard.

PPE includes:

- face shields, which designed to protect face and neck from:
 - * sprays of hazardous liquids
 - * flying particles
 - * splashes of molten metals
 - * hot solutions

- Safety glasses are required for operations, which present hazards of:
 - * flying objects/particulate
 - * glare
 - * safety goggles should be worn for chemical splashes
- Chemical resisted gloves and apron appropriate for the chemical hazard
- Air-purifying respirator is used in adequately ventilated areas containing at least 19.5% oxygen to protect one from hazardous fumes and particles. Respirator fit test and medical examination are required.
- Self-contained breathing apparatus (SCBA) is used in unknown concentrations and immediately dangerous to life or health atmospheres, and for firefighting. Medical examination and evaluation of potential respirator user is required. Only NFF (CWB) staff will be BA trained.

K. Toxic Gas Alarm System

We are using several kinds of electronic gases in NFF (CWB) phase 2, which include:

- 1) Silane (SiH_4);
- 2) Germane (GeH_4);
- 3) Dichlorosilane (SiCl_2H_2);
- 4) Chlorine (Cl_2);
- 5) Boron Trichloride (BCl_3);
- 6) Ammonia (NH_3);
- 7) 50% Phosphine in Silane (50 % PH_3 in SiH_4);
- 8) Arsine (AsH_3);
- 9) Phosphine (PH_3);
- 10) Boron Trifluoride (BF_3).
- 11) 0.3% Phosphine in Silane (0.3 % PH_3 in SiH_4);
- 12) 100ppm Diborane in Hydrogen (100ppm B_2H_6 in H_2)

Some of them are toxic, corrosive, or pyrophoric. In order to prevent the danger of gas leakage into the environment, all electronic gas cylinders are put inside negative pressure cabinets and monitoring with a toxic gas detection system. In addition, every piece of equipment using the electronic

gases are monitoring by that system. Once the system detect the gas concentration is above the TLV-TWA (8 hours Threshold Limit Value), it will give us an audio and visual alarm and at the same time will shut off the corresponding gas cylinder.

There are six repeater panels located at different areas all over the lab. If you hear an alarm come from the panels, please follow the evacuation procedure to leave the lab.

L. Emergency Alarm Buttons

In case of emergency, i.e. acid/chemical spill, fire, gas leakage or other situation occur which will cause a loss of human life, we may activate the emergency alarm button to notify the lab user to evacuate from the lab. Please familiar with the location of the emergency buttons.

M. MSDS

The Material Safety Data Sheets (MSDS) for different kinds of chemicals using inside the lab placed at the Right-To-Know Center at the main entrance of the lab. Please study the safety precaution list of the MSDS before working on those chemicals.

2. NFF (CWB) Laboratory Safety Rule and Procedures

A. Introduction

In order to provide a safe and good research facility to NFF (CWB) users, all NFF (CWB) users and HKUST staff must follow the following rules.

B. General Clean Room Safety Precautions

1. User must familiar with the location of fire-fighting equipment, first aid kits, safety showers and eye washers, emergency alarm buttons, fire escape routes, safety equipment and assembly points;
2. Get proper training before operating the machine. If you are not familiar with the operation, consult with NFF (CWB) staff;

3. Know the chemicals which you are using, by referring the MSDS which provide information of physical, chemical, and toxicological properties of the chemical;
4. Plan your operation or experiment carefully and take into consideration of the hazardous properties of material involved;
5. Learn how to use fire-fighting equipment;
6. Keep all fire doors close;
7. Never run;
8. Beware of floor opening;
9. If you hear an alarm, don't panic and make sure that where the alarm comes from;
10. Do not temper with any gas boxes location onto the floor;
11. Using of appropriate Personal Protective Equipment on different operation;
12. Familiar all emergency procedures now. Don't go through those procedure in case of emergency;
13. Know the emergency contact point (post beside on each telephone).
14. A buddy system should always be used when working in or near a hazardous environment, Never work alone even for a minute;
15. Do not take anything for granted when working with inexperienced help. Check every operation before and after it is performed;
16. Do not wear jewelry. Any jewelry, especially a ring, is hazardous to wear around equipment with moving parts. It can become trapped in the moving part and can cause severe injuries.
17. Clean room attire protects the product, but does not protect the person wearing it.
18. When you wear a bunny suit, your skin is usually damp with perspiration, lowering your electrical resistance to current. Be extra cautious around electrical equipment.
19. A clearness hood, safety glasses, or goggles drastically reduce your peripheral vision. Use extra caution when moving about the clean room.
20. The loose fabric of clean room attire can easily become tangled in machinery. Allow yourself extra room around mechanical equipment.
21. Clean room gloves impair your manual dexterity and your sense of touch and response to heat. By the time you feel warmth, the glove may have already melted to your hand.

22. The hood or face shield covers your nose. This raises the threshold detection value for all chemicals.
23. The bunny suit desensitizes all of your body. You are less likely to be aware of brushing against objects in the clean room.
24. Clean room booties worn over shoes are slippery, and the more booties are worn, the more slippery they become.

C. Equipment Operation Safety

User must go through equipment operation training either by hand-on training provided by NFF (CWB) staffs or video training; and pass qualification test before having permission to operate particular equipment.

Equipment operation precaution will be posted by the equipment, please read and understand those precautions before work on the machine.

D. Operation Guideline inside NFF (CWB) Phase 2 Basement

Only HKUST staff can work inside the basement. Do not stay inside the basement without permission.

Before working inside NFF (CWB) phase 2 basement, we should familiar with the location and/or the operation of the safety equipment:

1. First Aid Kit;
2. Eye Washer and Safety shower;
3. Fire Fighting Equipment;
4. Chemical Spill Control Kit;
5. Evacuation Route Map;
6. Emergency contact point.

Moreover, the appropriate Personal Protective Equipment (PPE) must be used all the time;

1. NFF (CWB) phase 2 basement is a “HARD HAT AREA”, wear the safety helmet when you work inside;

2. When you work on the acid neutralization plant, HF collection tank and water scrubber face shield, apron and chemical resistance glove should be used and after using keep them clean and dry;
3. Use the ear plug when you are working on a high noise level area, i.e., compressed air plant, house vacuum plant, D.I. water plant and mechanical pump stacks;
4. Use the safety goggle to prevent fly object and the use of glove is prohibited when you are working on rotary part of the machine.

General safety precaution in NFF (CWB) basement:

1. Never work alone;
2. No food and smoke inside the basement;
3. Unauthorized person should not enter the basement;
4. Chemical waste should be handled by a trained personnel only and they should know the properties of the chemical which handled;
5. If you found any facility inside basement have problem, notify the person in charge of that facility and don't try to fix it if you not familiar with its operation;
6. In case of chemical spill, follow the Chemical Spill Control Procedure (on Section 3C);
7. In case of fire, follow the Emergency Respond Plan.

| FACILITY | PERSON IN CHARGE |
|----------------------------|---------------------------------|
| Compressed Air Plant | CMO (Ext. 6465) |
| Water Scrubber | Ho LI (Ext. 7896/7216) |
| C.D.O. | Ho LI (Ext. 7896/7216) |
| Exhaust Fan | CMO (Ext. 6465) |
| Electrical Installation | CMO (Ext. 6465) |
| Equipment Vacuum Pump | M.W. LEE (Ext. 7896/7900) |
| Chillier or Heat exchanger | C.K. WONG (Ext. 7896/7226) |
| Air Handling Unit | CMO (Ext. 6465) |
| Fire Alarm Panel | CMO (Ext. 6465) |
| HF Collection Tank | Chun Fai YEUNG (Ext. 7896/7219) |
| Acid Neutralization Tank | Chun Fai YEUNG (Ext. 7896/7219) |
| D.I. Water Plant | Chun Fai YEUNG (Ext. 7896/7219) |
| House Vacuum | Chun Fai YEUNG (Ext. 7896/7219) |

E. DG Store Operation Procedures

Two DG stores supply process gases to our equipment for wafer processes; the daily operation of the DG stores and gas cylinders is handled by NFF

(CWB) staff only. Before work on the DG store, all personnel must be familiar with the individual gas properties.

| DG STORE No.1 | | DG STORE NO.2 | |
|---|------------|-------------------------------|----------|
| GASES | PROPERTY | GASES | PROPERTY |
| SiH ₄ | F, T | N ₂ (DEWAR) | A |
| SiH ₂ Cl ₂ | I, C, F, T | N ₂ | A |
| GeH ₄ | F, T | CF ₄ | A, I |
| Cl ₂ | I, C, O, T | CHF ₃ | A, I |
| BCl ₃ | C, I, T | SF ₆ | A |
| NH ₃ | C, I, T | C ₂ F ₆ | A, I |
| 50% PH ₃ in SiH ₄ | I, F, T | CO ₂ | A |
| 15 % AsH ₃ in H ₂ | I, F, T | Ar | A |
| 15 % PH ₃ in H ₂ | I, F, T | He | A |
| BF ₃ | C, I, T | O ₂ | O |
| N ₂ | A | N ₂ O | C, O |
| H ₂ | A, F | | |
| 5 % H ₂ in N ₂ | A, F | | |

LEGEND :

A : Asphyxia O : Oxidizer
 I : Irritation C : Corrosive
 F : Flammable T : Toxic

The following is the general Precaution or Rule that must be followed if you are working inside the DG stores:

1. Never work alone ;
2. Only qualify and trained persons will permitted to handle gas cylinder and/or gas cabinets;
3. Cylinders when not in use should be properly plugged and cap;
4. No gas decanting is allowed;
5. Force ventilation should be on all the time; if it fail never work inside the DG store;
6. Inspect each incoming cylinder to ensure that it is free of leak and contain the correct product;
7. MSDS should readily available outside the DG store;
8. Move Cylinder using cylinder hand truck;
9. Secure all cylinders properly while in use and during storage;
10. All personnel should familiar with all emergency procedures and equipment necessary to deal with leaking cylinders and control equipment (Fire extinguishers, SCBA...);

11. Cylinder containing flammable gases and mixtures should be properly ground;
12. Control equipment for oxidizing gases and mixtures must be free of any non-oxidant compatible lubricant;
13. Use proper check valves and purge venting with all corrosive gases;
14. Gas cylinder connected to the cabinet should be pressure tested with nitrogen at least 24 hrs. to ensure no leakage;
15. Connecting and disconnecting of gas cylinders from the gas cabinet should be done by qualified and trained NFF (CWB) staff member, other people in the vicinity should be evacuated;
16. Leak check should be carried out by qualified and trained persons during office hour and the results are to be suitably recorded;
17. Purging of gas cabinet and pipe line with N₂ (at least 10 times) before disconnecting the cylinder;
18. All personnel should be familiar with the emergency response plan;
19. If leakage is found, stop leak if you can do it without risk;
20. If Silane fire happens, LET BURN UNLESS LEAK CAN BE STOPPED IMMEDIATELY;

F. Chemical Spill Control

In the event of chemical spill, NFF (CWB) has a “Spill Response Kit” to clean up and contain the chemicals. Those are located in the staff office, basement and class 10,000 clean room. And, only trained personnel can handle the cleanup.

In the event of small spill, NFF (CWB) staff can usually clean it up safely, but the spill is too large to clean up safely or if employees have been injured or contaminated, immediately call the SCC. Report all spills of hazardous chemicals to HSEO.

Emergency procedure for Hazardous Chemical Spill in NFF (CWB)

1. Alert all NFF (CWB) users inside the lab with the emergency alarm button to evacuate the lab. (followed the Emergency Evacuation Procedure);
2. Confine spill if safe to do so;
3. Inform the SCC by dialing 8999. Do not use a telephone nearby to the spill;

4. Inform NFF (CWB) staff about the situation;
5. NFF (CWB) staff must restrict the people come into the lab. before the arrival of emergency;
6. Describe the accident to the emergency response team upon its arrival, including the name of chemical, the quantity of spills, MSDS of that chemical;

Before decide to clean-up the spill, all personnel must wear appropriate Personal Protective Equipment (such as rubber boots, rubber gloves, apron, respiratory protector or BA set).

G. Disposal of Hazardous Materials

i.Disposal of broken glassware and broken wafer

All broken glassware should be placed in the glass collection box provided by Chemical Inventory Store, if you have a need please consult NFF (CWB) staff.

ii.Disposal of broken thermometer

Because of the danger of metallic mercury, contact NFF (CWB) staff for disposing of heavy metal or consult HSEO for cleaning and evaluation if you break a thermometer.

iii.Disposal of chemical

Disposal of chemical should be done by NFF (CWB) staff only. Different chemicals may have different disposal methods and please follow the table shown below:

| Chemical | Disposal Method |
|-----------------------------------|--------------------------------|
| Hydrogen Peroxide | Acid Waste to N-tank |
| Sulfuric Acid | Acid Waste to N-tank |
| Nitric Acid | Acid Waste to N-tank |
| Hydrofluoric Acid and its mixture | HF Waste to HF Collection Tank |
| Phosphoric Acid | Acid Waste to N-tank |
| Freckle Etch Solution | HF Waste to HF Collection Tank |

| | |
|---------------------------------|---|
| PAD Etch solution (777 etchant) | Acid Waste to N-tank |
| Hydrochloric Acid | Acid Waste to N-tank |
| Acetic Acid | Acid Waste to N-tank |
| Buffer Oxide Etchant (BOE) | HF Waste to HF Collection Tank |
| TMAH | Acid Waste to N-tank |
| Potassium Hydroxide | Acid Waste to N-tank |
| Ammonia Hydroxide | Acid Waste to N-tank |
| Photoresist | Non-halogenated Organic Waste Container |
| Acetone | Non-halogenated Organic Waste Container |
| IPA | Non-halogenated Organic Waste Container |
| Thinner | Non-halogenated Organic Waste Container |
| Chrome Etchant | Acid Waste to N-tank |
| Chlorobenzene | Halogenated Organic Waste Container |
| Developer | Non-halogenated Organic Waste Container |
| HMDS | Non-halogenated Organic Waste Container |
| Resist stripper | Non-halogenated Organic Waste Container |
| Mechanical Pump Oil | Lubrication Oil Tank |
| Water | Acid Waste to N-tank |

The collection tank can be ordered from HSEO. And, each time we fill the chemical waste tank, we must fill out the hazardous waste sheet located by the disposal tank with the following information:

- a. Your Name
- b. Contact phone number
- c. Date
- d. Material identification
- e. Quantity.

After these tanks are full, they will be picked up by HSEO.

The chemical drain to N-tank will be neutralized and then pump to the sewage system.

The chemical drain to HF tank will be further neutralized and then collected by HSEO.

Precaution:

1. Never mix acid with solvent because it may cause explosion;
2. Keep each container to 70 % of its max. capacity;
3. When the tank is full, keep the capped loosely to prevent pressure build-up;
4. Always keep the waste tank inside the waste cabinets;
5. Make sure each container is properly labelled;
6. Always use the PPE when handling the waste.

iv. Disposal of contaminated paper or cleaning residues

All paper or absorbent soaked with chemical should be placed inside a plastic double bag and properly sealed, labeled, and MSDS should be attached on the waste package. This package is picked up by HSEO.

All contaminated cleaning residues (example: IPA with pump oil) should be put in a separate container and ask HSEO for special disposal method.

H. Electrical Hazards**i. Principle causes of shock or electrocution**

The following is a partial list of unsafe acts that may lead to you or someone else being shocked or electrocuted:

- Failure to follow procedures and pay attention to details.
- Failure to shut off equipment and lock out power.
- Violation of lockout and tag out by using equipment that has been tagged as defective or out of service.
- Attempt of repairs. You are not trained to do so or do not have proper equipment to do so.
- Failure to discharge capacitors to ground.
- Working alone. An observer cannot prevent a shock, but can give CPR.
- Repetition, which leads to inattention or carelessness.

- Stress, which leads to inattention or hurrying to finish.
- Lack of final inspection before reconnecting power: someone could be working on another section of the circuit you energize.

Some hazardous conditions that may contribute to shock or electrocution are:

- Improper grounding of equipment.
- Improper tools
- Equipment improperly installed or maintained.
- Modifications to original installation; for example, bypassed safety interlocks and overloaded circuits.
- Poor documentation of the original installation and any modifications, leading to misidentification of circuits.
- Inadequate shielding of RF circuits, or failure to replace shielding.

ii.First Aid for shock or electrocution

In case of electric shock, follow the procedures below.

- Immediately cut power to the circuit. Do not attempt to drag the victim free until the power is off, or you may become victim number two.
- Immediately check the victim for pulse and breathing; begin CPR if needed. Paralysis of the respiratory muscles is a common effect of electric shock. If you are in doubt whether the victim is breathing, begin artificial respiration. It will not harm the victim, and not beginning it could allow the victim to die.
- Send for medical assistance. If you are alone with the victim, do not interrupt the CPR to go for help. Shout to attract attention between breaths.

iii.Effect of low frequency current on human body

The damage is done to the victim by current flowing through the body. The magnitude of the current depends on both the voltage of the circuit and the resistance of the human body. The skin's contact resistance mainly determines the resistance to the flow of DC or AC currents. The

interior of the body is very conductive once the skin resistance breaks down. Also, the longer the victim is in contact with the source, the greater the injury, because body resistance decreases with time.

- Dry skin has a resistance of 100,000 to 600,000 ohms.
- Wet skin has a resistance of 1,000 ohms or less. The skin of a person wearing a bunny suit is usually wet with perspiration.

Current of 1-15 milliamperes AC (5-75 mA DC) is in the "LET GO" range because, although the sensation may be unpleasant or painful, the victim can escape the current. A person can withstand repeated exposure to let-go current, at least for the time required to release the conductor, without ill effects. Current in the let-go range is more than sufficient to produce burns if the victim is unconscious or physically trapped in contact with the current.

Currents above 15-20 milliamperes AC (50-75 mA DC) are considered to be in the "CANNOT LET GO" range. Currents of this level cause severe muscle contractions and can paralyze the muscles needed for breathing. Prolonged exposure to currents only slightly greater than one's let-go current can cause death due to burns and lack of breathing.

Currents of 15-200 milliamperes AC (50-500 mA DC) can cause ventricular fibrillation (the heart muscle quivers uncontrollably instead of pumping blood). Once fibrillation has begun, it seldom stops without medical intervention. CPR must be started immediately and continued until the defibrillation apparatus is available.

Currents at or above 200 milliamperes can cause severe burns and nerve damage, and may stop the heart. The exposure needs not be prolonged for serious injuries to occur.

Alternating current typically causes the most serious injuries because the currents are typically above 20 mA, in the "cannot let go" range. The area affected will produce localized heavy sweating that, in turn, increases conductivity and allows more current to flow. The attitude that "it's only 230 VAC" is a contributing factor to many accidents.

Direct current impulse shocks, perhaps from a discharging capacitor, are typically one jolt that may cause a massive muscular contraction and possibly stop the heart or cause ventricular fibrillation. The victim may be thrown a considerable distance by the muscle contractions and be injured by the impact. Bone fractures due to the contractions are also possible. Lesser DC shocks are still hazardous because of the involuntary muscle contraction they cause. The victim may be injured when the affected part of the body forcefully strikes the equipment.

WARNING: FEELING EVEN A SLIGHT TINGLING SENSATION WHILE WORKING ON EQUIPMENT INDICATES THAT THERE IS A POTENTIALLY HAZARDOUS PROBLEM WITH THE WIRING OR GROUNDING. THE CAUSE OF THE SENSATION SHOULD BE DETERMINED IMMEDIATELY.

WARNING: IN CIRCUITS CARRYING OVER 24 VOLTS, SEVERE SHOCK MAY RESULT FROM THE DIRECT CURRENT IMPULSE.

IN CIRCUITS CARRYING LESS THAN 24 VOLTS, IT IS THE CURRENT, RATHER THAN THE VOLTAGE, THAT IS THE LETHAL COMPONENT OF ELECTRICITY.

IT IS IMPORTANT TO NOTE THAT THE "CANNOT LET GO" AND "LETHAL RANGE" CURRENT THRESHOLDS ARE LOWER FOR 50 HZ ALTERNATING CURRENT THAN FOR HIGH FREQUENCY CURRENT. THIS DOES NOT IMPLY THAT IT IS SAFE TO HANDLE RF CURRENT. RATHER, FOR ANY GIVEN VOLTAGE LEVEL, IT TAKES EVEN LESS CURRENT TO CAUSE HARM AT 50 HZ THAN IN THE RF RANGE. ALL OF THE THREE TYPES OF POWER ARE DANGEROUS.

iv. Effect of high frequency current on human body

The principle hazards in Radio Frequency (RF) equipment are RF burns, thermal burns, and electrical shock. In addition to the RF output, the components inside the generator may have a high DC potential. The AC input to RF generators is usually 220 VAC and 20 amps or more.

Thermal burns can occur if you are close to an arc of high voltage or RF. The air around the arc ionizes (becomes plasma) and the hot plasma causes the burn. RF fields can also induce current in nearby conductors, such as rings and watches or the coins in your pockets. This current quickly heats the conductor to temperatures that can cause thermal burns.

The danger of high-frequency burns is not limited to RF equipment. Large audio frequency (40 Hz - 20 kHz) equipment can also produce high frequency parasitic oscillations.

At 200 kHz and above, current stops flowing through a conductor (your body) and starts flowing in a thin layer on the conductor surface is known as the "skin effect". Serious burns can result as the RF current flows across your skin on its way to ground.

A contact with an RF power source will usually cause burns. This results from the involuntary tendency to pull away from the conductor, thereby causing an arc between the RF source and the closest body part. The arc can follow the contact for a distance that depends on the wattage and amperage of the RF source.

v. Hot work precaution

When it is necessary to work on an energized circuit, take the following precautions:

- Check the equipment with a voltmeter to detect potential shock hazards.
- Treat low voltage systems with the same respect as high voltage systems. Current kills, not voltage.
- To minimize the possibility of shorting out a circuit through your body, keep one hand free at all times. Keep your free hand behind you, or preferably, in your pocket (keeping your hand in your pocket prevents the instinct to use that hand on the circuit).

- Never work on energized electrical systems unless there is an observer who can rescue you in case of emergency. Your helper is not an observer because the helper is also at risk.
- Only personnel who have successfully completed electrical safety B, CPR, first aid and machine-specific training should be permitted to work on -hot electrical systems.
- Always use tools with non-conductive handles.
- Use tools appropriate for the circuit. High voltage circuits require special tools.

vi. Safe practices for RF current and high voltage

High voltage will arc across a gap if the material on the other side of the gap is at a lower potential. It will also produce a corona discharge on edges or points in and around the equipment if the shielding is damaged or not replaced properly.

High voltage is often not fully understood by personnel who work on RF equipment. Some of the most overlooked, but simple, precautions include:

- Place signs and rope off passageways where high voltage electrical maintenance is taking place;
- Regard all floors as conductive and grounded unless they are covered with a well-maintained, dry, rubber mat designed as an insulator for high voltage work.
- Do not bypass high voltage interlocks. This can cause high voltage to be exposed to persons unaware of the hazards.
- Use high voltage probes when making measurements on high voltage components.
- Make sure you use a grounding rod designed to short out high voltage components such as capacitors before performing electrical measurements or replacing parts.
- Discharge capacitors to eliminate accidental shock or damage to the equipment.

Principal high voltage danger points are:

- Transformer terminals inside the primary and secondary power distribution panels.
- RF tuning capacitors and coils inside the RF generators;
- Fuse panels on or in most sub circuits.
- Filter capacitor terminals on many circuit boards.
- Cathode ray tube (CRT) terminals.

vii. Safety for electronic component

- Wear grounding straps when handling static-sensitive devices or the circuit boards obtaining them;
- Do not remove a circuit board or a component on that board while the power to the board is on;
- Use the appropriate tools to remove and replace electronic components.

I. Lock out/Tag out

While the equipment is being serviced, the controls, valves and breakers for that equipment must be controlled by the persons doing the maintenance. Ideally, the equipment is shut down and each person applies an individual lock and retains the key so that the equipment cannot be returned to service until all persons have removed their locks. A tag on each lock should identify the person or persons working on the equipment, the time the locks were applied and the reason for the lockout.

Lockouts should be used for the following:

- ◆ Electrical systems and circuits where a hazard of electrical shock exists. This prevents a person who is unaware of the problem from using the equipment.
- ◆ Repair and service of mechanical equipment where moving parts would create a safety hazard for the maintenance person.
- ◆ Work on lines that carry hazardous substances or that is under high pressure.

If locks are not possible, the controls, valves and breakers should be tagged with a tape or tag that identifies the person or persons working on the

equipment, the time the tag was applied and the reason for the tag out. The tag or tape should cover the controls so that it must be deliberately removed in order to actuate the equipment.

- ◆ If lockout or tag out is not practical, as when equipment must be turned on and off during maintenance, station someone at the controls to prevent accidental activation.
- ◆ Do not have spare keys or use combination locks for lockouts. Only the person who placed the lock should be able to remove it.
- ◆ Educate all personnel about the locks and tags. They must be taught to never remove a tag or use tagged-out equipment.
- ◆ Do not return equipment to service until all the personnel listed on the lockout or tag out have verified its operation and authorized its return to service.

J. Chemical Control

i. General

All chemicals used in NFF (CWB) are controlled items. No chemicals can be brought in or taken away without NFF (CWB) management's approval.

ii. Standard and Special items

All chemicals used in NFF (CWB) are classified into two groups, namely Standard and Special Items. Standard items refer to the chemicals that are supported and provided by NFF (CWB). (See Tables 1 – 6 for the full account of chemical items)

Special items refer to the chemicals that are not included in Tables 1 – 6. NFF (CWB) is not responsible for the provision of these items.

iii. Bringing-in chemicals

When users want to bring any chemicals into the laboratory, they have to submit their application to NFF (CWB) management for approval by completing an application form entitled Safety Assessment on Users Requested Process.

Those approved chemicals are only allowed to be stored in NFF (CWB) for a certain period. Once the covering period expires, those items must be taken out of the laboratory.

The owners of the chemicals should be responsible for the provision and disposal.

iv. Taking-away chemicals

Formal written notices must be given to NFF (CWB) management for approval.

These notices must contain two obligatory elements:

- a. Declaration of responsibility and liability in relation to safety
- b. Signature of the project supervisors.

v. Table of standard items

Table 1 - Standard Photoresists

| Item | Photoresist | Applications and Characteristics |
|------|-------------|--|
| PR-1 | HPR504 | g-line +ve PR, For normal thickness (1.0 ~ 1.5um) |
| PR-2 | HPR506 | g-line +ve PR, For thick film thickness (2 ~ 3um) |
| PR-3 | SPR660 | i-line +ve PR, For normal thickness (1.0 ~ 1.2um) |
| PR-4 | FH 6400L | g-line +ve PR, For normal thickness (1.0 ~ 1.2um) |
| PR-5 | AZ9260 | i-line +ve PR, For spray coating |
| PR-6 | AZ4620 | g-line +ve PR, For thick film thickness (~6um) |
| PR-7 | AZ4903 | g-line +ve PR, For thick film thickness (25 ~100um) |
| PR-8 | AZ5206E | 310-405nm dual-tone PR, For normal thickness (0.8 ~ 1.2um) |
| PR-9 | AZ5214E | 310-405nm dual-tone PR, For normal thickness (1.3 ~ 2um) |

| | | |
|-------|--------|--|
| PR-10 | AZ7908 | i-line +ve PR, For normal thickness (0.6 ~ 0.8 um) |
|-------|--------|--|

Table 2 – Standard Developers

| Item | Developer | Applications and Characteristics |
|------|-----------|----------------------------------|
| D-1 | FHD-5 | For PR-1 to PR-6; PR-8 to PR-10 |
| D-2 | AZ400K | For PR-7 |

Table 3 – Standard Organic Solvents

| Item | Organic Solvent | Applications and Characteristics |
|------|-------------------------|--|
| S-1 | MS2001 | +ve Photoresist stripper for PR1 to PR10 |
| S-2 | HMDS | Adhesion promoter for positive resist processing |
| S-3 | Acetone | Cleaning, and lift-off |
| S-4 | Isopropyl Alcohol (IPA) | Cleaning |
| S-5 | FH-ER | Back and front side rinsing |
| S-6 | MEK | For spray coating |
| S-7 | PGMEA | For spray coating and photoresist dilution |

Table 4 – Standard Acids

| Item | Acid | Applications and Characteristics |
|------|-------------------------|--|
| A-1 | Acetic Acid | For Aluminum etch |
| A-2 | Hydrochloric Acid (HCl) | For RCA2 and decontamination |
| A-3 | Phosphoric Acid | For Nitride removal and Aluminum etch |
| A-4 | Sulfuric Acid | For photoresist stripping, and piranha clean |
| A-5 | Nitric Acid | For Aluminum etch |
| A-6 | 777 Pad Etch | For etching Silicon Dioxide |
| A-7 | Freckle Etch | For Silicon residue removal |

| | | |
|------|----------------------------|--------------------------------------|
| A-8 | CEP-2000 | For Chrome etch |
| A-9 | Hydrofluoric Acid (HF) | For Oxide etch, and piranha cleaning |
| A-10 | Buffered Oxide Etchant BOE | For Oxide etch |

Table 5 – Standard Bases

| Item | Organic Solvents | Applications and Characteristics |
|------|--|--|
| B-1 | Ammonium Hydroxide | For RCA1 |
| B-2 | Sodium Thiosulphate | For neutralization of Potassium Iodide (KI) solution |
| B-3 | Tetramethylammonium Hydroxide 25% (TMAH) | For Silicon etch (used at wetstation G and J only) |

Table 6 – Miscellaneous

| Item | Miscellaneous | Applications and Characteristics |
|------|--|--|
| M-1 | Hydrogen Peroxide (H ₂ O ₂) | For cleaning and photoresist stripping |
| M-2 | Potassium Hydroxide (KOH) Pellet | For Silicon etch |
| M-3 | Potassium Iodide | For Gold etch etc. |
| M-4 | Iodine | For Gold etch |

3. Special Guideline on HF Safety

A. Description

HYDROFLOURIC ACID (HF) is a very strong inorganic acid and its solution is clear, colorless liquids. When exposed to air, concentrated solutions produce pungent fumes which are special dangerous. HF differs in many ways from the other hydrogen halides because of its greater ionic character and its tendency to associate through hydrogen bonding. Association characterizes the liquid state and continues into the vapor state. All the HF used in NFF is less than 50 %.

WARNING: BURN WITH CONCENTRATION HF ARE USUALLY VERY SERIOUS. WITH THE POTENTIAL FOR SIGNIFICANT COMPLICATIONS DUE TO FLUORIDE TOXICITY, CONCENTRATION HF LIQUID OR VAPOR MAY CAUSE SEVERE BURNS, METABOLIC IMBLANCES, PULMONARY EDEMA AND LIFE THREATENING CARDIAC ARRYTHMIAS, EVEN MODERATE EXPOSURES TO CONCENTRATED HF MAY RAPIDLY PROGRESS TO A FATALITY IF LEFT UNTREATED.

B. Toxicity and the Effects in Man

The concentration that produces acute effects varies with the time of exposure; 50 ppm may be fatal if inhaled for 30-60 minutes. Less severe exposures cause irritation of the nose and eyes, smarting of the skin, some degree of respiratory irritation. More severe exposures can lead to severe irritation of the eyes and eyelids and to inflammation and congestion of the lungs and circulatory (cardiovascular) collapse. Skin contact with the liquor or vapor of any member of this group can cause severe burns. Hydrogen fluoride is readily detectable in air by its sharp, irritating odor. The 1983 ACGIH has established a Threshold Limit Value (TLV) of 3 ppm (2.5 mg/m³) for hydrogen fluoride (as F).

C. Symptom

HF differs from other acid because the fluoride ion readily penetrates the skin, causing destruction of the deep tissue layers including bone. Unlike other acids that are rapidly neutralized, this process may continue for days.

Strong acid concentration (over 50%) usually causes immediate, severe, burning pain and a whitish discoloration of the skin that usually proceeds to blister formation. In contrast to the immediate effect of concentrated HF, the effect of contrast with more dilute HF or its vapors may be delayed, and this is one of the problems with the recognition of some HF burns. Contact with acid concentrations in the 20% to 50% ranges may not produce clinical signs or symptoms for one to eight hours. With concentration less than 20%, the latent period may up to twenty-four hours. HF concentration as low as 2% may cause symptoms if the contact time is long enough.

HF skin burn are accompanied by severe, throbbing pain which is thought to be due to irritation of nerve endings by increased levels of potassium ions entering the extracellular space to compensate for the reduced levels of calcium ions, which have been bound to the fluoride. Thus, relief of pain is an important guide to the success of treatment.

The usual initial signs of an HF burn are redness, edema, and blistering. With more concentration acids, a blanched white area appears.

D. First Aid Treatment

Speed in removing the patient from the contaminated atmosphere or removing the vapor or liquid from the skin or eyes is essential. First aid must be started immediately in all cases of contact with the particular gas in any form. All affected persons should be referred to a physician, no matter how slight the injury, and the physician given a detailed account of the accident.

HF can cause serious, painful burns of the skin. Specialized first aid and immediate medical treatment differing from other chemical burn is required. If untreated or improperly treated, permanent damage, disability or death may result. SPEED IS OF THE ESSENCE.

In case of contact or suspected contact with HF, please following the procedures:

i. Inhalation

In minor exposures, remove the victim to an uncontaminated atmosphere and administer as quickly as possible 100% oxygen. It has been found helpful to expose even borderline cases to 100% oxygen at half hour intervals for 3-4 hours.

In severe exposures, the worker must be carried at once into an uncontaminated atmosphere. A physician should be called immediately and the administration of 100% oxygen should be started at once. The victim should receive oxygen under positive pressure (<4 cm) for half hour periods for at least 6 hours until breathing is easy and the color of the skin and mucous membranes is normal. He should be kept comfortably warm, but not hot. Under no circumstances should the patient be permitted to return home or to work following a severe exposure until examined and discharged by a physician who is aware of the nature of the exposure. Mild analgesics and sedatives, such as aspirin or sodium bromide, may be given if thought to be desirable by the physician, but medication is usually unnecessary when adequate oxygen has been administered immediately after exposure. Morphine and barbiturates should never be given because of their depressant effect on respiration. Cardiac and respiratory stimulants are not recommended.

ARTIFICIAL RESPIRATION SHOULD NOT BE GIVEN UNLESS BREATHING HAS CEASED.

ii. For skin contact

1. Move victim immediately under safety shower and flush affected area with large amounts of cool running water.
2. Remove all contaminated clothing while flushing with water.
3. The rinsing may be limited to 5 minutes, with 2.5% calcium gluconate gel (available in first aid kit) applied as soon as the rinsing is stopped.
4. While the victim is being rinsed with water, someone should alert first aid or medical personnel and arrange for subsequent treatment.

5. Apply the gel every 15 minutes and rubs in continuously until pain and/or redness disappear. It is advisable for the individual applying the gel to wear surgical gloves to prevent a possible secondary HF burn.
6. After treatment of burned area is begun, the victim should be examined to ensure there are no other burned areas that have overlooked.
7. Arrange to have the victim seen by a physician. During transportation to hospital or waiting for a physician to see the victim, continue massaging calcium gluconate gel.

iii. For eye contact

1. Immediately flush the eyes for at least 15 minutes with large amount of gently flow water under eye washer.
2. While the victim is being rinse with water, someone should alert first aid or medical personnel and arrange for subsequent treatment.
3. Take the victim to a doctor, preferably an eye specialist, as soon as possible.
4. Rubbing of eyes is to be avoided.

E. Prevention

It must be emphasized that PREVENTION of exposure or injury must be the primary goal. Preventive measures include making sure that:

1. Everyone who handles or uses HF is aware of its properties and dangers.
2. Everyone handling or using HF is trained in proper handling and safety precautions.
3. All appropriate engineering controls are in place, are maintained, are functioning properly, and are utilized.
4. Everyone who handles or uses HF has available, know how to use, and is required to use appropriate safety and personal protective equipment.
5. Arrangements are made ahead of time to provide first aid or medical treatment measures if necessary.

6. Employees should be instructed to avoid contact with liquid or gaseous hydrogen fluoride at all times, and in the appropriate procedures in case of contact.
7. Adequate emergency showers and wash-up facilities should be available in areas where hydrogen fluoride is used.
8. Eye-washing fountains should be placed in accessible locations and workers instructed in their use.
9. A hose mask, an air-line mask, or a self-contained breathing apparatus should be conveniently located in case of emergency, but in areas less likely to become contaminated.
10. People handling hydrogen fluoride should use full coverage of clothing at all times. These include the use of rubber shoes soled with neoprene or rubbers, a hat or protective head covering, a full face mask and/or chemical goggles with plastic lenses, and gauntlet-type gloves made of neoprene, plasticized polyvinyl chloride (0.028 inch thick), or an equally resistant material.
11. All spillage should be flushed promptly with water. Excessive quantities of hydrogen fluoride should be neutralized with soda ash or lime before admitting wastes to drains and sewers.

4. Emergency Procedures

NFF (CWB) has a state-of-art monitoring and alarm system for detecting fires and hazardous gas release. If detected, a visual alarm will flash and the audio alarm will sound. The users are trained in emergency procedure and are informed of the hazards involved. An evacuation drill is scheduled yearly (at minimum) with the collaboration of HSEO and FSD. Spot check after office hours will always be done to check student emergency procedures.

A. Reporting procedures

In case of any incident happened in NFF (CWB) lab, all users and NFF (CWB) staff must follow this reporting procedure to get the sufficient support from NFF (CWB) staff or even the emergency response teams from HSEO/Security Office.

i. Office hours:

1. All NFF (CWB) users have to report any abnormal cases to NFF staff immediately
2. The NFF staff needs to report the incident to the senior staff who are in the lab area:
Mr. Man Wai LEE
Mr. Chun Keung WONG
Mr. Chun Fai YEUNG
Mr. Ho LI
Mr. Wilson YIP
3. Report to Security Office if the incident needs the immediate help from other emergency response team (HSEO, FSD);
4. Report to NFF (CWB) management team
Mr. Wing Leong CHUNG
Prof. Andrew W O POON

ii. Non-office hours

NFF (CWB) on campus emergency response team is 24 hours on duty on HKUST campus. If there is any emergency case, please directly ask for assistance with the following numbers:

| | |
|---------------------|-------------|
| Mr. CK WONG | (9753 1662) |
| Mr. Peter PUN | (9789 9508) |
| Mr. Boris CHOI | (9492 1482) |
| Mr. Brial KWOK | (6622 3455) |
| Emergency duty call | (9372 0987) |

Directly call security Office to get a rapid response and assistance

Security Control Center 2358 8999

B. Immediate Treatment

NFF (CWB) staff have the responsibility to take care of the injury inside NFF (CWB) lab. Only the necessary first aid or proper treatment such as flushing process by the use of eye washer and safety shower, calcium gluconate gel or stop bleeding can be performed. Further medical treatment must refer to university clinic or TKO hospital.

1. If ambulance service is needed in the serious case, one of NFF (CWB) staff is assigned to communicate with the Security Control Center;
2. NFF (CWB) staff have to report the incident through the proper report channel to communicate with NFF (CWB) management team, Security Control Center and HSEO for support;
3. If the victim needs to be sent to the clinic for further medical consultation and a NFF (CWB) staff must accompany all the way, even to the hospital for further medical inspection;
4. NFF (CWB) staff have a responsibility to report the updated status of the victim to the NFF (CWB) management team.

C. Emergency Response Plan

The NFF (CWB) Emergency Response Plan (Appendix 5.F) is posted by the telephones. Please read and be familiar with the plan and follow the procedures listed on the plan. The following is a list of the phone numbers detailed in the Emergency Response Plan, call them in the order listed.

| NAME | EXTENSION | MOBILE |
|--------------------------------|------------------|---------------|
| Mr. Man Wai LEE / NFF | 7900/7896 | 96217708 |
| Mr. Chun Keung WONG / NFF | 7226/7896 | 97531662 |
| Mr. Chun Fai YEUNG / NFF | 7219/7896 | 96573572 |
| Building or Facilities Problem | 6565 | |
| Emergency (24 hours) / SCC | 8999 | |
| Serious Injury or Fire | 9999 | |
| Police | 9999 | |

According to the general fire emergency procedure of HKUST, please report the accident to the Security Control Center first. The nature of other emergencies will determine whether you will call police, staff, or both. If someone is injured, please call NFF (CWB) staff or SCC. If there is a facilities problem, such as a flood or a utility problem that does not present a danger to lab users but may result in damage to equipment, the staff or FMO need to be called. The 9-999 emergencies should not be called for facility or equipment problem.

Always call 9-999 when a potentially life threatening situation might exist (injury, fire, gas leak, etc.)

If the NFF (CWB) needs to be evacuated, an alarm and an emergency evacuation message will be broadcasted.

Emergency Response after Office hour

In case of:

1. Chemical spill with/without body injured
 - > locate your buddy or other users
 - > Proper treatment
 - > call Security Control Center 9-8999 for assistance or for ambulance service
2. Fire Alarm, Gas leakage Alarm, Exhaust Alarm
 - > locate your buddy or other users
 - > evacuate immediately
 - > do not go away and wait for NFF (CWB) staff arrival
3. DI water Alarm, N-tank Alarm, other equipment Alarm or equipment issues
 - > call NFF (CWB) on campus response team for assistance
4. Any smoke, fire or abnormal issue of the equipment
 - > press the “Emergency Stop Switch” of that equipment
 - > evacuate immediately and call Security Control Center 9-8999
 - > call NFF (CWB) on campus response team

Please remember that work safely is the first priority in our University policy, please always keep you and your buddy are all working in a safe place.

D. Evacuation Procedure

When the fire alarm, gas leakage alarm or exhaust alarm is activated, you must evacuate from NFF (CWB). Following the NFF (CWB) evacuation escape routes post by the telephone. Be familiar with and memorize the procedures, as during emergency is NOT the time to become acquainted with the procedures. When an evacuation announcement is made over the intercom system, you must evacuate the NFF (CWB).

NOTE: DEGOWNING IS NOT NECESSARY

If an alarm sounds and the NFF (CWB) staff is not present, evacuate other lab user are as you leave. Place the laminated evacuation sign (located at Right-To-Know Center at the log-in counter) onto the notice board. The sign reads: NFF HAS BEEN EVACUATED DO NOT ENTER.



**NFF HAS BEEN
EVACUATED
DO NOT ENTER**

1. REMAIN CALM.
2. SECURE YOUR PROCESSES.
3. TURN OFF ALL EQUIPMENT IF PRACTICABLE.
4. LEAVE VIA THE SHORTEST AVAILABLE EXIT.
5. WALK, DO NOT RUN AND AVOID PANIC.
6. WHEN AN EXIT IS AFFECTED BY EMERGENCIES OR FIRE, REMAIN CALM AND TURN TO THE ALTERNATIVE ROUTE.
7. NFF STAFF SHOULD MAKE SURE THAT ALL PEOPLE HAVE EVACUATED FROM CLEANROOM AND BASEMENT.

8. DO NOT CARRY ITEM WHICH IS LARGER THAN A BRIEF CASE.
9. ASSEMBLE AT THE DESIGNATED ASSEMBLY POINT, REPORT TO THE DEPARTMENTAL SAFETY OFFICER OR YOUR SUPERVISOR.
10. DO NOT RETURN TO THE LABORATORY

E. Evacuation Route

The evacuation route maps are posted nearby the telephone:

Appendix A: NFF (CWB) phase 2, cleanroom

Appendix B: NFF (CWB) phase 2, basement

Appendix C: NFF (CWB)-EC (Enterprise Centre)

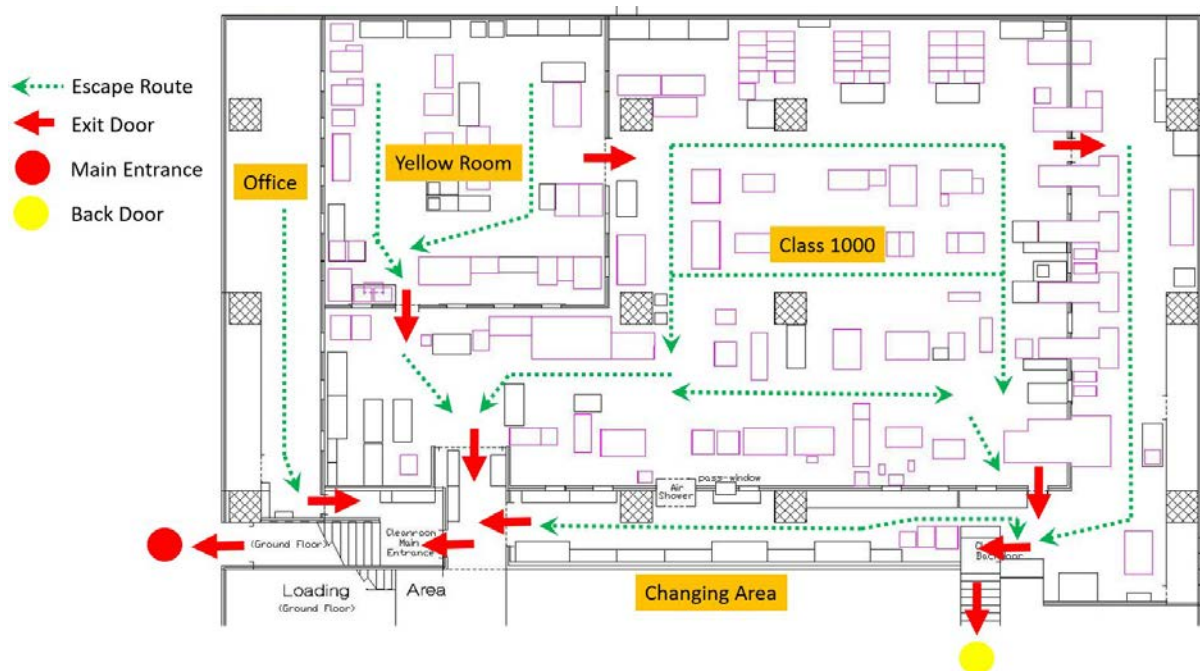
Appendix D: NFF (CWB)-DPC (DRIE Process Centre)

Appendix E: NFF (CWB)-NDL

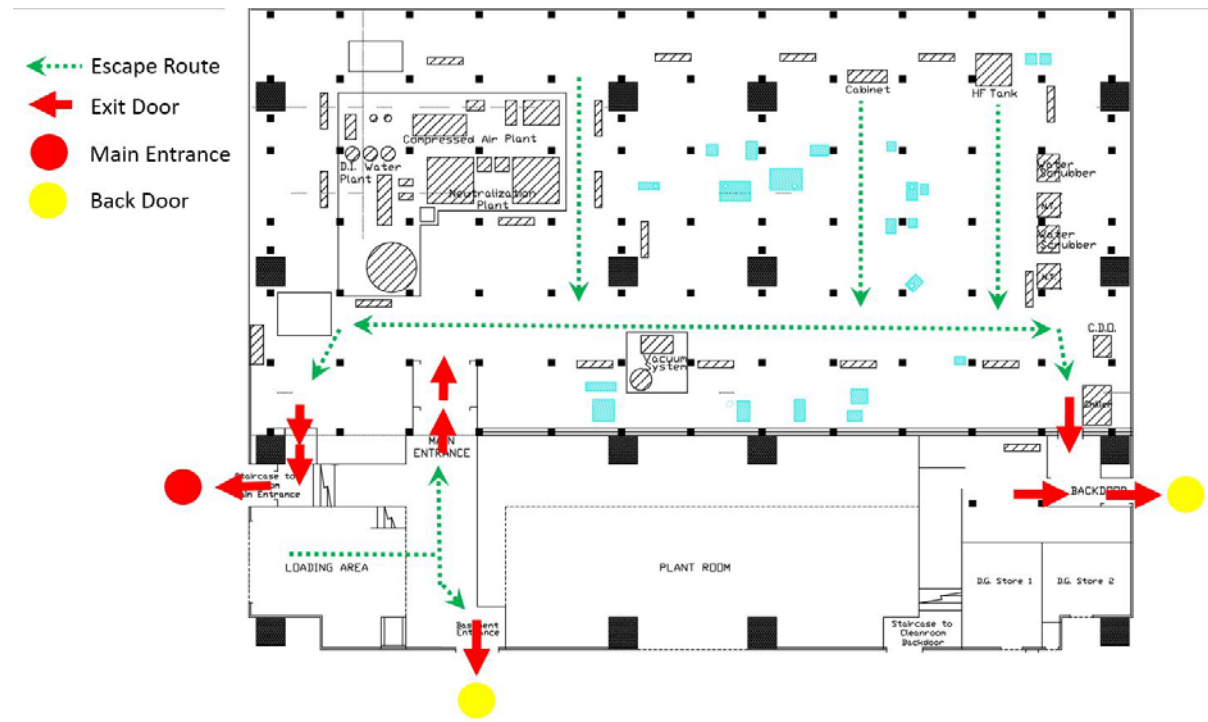
Please familiarize yourself with all the emergency exits.

5. Appendix

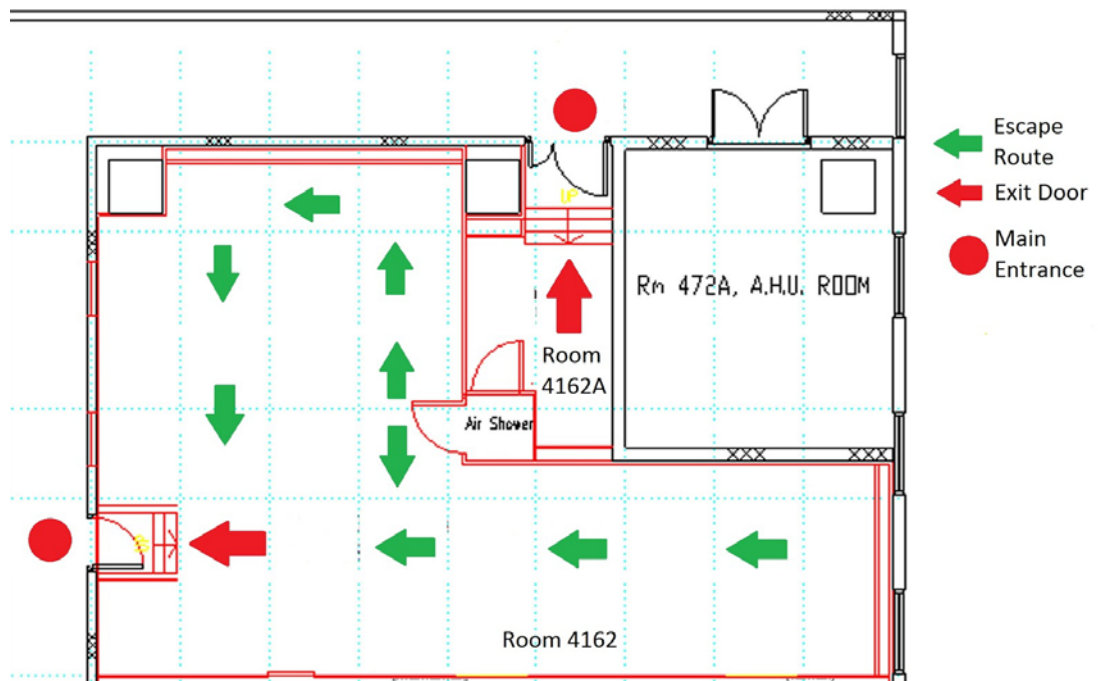
A. Emergency Escape Routes of Phase II Clean Room



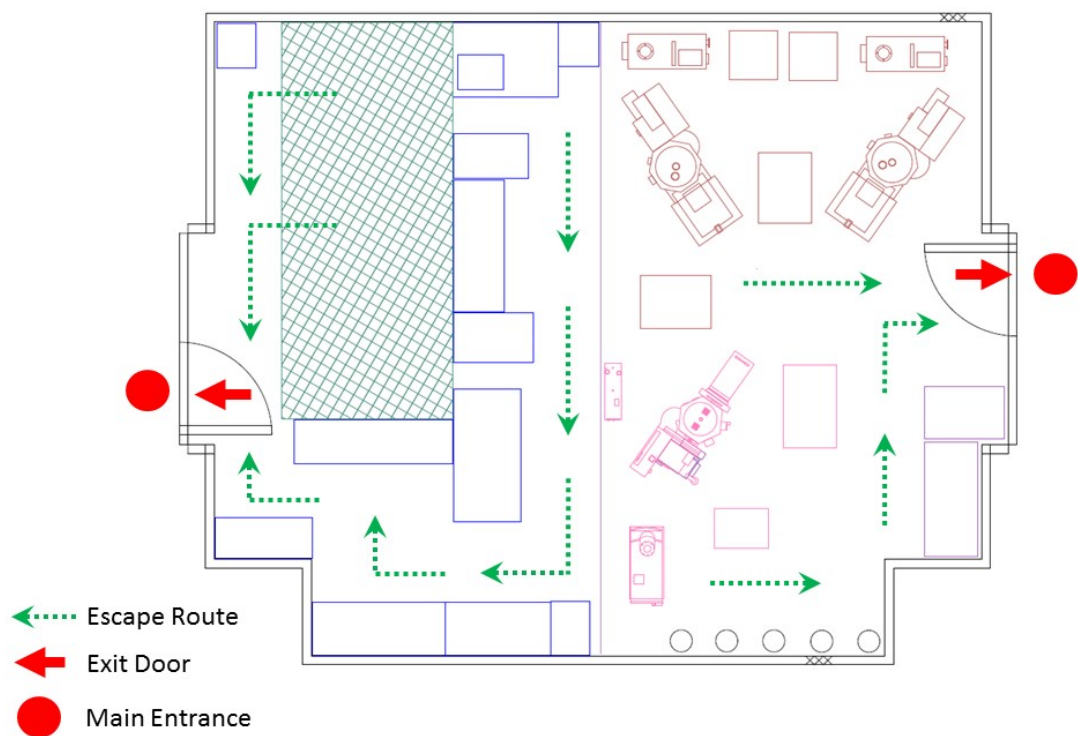
B. Emergency Escape Routes of Phase II Basement



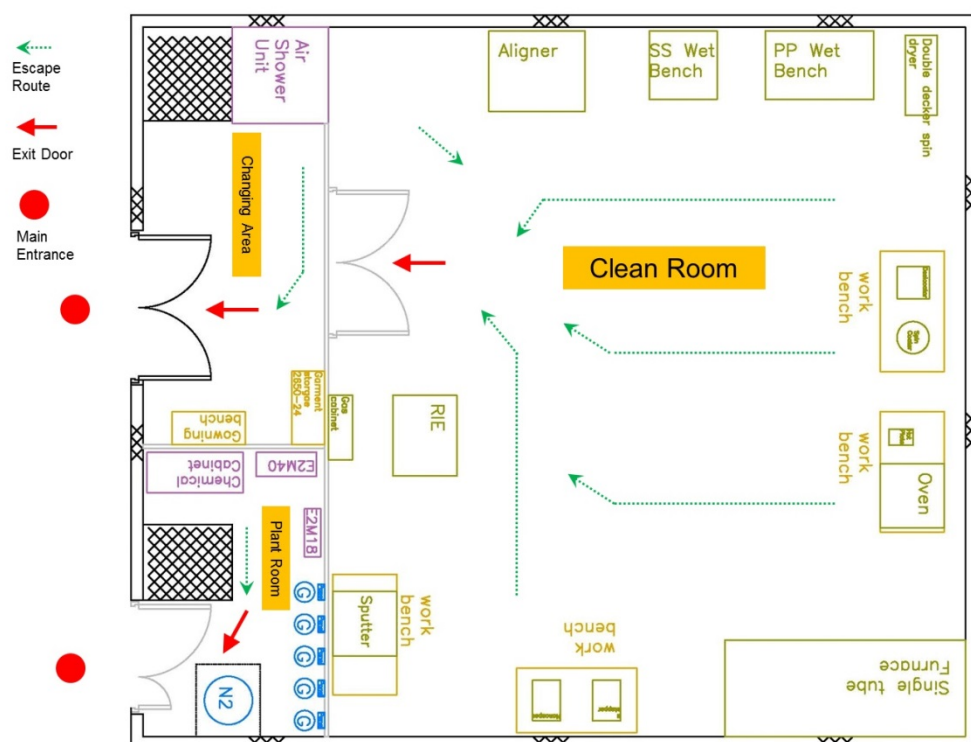
C. Emergency Escape Routes of NFF (CWB)-EC



D. Emergency Escape Routes of NFF (CWB)-DPC



E. Emergency Escape Routes of NFF (CWB)-NDL



F. Emergency Response Plan

Emergency Response Plan

