SAFE PRACTICES & SAFE WORK PROCEDURES (SWP)

1. Use of Autoclave
2. Use of Fume Hood
3. Use of Biological safety Cabinet (BSC)
4. Use of Centrifuge
5. Use of Petroleum and Flammable Materials (PFM)
6. Use of Hazardous Substances (HS)
7. Use of Radioactive Materials
8. Use of Radiating Equipment
9. Purchase of Chemical / lab Equipment
10. Change of Compressed Gas Cylinder
12. Chemical Waste Management
13. Transport of Chemical Reagent and Waste
14. Use of Ethidium Bromide & Waste management
15. Use of Cryogenic Liquid (N2)
16. Risk Assessment
17. Incident Investigation and Reporting
18. Safety Training
19. Safety Inspection and Audit
20. Safety Meeting

Prepared by:
Tin Tun
Safety Manager

Approved by:
Prof. Peter Preiser
Chair, School of Biological Sciences

8 February 2013
USE OF AUTOCLAVE

(Caution: High Temperature & High Pressure)

Safe Practices

1. Get MOM certification for pressure vessel (annually).
2. Check water level in the autoclave chamber before start.
3. Waste package should be double bagged and NOT be sealed too tight.
4. Put some water in the waste package.
5. Always use autoclave control tape for every run.
6. Open the lid only when pressure is zero.
7. Use thermal thick gloves.

Safe Work Procedures (SWP)

1. Turn the power on.
2. Open the lid and pour water until you can see water through the hole at the centre of heater cover (about 2 liters of water is needed).
3. Load the substance to be sterilized into the chamber. Do not include items such as highly corrosive and flammable materials.
4. Close the lid and slide the Open/Close lever to the LOCK side.
5. Select MODE for Operation Cycle. The setting values are displayed. (Liquid / Solid).
6. Check water level in the exhaust bottle is at LOW level and confirm that the exhaust knob is closed.
7. Press Start/Stop switch.
8. When the operation cycle is completed, confirm that the gauge for pressure in chamber reads 0 MPa.
9. Slide the Open/Close lever to the UNLOCK side and open the lid.
10. Unload substance and turn the power off.
11. Update user log.
USE OF FUME HOOD

Safe Practices

1. Keep Fume hood well maintained (regular maintenance by ODFM).
2. Make sure the fume hood is functioning well before use (e.g., no alarm is on).
3. Do not have excess clutter inside a fume hood.
4. Do not use fume hood for chemical storage.
5. Flammable or hazardous substances should always be handled in fume hood.

Safe Work Procedures (SWP)

1. Check and monitor air flow before and during use. All fume hoods should be equipped with an air flow velocity indicator/alarm. You can also use a small piece of crepe paper (or similar) attached to the bottom of the sash, which should blow with the air current through the hood in the proper direction. If you suspect the hood is not working properly, do not use it until it is repaired and certified for use.
2. Keep the sash as low as possible to minimize the risk of exposure. The sash acts a safety shield and protects your face, so you should be looking through the sash to perform your work. Sash height should be adjusted depending on the height of the person using the hood and it should always be lower than the face level of the user. Never stick your head into the fume hood!
3. Whenever you are not using the fume hood, always close the sash of the hood as low as possible. Closing the fume hood sash provides added protection of better capture ability of any chemicals being stored in the hood as part of an experiment and also greatly enhances energy conservation measures for the laboratory.
4. Work at least 15 cm into the hood from the plane of the sash. This will reduce the risk of eddy currents blowing vapors back at you and will maximize capture ability of the hood. Hazardous materials must be handled as far back in the hood as possible.
5. Position apparatus as far back in the hood as possible. Air flow is not as efficient at the front of the hood.
6. Fume hoods are good at containing fire, explosions etc. However, if there is a potential for an explosion hazard due to the chemicals you are using or the experiment you are conducting, special shielding should be used in addition to the sash.
7. Limit traffic near hoods when in use as hazardous procedures are often carried out in hoods. In addition, pedestrian traffic or fast movement in front of hoods can cause turbulence and can negatively affect the capture ability of the fume hood.
8. Remove all unnecessary materials (especially containers of waste or solvents) when performing an experiment/procedure in a fume hood. Excess clutter and chemicals can impede airflow especially to the lower openings. Necessary bottles and equipment should be elevated 5-10 cm to allow airflow underneath to the rear baffles (a small shelf will work for this). Excess chemicals can be a hazard in themselves due to their properties. Store chemicals in cabinets or on shelves, except for the chemicals you need immediately for the work at hand.
9. Do not use perchloric acid in a fume hood unless it is specially designed for this purpose. Explosive perchlorate salts could accumulate in the exhaust system.
10. Keep lab doors and windows closed. These extra sources of inlet air can affect the performance of the hood, cause turbulent air currents in the room or cause the room to lose its negative pressure.
USE OF BIOLOGICAL SAFETY CABINET (BSC)

Safe Practices

1. Get the BSC certified annually which is arranged by the Operation Dept.
2. Make sure that the BSC is functioning well (e.g., no alarm is on).
3. Switch on UV light for at least 10 min before and after use.
4. Do not block air flow inside the BSC.
5. Do not have excess clutter inside the BSC.
6. Do not leave anything in the BSC after use.
7. Wipe clean the BSC with 70% alcohol.

Safe Work Procedures (SWP)

Start-up Procedures

1. Turn off the UV light and turn on the light.
2. Check air flows and alarm system and make sure the BSC is functioning properly.
3. Assemble all materials required. Segregate clean items from the contaminated items and make sure no obstructions to air flows inside the BSC.
4. Make sure waste containers containing biohazard bag for solid waste and for liquid and sharp items are available at the rear part of the BSC.
5. Put absorbent paper (bench guard) at the central part of the BSC, which is the working area and reduces aerosol generation.
6. Wait 5 min to purge airborne contaminants from working area.

Working in the BSC

7. Always wear double layers of gloves when working.
8. Always use pipettes and pipette aid for transferring liquid materials carefully to minimize aerosol generation.
9. Avoid excessive and sudden movements of materials and hands through the front access opening of the BSC.
10. Allow the cabinet to run for 5 min with no activity.
11. Change outer layer of gloves and dispose into waste container inside the BSC.
12. Decontaminate surfaces of all objects with 1% virkon / 70% alcohol and leave for 10 min.

Upon completion of Work

13. Take out all objects used for experiments except waste containers.
14. Fold the absorbent paper and discard into waste container inside the BSC.
15. Wipe clean the BSC with paper towel soaked in 1% virkon / 70% alcohol.
16. Discard paper towel into waste container. Seal the yellow bag inside the waste container if it is full. Put new yellow bag in the waste container. Put sealed bag into the bin for autoclaving.
17. Leave waste containers inside the BSC.
18. Turn on UV light at least 10 min.
USE OF CENTRIFUGE

Safe Practices

1. Keep Centrifuge well maintained.
2. Loads must be in balance.
3. Close the cover and safe lock before start.
4. Open the cover only if the machine completely stops.
5. Use trolley for loading and unloading of samples and buckets.

Safe Work Procedures (SWP)

1. Check centrifuge tubes and containers for any defects or cracks before use.
2. Specimen tubes and specimen containers should always be securely capped. Never fill the centrifuge tubes with liquid specimen too full.
3. Specimen tubes must be balanced correctly by weights, liquid levels and positions in the buckets.
4. The buckets must be securely capped with safety covers.
5. The centrifuge lid must be locked after loading the samples.
6. Set speed and time as required.
7. Start machine. Do not leave the centrifuge until it reaches the set speed after starting. In case of any abnormality, stop the centrifuge immediately.
8. Wait for the centrifuge totally stopped for unloading.
9. Unloading the biohazard samples from the buckets must be done inside the BSC.
10. Transfer of buckets between the centrifuge and the BSC should be done with great care since the buckets are heavy. Use of trolley can help to reduce the incidents of accidents.
USE OF PETROLEUM & FLAMMABLE MATERIALS (PFM)

Safe Practices

1. Get Petroleum & Flammable Material (PFM) storage license (SCDF).
2. Refer to the Guideline on Storage of PFM in Laboratory by the OHS.
3. Refer to the Guideline on Flammable Liquid safety cabinets by the OHS.
4. Use the SCDF approved cabinet for storage.
5. Comply with GHS Labeling system.
6. Store minimum quantity and keep Inventory record updated.
8. Handle PFM inside the fume hood. Keep away from source of ignition.
9. Take special care for transport and waste disposal.

Safe Work Procedures (SWP)

Storage:
1. Do not overload the flammable cabinet (Max: 150 L).
2. Keep PFM liquid 5 L maximum per bottle.
3. Keep PFM separate from other Hazardous Substances (HS).
4. Do not store solid PFM and liquid PFM together.
5. Always use containment tray for liquid PFM during use and transport.

PFM Usage

6. Handle the PFM only in fume hood.
7. Use proper PPE.
8. Fire safety equipment and facilities are in place.
10. Keep PFM away from source of ignition / lighter/ open flame.
11. Keep the bottle capped.

PFM Waste Disposal

12. Label waste container accordingly.
13. Use containment tray for waste bottle.
14. Use trolley and secure of spillage during transport.
USE OF HAZARDOUS SUBSTANCES (HS)

Safe Practices

1. Get Hazardous Substances (HS) storage license (NEA).
2. Refer to Guide on Handling Spills by the OHS.
3. Comply with GHS Labeling system.
5. Keep the SDS document updated.
6. Handle toxic, corrosive, explosive and any other hazardous substances inside the fume hood.
7. Take special care for transport and waste disposal.

Safe Work Procedures (SWP)

Storage:
1. Keep HS in corrosive cabinet / cabinet.
2. Keep incompatible chemicals separate (be aware of chemical compatibility).
3. Keep poison / highly toxic chemical under lock and key with access control.
4. Always use containment tray for liquid if required.

Use of HS

5. Always handle hazardous chemicals in fume hood.
6. Use PPE- Lab coat, glove, safety goggles, etc.
7. Make sure chemical spill kit is easily available.
8. Get spill management training.
9. Always keep the bottle capped.
10. Put bottle back into cabinet after use.

HS Waste Disposal

11. Label solid waste bag and liquid waste container.
12. Use containment tray for liquid waste container or bottle.
13. Use trolley and secure of spillage during transport.
USE OF RADIOACTIVE MATERIALS

Safe Practices

1. L4 (possession) and L6 (user) licenses must be obtained from the NEA.
2. Radiation workers (R1) work under supervision of L6 licensee.
4. Users have proper training (The PI trains the staff).
5. Use appropriate PPE, radiation guard, face shield, etc.
6. Use calibrated radioactive counter.
8. Proper radiation waste management in place.

Safe Work Procedures

1. Get R1 license at least before start work.
2. Use appropriate PPE including Perspex face shield.
3. Radioactive labels must be on all containers including waste containers.
4. Work in designated area only.
5. Check radioactivity of the designated area before and after work.
6. Dispose into Perspex waste box.
7. Bring waste box down to radioactive waste holding area for disposal.
8. Keep the waste at holding area for decay (depend on shelve life) until radioactivity reduces to ground or acceptable level.
USE OF RADIATING EQUIPMENT

Safe Practices

1. L3 (possession) and L5 (user) licenses for radiating machine (X-ray / Biobeam 8000).
2. N2 (possession) licenses for Laser sources and ultrasonic machines.
3. Permit to work - N3 license for laser user, L5 for radiating machine.
5. R1 Radiation worker license (Work under supervision of L5 licensee).
7. Users have proper training (The PI trains the staff).
8. Use appropriate PPE, radiation guard, face shield, etc.

Safe Work Procedures

1. Get R1 license at least before the start of work (Permit to work).
2. Use appropriate PPE including ear plug.
5. Keep the lab neat and tidy.
PURCHASE OF CHEMICAL / LAB EQUIPMENT

Safe Practices

1. The PI and Lab user get specification and quotation for the product.
2. License requirement - existing / new application.
3. Purchase Department processes the PO.
4. Delivery to the General Store (direct delivery to the lab sometimes applies).
5. Lab user / buyer collects product from the General Store.

Safe Works Procedures (SWP)

1. The PI / Lab user gets quotation for product from the manufacturer / supplier.
2. Check with Safety Department if license is required for the product.
3. Approach the Purchase Department for process of PO.
4. Send the copy of valid license to the supplier for controlled item.
5. Delivery of the product to the General Store or directly to the lab.
6. Collect the product from the General Store.
7. Forward the Delivery Order (DO) to the Purchase Department for payment.
8. Apply for equipment possession license through the Safety Department if required.
9. Update inventory record or equipment list.
CHANGE OF COMPRESSED GAS CYLINDER

Safe Practices

1. Refer to Guideline on Compressed Gas Cylinder Safety by the OHS.
2. Secure gas cylinder with chain and bracket.
3. Do not keep extra cylinder in the lab. Return to storage area.
4. Secure connection and prevent leakage.
5. Use of trolley for transport of gas cylinder.
6. Use of Cargo lift.

Safe Work Procedures (SWP)

1. Get the key to SBS B1 Gas Storage area which is kept in the S2 core lab.
2. Use trolley for transport of gas cylinder.
3. Close the regulator valve and remove connecting tubing from empty cylinder.
4. Take out the empty cylinder from the bracket fixed to the wall.
5. Use trolley and cargo lift to bring down empty cylinder to B1 gas area.
7. Secure new cylinder with bracket and chain in the lab.
8. Attach the connecting tubing to the new cylinder and firmly tight the screw. Seal tape may be required to prevent any leakage.
9. Open the valve on connecting tubing.
10. Open the screw valve on new gas cylinder slowly. Pressure should not be in Red zone.
11. Observe the pressure gauze stable.
BIO-WASTE MANAGEMENT

Safe Practices

1. Check Guidelines on Disposal of Laboratory waste by the OHS.
3. Do not autoclave waste treated with 1% bleach overnight.
4. All solid bio-wastes are double bagged for autoclaving.
5. Waste collected by authorized contractor.

Safe Work Procedures (SWP)

Solid Bio-Waste

1. Discard all solid wastes generated in the BSC into waste container with yellow biohazard bag inside the BSC.
2. Discard other solid wastes into biohazard bin / bag in the laboratory.
3. Seal biohazard bags, not too tight to allow steam enter inside during autoclaving and put into autoclave-able white bag (Double bagged)
4. Seal the autoclave-able bag (Not too tight), apply autoclave control tape and label laboratory number, the PI’s name and type of waste.
5. Bring down to B1 waste room where all biological wastes are autoclaved at 121 C for 15 min (a total of 90-min cycle).
6. Bio-wastes after autoclaving are disposed as Normal waste by cleaner.
7. Bio-waste with Antibiotics must be treated similarly but in separate bag using biohazard bag and autoclave-able bag. (The NEA wants this waste separate)
8. Bio-wastes with Antibiotics after autoclaving are Hazardous wastes and collected by authorized contractor.

Sharp Item Bio-Waste

9. Dispose sharp items into sharp box provided. Do not over fill.
10. Seal sharp box and put into autoclave-able bag and apply autoclave control tape.
11. Label “Sharp Item” and lab info and bring to B1 waste room for autoclave service.
12. Sharp item wastes are collected authorized contractor for incineration.

Liquid Bio-Waste

13. Dispose liquid waste into disinfectant bottle containing 1% virkon.
14. Replace the lid when waste bottle is 2/3 full and prepare for autoclaving.
15. Make sure to unscrew the lid of the waste bottle before autoclaving. IMPORTANT – Failure to do this will cause collapse of container.
16. Autoclave at 121 C for 15 min (a total of 90 min cycle).
17. After autoclaving dispose the liquid waste in the laboratory sink.
(Note: Do not autoclave liquid waste treated with 1% bleach overnight)
CHEMICAL WASTE MANAGEMENT

Safe Practices

1. Check the NTU Chemical Safety Manual issued by the NTU Chemical Sub-Committee.
2. Refer to Guidelines on Disposal of Laboratory Waste by the OHS.
3. Dispose solid waste in plastic bag.
4. Dispose liquid in carboy which is resistant to most chemicals.
5. Bring waste down to B1 waste collection room (once a week).
6. Waste collected by authorized contractor.

Safe Work Procedures (SWP)

Liquid Chemical waste

1. Dispose liquid chemical waste into the carboy provided by the contractor which is resistant to most chemicals.
2. Label waste carboy with complete information – Type of waste, lab, PI, etc.
3. Use separate container for incompatible chemicals. Be aware of chemical compatibility for chemical waste mixture.
4. Waste carboy must be tightly capped and put into secondary containment tray.
5. Bring waste to B1 waste collection room every Thursday 3:30 pm.
6. Use secured trolley and cargo lift for transport.
7. Handover to waste collection room and exchange for new carboy.

Solid Chemical Waste

8. Dispose solid chemical waste – Test tube, pipette, tray for assay, gloves, etc. into plastic bag.
9. Label waste bag with complete information – PI, Lab no and lab representative.
10. Bring to B1 waste Collection room every Thursday 3:30 pm.
12. Dispose into Big green colour bin.
13. Authorized contractor collect Chemical wastes once a week.

Sharp Item Chemical Waste

14. Dispose sharp items into sharp box provided. Do not over fill.
15. Seal sharp box and put into plastic bag.
16. Label "Sharp Item" and lab info and bring to B1 waste collection room.
17. Sharp item wastes are collected by authorized contractor for incineration.
TRANSPORT OF CHEMICAL, REAGENT AND WASTE

Safe Practices

2. Refer to Guide on Handling Spills by the OHS.
3. Use of trolley.
4. Use of cargo lift (Do not use Passenger lift).
5. Use containment tray for liquid bottles.
6. Spill kit available.
7. Training on Spill management.

Safe Work Procedures (SWP)

1. Always use cargo lift for transport of chemical, reagent, cylinder, liquid N2 tank and waste.
2. Use trolley which is secured that the load will not fall off.
4. Do not hold primary container by the neck of bottle for transport.
5. Apply PPE for transport of chemical, reagent and waste.
6. Do not stack chemical containers during transport.
7. Avoid overload the trolley. Take another trip if necessary.
USE OF ETHIDIUM BROMIDE & WASTE MANAGEMENT

Safe Practices

2. Collect solid waste for incineration.
3. Deactivate liquid waste with activated charcoal.
4. Waste should be collected by authorized contractor.

Safe Work Procedures (SWP)

1. Put solid waste (gel, charcoal used for deactivation & others) in double plastic bag.
2. Discard very dilute solution (< 10 ug/ml) into sewage or sink and flush with water (volume x5 times).
3. Deactivate ET Br solution with charcoal (100mg activated charcoal + 50 ug EtBr); stand for overnight; filter and collect charcoal as solid waste.
4. Bring down solid waste to B1 collection room as hazardous chemical waste.
5. Chemical waste collected by authorized contractor for incineration.
USE OF CRYOGENIC LIQUID (N2)

Safe Practices

1. Check Guidelines on Safe Use of Cryogenic Liquid by the OHS.
2. Designate Cryogenic Liquid Storage Area (B1 Car park corner).
3. Use Liquid N2 Tank / Dewar with a loose fitting lid to withstand extreme low temperature.
4. Conduct RA for use and handling of Cryogenic liquid.

Safe Work Procedures (SWP)

1. Use adequate PPE- lab coat, cryo-gloves, fully covered shoes, face shield / goggle.
2. At least two persons conduct activities of transport and topping up.
3. Get training for use and handling of cryogenic liquid.
4. Use secure trolley and cargo lift for transport of container.
5. Do not share lift with passenger during transport (Put NO ENTRY sign in the lift).
6. Be aware of evaporation during dewar filling and top-up.
7. Be aware of cold burn upon skin contact.
8. Keep the cryogenic liquid tank in a fairly large room with proper ventilation.
9. Display adequate signs on the dewar / tank to identify content and hazards.
RISK ASSESSMENT

Safe Practices

1. Follow the SOP on Risk Management issued by the OHS.
2. Activity-based risk assessment and a 5 x 5 Risk Matrix Methodology is used.
3. Training has been provided for research staff, technical staff, post graduate students and office staff.
4. The PI or Person In-Charge approves and signs the document.
5. The original document is dated, signed and filed at the lab / workplace.
6. The RA documents and in the process of uploading online. Once the Online upload is completed, hard copy may be no longer required.

Safe Work Procedures (SWP)

1. Research staff and technical staff conduct the activity-based RA at their labs / workplaces.
2. Hazards are identified and basically depend on material, machine, man and procedures performed in the lab / workplace.
3. A standard form is used for documentation.
4. Set Severity (S) and Likelihood (L) levels and calculate RPN.
5. Control measures are considered to minimize risk levels
6. Make sure that all lab users read and understand the RA documents.
7. Communicate new comers with the RA documents.
8. Review and update the RA every 3 years
9. Earlier review and update whenever changes are made in materials and methods or workplace accident / incident happened.
INCIDENT INVESTIGATION AND REPORTING

Safe Practices

1. Comply with the SOP on Workplace Incident Investigation and Reporting by the OHS.
2. Report accident, dangerous occurrence and near miss using the online IIRF form (OHS Website) within 24 hour.
3. The system notifies the School Chair and School Safety Officer of incident.
4. The School submits the investigation report to the OHS within 7 days.
5. The OHS submits the reportable incidents to the MOM within 10 days.

Safe Work Procedures (SWP)

1. Staff / students report the incident / accident through the online IIRF form on OHS website.
2. The OHS reviews the report for major or minor incident.
3. The OHS notifies the School Chair and safety Officer.
4. The School conducts Investigation of the incident.
5. The school submits investigation report which includes root causes, corrective and preventive action plans.
6. Review the Risk Assessment for control measures and do necessary updates.
7. The OHS reviews the report for closure of the case.
8. The OHS reports to the MOM for reportable incidents.
SAFETY TRAINING

Safe Practices

1. Online Safety Courses on edveNTUre.
2. School Safety Briefing (Compulsory to Staff / Postgraduates / Undergraduates).
3. The OHS Safety Induction Course (Compulsory for new staff).
4. Training courses offered by the OHS.
5. Training courses offered by other organizations.
6. Apply to Training Need Analysis by the OHS.

Safe Work Procedures (SWP)

1. New staff attends School Safety Briefing for Staff weekly (every Thursday).
2. Conduct Safety Briefing for Undergraduates (Freshmen) at the beginning of academic year or for Exchange / Elective students at the beginning of semester. Conduct Safety Briefing for Final Year Students at the beginning of attachment to the SBS laboratories.
3. Conduct Safety Briefing for Postgraduate students at the beginning of intakes.
4. Staff and students complete trainings stated in the Basic Safety Training Matrix.
5. Research staff, technical staff, postgraduate and undergraduate students take the Online Basic Biosafety Course (Compulsory).
6. Technical staff, research staff and postgraduate student attend Spill Management training.
7. All staff attend Risk Management course offered by the OHS.
8. All staff are encouraged to attend Fire Safety Awareness course by the OHS.
9. All staff are encouraged to attend First Aid Awareness course.
10. All staff are encouraged to attend CPR+AED Awareness course.
SAFETY INSPECTION AND AUDIT

Safe Practices

1. Internal Inspection by School Safety Officer.
2. Internal Audit by the OHS.
3. External Audit by other organization such as MOM, MOH, etc.
4. Use of Workplace Safety Inspection Checklist by the OHS.
5. Use of Internal Safety Audit Checklist.

Safe Work Procedures (SWP)

1. School Safety Officer inspects workplaces regularly (Monthly).
2. The OHS conducts Safety Walkabout (Bi-monthly).
3. The OHS conducts PFM Audit.
4. The OHS conducts RA Audit.
5. The OHS conducts Fire Safety Audit.
6. The OHS conducts Radiation Safety Audit.
7. Audit report on Non-Compliances.
8. School Safety Officer makes Follow-up and submits corrective actions and preventive action plans for NCs.
9. BSL3 facility Certification and Registration- Biological Safety Committee (BSC), MOH-Approved Facility Certifier (AFC) & MOH (Annually).
SAFETY MEETING

Safe Practices

2. NTU WSH Committee Meeting.
3. Safety Officers Sharing Session by the OHS (Annually).
4. Other Meetings.

Safe Works Procedures (SWP)

1. SSC Members meet regularly on safety issues – School level.
2. University WSH Committee Meeting- Safety Officers from all schools are members and the OHS organizes the meeting bi-monthly.
3. Preparation meeting for fire drill – University FSM, ODFM, SSC.
4. BSL3 Emergency Response – SCDF, MOH, ODFM, SSC, BSC.
7. Other meetings on Safety issues.