

Appendix I

The Hong Kong University of Science and Technology Laboratory Decommissioning and Repurposing Checklist

The purpose of this checklist is to assist Faculty Member or Principal Investigator for proper decommissioning and repurposing of his/her laboratory and to ensure the laboratory is safe for next use.

Department:	Room Number:
Faculty Member or Principal Investigator:	Laboratory Closeout / Relocation Date: If relocation, new room number:
Contact Person:	Contact number:

Laboratory Cleanup and Waste Disposal

Prior Decommissioning Preparation	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Ensure the personnel responsible for decommissioning are trained and received appropriate safety training. Contact FMO, CLS and HSEO to coordinate activities involving transfer of equipment, transfer and disposal of hazardous materials. 		<input type="checkbox"/>

Decommissioning		
General Chemicals	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Packed and labeled all chemical containers. (Please refer to Attachment <u>1</u>) Offered the unused/unwanted chemicals to Chemical Exchange Program. (Please refer to Attachment <u>2</u>) 		<input type="checkbox"/>

Controlled Chemicals	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Report relocation or disposal of all regulated chemicals in the Hazardous Material Inventory System. Refer to Attachment <u>3</u> for request of hazardous wastes collection. 		<input type="checkbox"/>
Peroxidizable Chemicals	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Performed peroxide test on peroxidizable chemicals. (Please refer to Attachment <u>4</u>) 		<input type="checkbox"/>
Chemical Waste	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Disposed of chemical wastes based on its waste type and filled out chemical waste log sheet accordingly. (Please refer to Attachment <u>5</u> and Attachment <u>6</u>) Request HSEO for collection of chemical wastes. (Please refer to Attachment <u>3</u>) 		<input type="checkbox"/>
Compressed Gas Cylinders and Cryogenic Dewars	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed.
<ul style="list-style-type: none"> Requested CLS for gas cylinder and dewar removal or relocation.(Please refer to Attachment <u>1</u>) Purged manifold and fixed piping. Transport gas cylinders using appropriate wheeled transportation cart. 		<input type="checkbox"/>
Mercury Vacuum Lines	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied and cleaned mercury vacuum lines before disposal or removal. Disposed of mercury contaminated materials as chemical waste.(Please refer to Attachment <u>7</u>) 		<input type="checkbox"/>
Solvent Stills	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied solvent stills. Treated drying agent before disposal or removal. 		<input type="checkbox"/>
Laboratory Fume Hoods, Gloves, Boxes, and Refrigerators	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed.
<ul style="list-style-type: none"> Emptied and cleaned equipment before disposal or relocation. 		<input type="checkbox"/>
Biological Safety Level 2 Materials	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Sterilized all biological safety level 2 materials according to BSL 2 safety precautions. (Please refer to Attachment <u>8</u>) 		<input type="checkbox"/>

Laboratory Animals	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Returned laboratory animals to APCF. Decontaminated animal handling area.(Please refer to Attachment <u>8</u>) 		<input type="checkbox"/>
Biological Wastes	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Separated broken glass and sharp and put them in labelled cardboard or plastic boxes for collection. (Please refer to Attachment <u>9</u> and <u>10</u>) 		<input type="checkbox"/>
Biological Safety Cabinets	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied BSC, request FMO-LS to decontaminate the BSC, dispose or relocate BSC 		<input type="checkbox"/>
Refrigerators, Shakers, and Centrifuges	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied and decontaminated all equipment before disposal or relocation (Please refer to Attachment <u>8</u>) 		<input type="checkbox"/>
Autoclaves	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied and decontaminated autoclaves before disposal or relocation. (Please refer to Attachment <u>8</u>) Informed DMSF-IMR to update re-certification records for relocating autoclaves. 		<input type="checkbox"/>
Radioactive Isotopes and Check Sources	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Request standard waste containers from HSEO. Disposed radioactive waste based on its isotope and physical activity. Amended the storage license of the radioactive materials. Properly labelled and packed wastes for disposal. Contacted HSEO for collection of radioactive wastes and updated inventory record with HSEO. (Please refer to Attachment <u>11</u>, <u>12</u> & <u>13</u> and Form) Conduct surface contamination swipe test and submit report to HSEO for verification. 		<input type="checkbox"/>
Scintillation Counters and Radiation Survey Meter	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Decontaminated scintillation counters or radiation survey meter before disposal or relocation. (Please refer to Attachment <u>14</u>) Requested HSEO for verification. 		<input type="checkbox"/>

Refrigerators, Protective Shield (Perspex/Lead), Radioactive Waste Containers	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied and decontaminated refrigerators before disposal or relocation. (Please refer to Attachment <u>14</u>) Decontaminated perspex shield / lead bricks prior to relocation. (Please refer to Attachment <u>14</u>) Requested HSEO for verification. 		<input type="checkbox"/>
Nanomaterial and Nanomaterial Waste	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Wear proper personal protective equipment when handling nanomaterial Destructed unwanted nanomaterials with verification. Disposed nanomaterial that cannot be destructed as chemical wastes based on its waste type and form. (Please refer to Attachment <u>3</u>) Follow all chemical waste disposal requirements including compatibility test where applicable. Contacted HSEO for assistance and verification. 		<input type="checkbox"/>
Experimental Setups (CVD, MOCVD, tube furnaces, reactors, etc.)	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Emptied and decontaminated the experimental setups with verification from HSEO Purged tubing systems by nitrogen gas before dismantling 		<input type="checkbox"/>
Laser System	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Informed HSEO for laser relocation or disposal. Purged thoroughly all gas pipes of Excimer lasers before dismantling. Disposed unwanted chemical dyes as chemical waste.(Please refer to Attachment <u>3</u>) Contact HSEO for assistance 		<input type="checkbox"/>
Laboratories Involving the Use of Equipment with Other Substantial Hazards	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> Disconnect electricity supply to high tension electrical equipment and discharge and ground any built-in capacitors before removal or disposal. Relief pressure built in any pressurized vessels and systems before removal. Follow safe handling procedures approved by HSEO for other substantial hazards. 		<input type="checkbox"/>
Any other hazards not covered above?	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# √ when completed
<ul style="list-style-type: none"> _____ _____ 		<input type="checkbox"/>
<p>* User is required to identify items which are applicable to his/her laboratory decommissioning exercise during initial review. # Check when the selected task is completed</p>		

Final Preparation	* Yes <input type="checkbox"/> No <input type="checkbox"/>	# <input checked="" type="checkbox"/> when completed
<ul style="list-style-type: none"> • Properly and clearly labeled the materials and quantity with warning labels or other instruction signs (if needed) outside the packing. • Emptied and decontaminated laboratory equipment before removal. • Decontaminate and clean all benches. • Dismantle and packaged equipment. • Relocate or return all gas cylinders to CLS. • Dispose all abandoned materials or wastes not otherwise specified. • Contact HSEO for site inspection before returning the vacated laboratory to FMO. 		<input type="checkbox"/>

Moving in a New Laboratory

Items	* <input checked="" type="checkbox"/> if applicable	# <input checked="" type="checkbox"/> when completed
• Update Placard information by filling the form of “ <i>Registration of Hazard Warnings</i> ”. (Please refer to Attachment <u>15</u> and Form <u>1</u>)		
• Update hazardous material inventory.		
• Update risk assessment database.		
• Update radioactive materials inventory, radiation license and radiation use authorization (if needed). (Please refer to Attachment <u>12</u> and Form <u>2</u>)		
• Update laser hazard control plan (if needed).		
• Segregate chemicals by hazard class		
• Store and handle the explosive, peroxidizable and pyrophoric chemicals according to Appendix 8B hazardous Chemical Storage Precautions, HKUST Safety Manual.		
• Request FMO-LS certification services of biological safety cabinets/chemical fume hoods.		
• Request adequate spill kits and first aid kits from CLS.		
• Request for metal powder fire extinguisher from FMO-BS (if needed).		
• Prepare Fire Escape Route Plan for the new laboratory		

I have, to the best of my knowledge, complied with the requirements of the University Laboratory Decommissioning and Repurposing Policy.

Faculty Member/ Principal Investigator:

Date:

Department Chair:

Date:

Clearance Inspection Sign-Off

HSEO Staff:

Date:

Attachment 1

Packing and Transporting of Chemicals between Floors and Buildings on Campus

1. Inform HSEO in advance for relocation of chemicals.
2. Wear appropriate personal protection equipment such as safety glasses, lab coat and chemical resistant gloves.
3. Make sure the exterior of the chemical containers is cleaned.
4. Make sure chemical containers are securely closed and properly labeled.
5. Separate chemicals into compatible groups (e.g. flammable, corrosive, pyrophoric, toxic, etc.).
6. Wherever possible, pack chemicals in their original packing containers.
7. Use absorbents as cushion materials to pack chemicals in suitable containers.
 - 7.1. For dry solid chemicals
 - Pack in carton boxes filled with absorbents.
 - 7.2. For liquid chemicals
 - Pack in plastic boxes filled with absorbents.
 - 7.3. For non-standard chemical containers
 - Make sure non-standard chemical containers such as round-bottom flasks and sample vials are closed tightly, leak-free, and kept in secondary containment. Paraffin, aluminum foil and septum are prohibited.
 - 7.4. For pyrophoric and water reactive chemicals
 - Pack pyrophoric and water reactive chemicals in desiccators and keep in plastic boxes with absorbents.

7.5. For temperature-sensitive chemicals stored in a refrigerator (4°C)

- Transfer refrigerated chemicals in large ice boxes with coolants in place.

7.6. For temperature-sensitive chemicals stored in a deep freezer (< 4°C)

- Transfer refrigerated chemicals in large ice boxes with dry ice in place.

8. Pack compatible chemicals in containers containing absorbent, leave enough room to completely close the box.
9. Make sure each carton/plastic box and ice box is properly labeled with the chemical list, the name and phone number of owner and destination.
10. Segregate incompatible chemicals and transport them at different times.
11. Use suitable carts with raised edges on four sides and emergency spill kits in place.
12. Transport chemicals to its final destination with no intermediate stops. (Do not transport chemicals across Chia-Wei Woo Academic Concourse)
13. Contact CLS (x6887) for moving chemicals between floors, laboratory buildings and coastal marine laboratory.

Packing and Transporting of Radioactive Materials between Floors and Buildings on Campus

1. Inform HSEO in advance for relocation of radioactive materials.
2. Wear appropriate personal protection equipment such as safety glasses, lab coat, lead apron and chemical resistant gloves.
3. Prepare suitable containers for different radionuclides (e.g. Perspex box for P-32, lead container for Cs-137, etc.).
4. Store radioactive materials stock in lead pig and properly labeled before removal.
5. Make sure the exterior of containers is cleaned and conduct swipe test to verify it.

6. Any radioactive materials must be stored in proper container with shielding before transporting.
7. Pack compatible radioactive materials in suitable containers with absorbent, leave enough room to completely close the box.
8. For non-standard radioactive materials containers
 - Make sure non-standard radioactive materials containers such as sample vials are closed tightly, leak-free and kept in secondary containment.
9. Make sure each container is properly labeled with the radioactive materials list, the name and phone number of owner and destination.
10. Contact HSEO (x8067) for assistance in moving radioactive materials between floors, laboratory buildings and coastal marine laboratory, use suitable carts with raised edges on four sides or lead-lined carts to move radioactive materials with emergency spill kits in place.
11. Segregate incompatible radioactive materials and transport them at different times
12. Transport the radioactive materials to its final destination with no intermediate stops. (Do not transport radioactive materials across Chia-Wei Woo Academic Concourse)

Packing and Transporting of Biological Agents (Biological Safety Level 2 between Floors and Buildings on Campus)

1. Inform HSEO in advance of relocation for biological agents.
2. Request carton box from Facilities Management Office.
3. Wear appropriate personal protection equipment such as safety glasses, lab coat and chemical resistant gloves.
4. Make sure containers of biological agents are securely closed and properly labeled.
5. Make sure the exterior of the containers for biological agent is disinfected.

6. Wherever possible, pack biological agent in their original packing containers.
7. Pack biological agents in suitable containers containing cushioning material, leave enough room to completely close the box.
8. For non-standard biological agents containers
 - Make sure non-standard biological agent containers such as sample vials are closed tightly, leak-free and kept in secondary containment.
9. Make sure each container is properly labeled with the biological agent list, the name and phone number of owner and destination.
10. Use suitable carts with raised edges on four sides to move biological agents with emergency spill kits in place.
11. Contact CLS (x6887) for assistance in moving **Biological Agents stored in Cryogenic Dewar** between floors, laboratory buildings and coastal marine laboratory.
12. Transport the biological agents to its final destination with no intermediate stops. (Do not transport biological agents across Chia-Wei Woo Academic Concourse)

Transporting of Gas Cylinders between Floors and Buildings on Campus

1. Wear appropriate personal protection equipment such as safety glasses, lab coat and chemical resistant gloves.
2. Turn off a gas cylinder at the main valve and release any excess pressure in the regulator.
3. Detach regulator from the gas cylinder.
4. Protect the gas cylinder valve with protection cap.
5. Contact CLS (x6887) for transporting gas cylinder to new laboratory.

Transporting of Cryogenic Dewars between Floors and Buildings on Campus

1. For transporting small cryogenic dewars ($\leq 100\text{L}$)
 - 1.1. Wear appropriate personal protection equipment such as safety glasses, face shield, lab coat and cryogenic gloves. Open-toe shoes are forbidden.
 - 1.2. Use cart to move small cryogenic dewar on the same floor.
2. For transporting a large cryogenic dewar ($> 100\text{L}$)
 - 2.1. Contact CLS (x6887) for transporting large cryogenic dewar to new laboratory.

Attachment 2

HKUST Chemical Exchange Program (CEP)

HKUST Chemical Exchange Program (CEP) is a waste minimization scheme with the objective to reduce:

- a) chemical waste generation,
- b) risk and manpower in handling and treating chemical wastes, and
- c) expenditure associated with chemical purchase and chemical waste management.

Through CEP, an unwanted chemical (i.e. a hazardous waste) can be donated to colleagues of HKUST and chemical users of other local tertiary institutions. Chemicals listed in the CEP are typically surplus chemicals of high quality with their original factory seals intact. Users are encouraged to utilize the CEP to release unwanted chemicals rather than disposing them as chemical wastes.

Please visit http://www.ab.ust.hk/hseo/chemical_ex for further information.

Attachment 3

General Chemical Wastes Disposal

1. The request for chemical waste collection and chemical waste container delivery can be submitted to HSEO at the following link: https://www.ab.ust.hk/cgi-bin/kx.cgi.sh/WService=broker_kw_p/prg/kw_chem_waste.r or by following this path: HSEO website > Hazardous Waste (left menu) > Request for Chemical Waste Collection
2. Fill in the "Request for Chemical Waste Collection and Chemical Waste Container Form" and submit electronically.
3. When the container is three quarters full, submit a "Request for Chemical Waste Collection Form" to HSEO for arranging chemical waste collection.
4. HSEO collects and delivers chemical waste containers every Tuesday afternoon. If Tuesday is not a working day, the service will be deferred to the next working day. All requests submitted online on or before Monday will be handled on the next working day.
5. To facilitate chemical waste collection and waste container delivery to unattended location, please contact HSEO staff for necessary arrangement by indicating the remarks in the request form or calling ext. 6546.


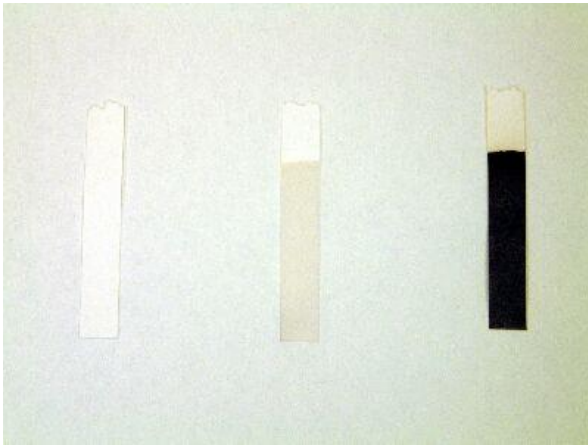
Attachment 4

Method for Testing Organic Peroxides

The presence of organic peroxide in chemicals can be tested with simple indicator paper - Whatman starch iodide paper. The Whatman starch iodide paper is sensitive to peroxide concentration below 100 ppm. Low concentration of peroxide present in chemicals turns the paper yellow whereas, high concentration of peroxide turns the paper blue. This test is sensitive to the formation of hydroperoxide which is the principal hazard associated with peroxide-forming solvent.

1. Immerse the test strip in the chemical for 1 second
2. Breathe slowly on the test strip for 15 to 30 seconds or until the color stabilizes (vapor in breathe provides water for the reaction to proceed)

3. A yellow color indicates a low concentration of peroxide in the sample while blue color indicates a high concentration.
4. If any positive results are observed, please inform HSEO immediately.

 A photograph showing the packaging for Whatman Starch Iodide Test Paper. On the left is a blue and white box with the Whatman logo and the text 'STARCH IODIDE'. To the right is a small, rectangular strip of the test paper, also labeled 'Whatman STARCH IODIDE'.	<p>Whatman Starch Iodide Test Paper</p>
 A photograph showing three vertical strips of Whatman Starch Iodide Test Paper against a light green background. From left to right: the first strip is white, the second strip is yellow, and the third strip is dark blue.	<p>Left: No peroxide present - White</p> <p>Middle: Low concentration of peroxide - Yellow</p> <p>Right: High concentration of peroxide - Blue</p>

The peroxide test paper is available at the Chemicals and DG unit, Center of Laboratory Supplies (ext. 6887)

Attachment 5

General Chemical Waste

Waste Scope

General chemical wastes include liquid, solid and sludge that can be grouped to the standardized chemical waste types listed below. Compatibility among chemicals in same chemical waste container is most importance. Mixing of incompatible chemicals could lead to disastrous consequences. Therefore, chemicals or mixtures which are highly reactive, water reactive or explosive must **NOT** be disposed of to the standard chemical waste containers.

Chemical Waste Streaming

Chemicals or mixtures which comply with Waste Scope Section can be disposed of to the following chemical waste containers according to the guidelines below. Solids which can be dissolved in solvents or corresponding liquid wastes can also be discarded into respective containers. For example, copper sulphate crystal can be first dissolved in (aqueous) metal solution waste from the metal solution waste container, and then dispose back to the same container; or dissolve the solid with minimum amount of water before discarding into the metal solution waste container.

a) **SPENT ALKALI, LAB**

Sodium hydroxide, potassium hydroxide, and ammonia solution shall go to this container. Metal solutions (except chromium (VI)) can also be collected in this container.

b) **SPENT CHROMIUM SOLUTION**

Solutions that contain chromium (VI) shall be disposed of to this container. Chromium solutions of lower oxidation states can be disposed of to metal solution or alkali containers.

c) **SPENT CYANIDE SOLUTION, LAB**

Cyanides or mixtures containing cyanides **MUST** be disposed of to this container. The pH of liquid inside this container **MUST** be kept strongly alkaline to prevent the evolution of a lethal gas-hydrogen cyanide.

d) SPENT FIXER AND DEVELOPER

This container is for fixing and developing agents used in film and photo processing.

e) SPENT HALO SOLVENT, LAB

Organic solvents and compounds with halogens (F, Cl, Br, & I) (e.g. trichloromethane, trichloroethylene, and dichloromethane) shall be collected in this container.

f) SPENT HYDROFLUORIC ACID

This container is for hydrofluoric acid. If the amount of hydrofluoric acid is small (the final concentration of hydrofluoric acid is less than 5% in the filled up waste content), it can be disposed of in inorganic acids container.

g) SPENT INORGANIC ACID

This container is for hydrochloric acid, nitric acid, sulphuric acid and perchloric acid. **Organic acids must be EXCLUDED.** Large amount of organic acids shall go to organic acid container; for small amount, they can be disposed of to halogenated or non-halogenated solvent container depending on halogen content. For safety, concentrated acids **MUST** be diluted (less than 25%) before poured into this container.

h) SPENT LUBE OIL

Pump oil, lubricating oil, liquid paraffins, mineral oil, hydraulic oil, etc., shall go to this container.

i) SPENT METAL SLUDGE

Sludges contain toxic metallic powders or ions can be disposed of to this container. The sludges should be dewatered as much as possible and the separated liquid should be disposed of metal solution container if the metal ion concentration is high.

j) SPENT METAL SOLUTION, LAB

Aqueous solutions containing metallic ions or precipitates (except chromium (VI)) shall be disposed of in this container. Waste containing chromium (VI) shall be collected in "SPENT CHROMIUM SOLUTION" container. Diluted acid and alkali can also be disposed of in this container.

k) SPENT NON-HALO SOLVENT, LAB

This container is for organic solvents and compounds without halogens (e.g. acetone, hexane, and petroleum ethers).

l) SPENT ORGANIC ACID

Collect organic acids in this container. Small amount of organic acids can be disposed of in non-halogenated or halogenated solvents container according to halogen content. Organic acids **MUST NOT** be discarded to inorganic acid container.

m) SPENT ORGANIC GEL, LAB

This container is for toxic gel, such as polyacrylamide gel, or gels contaminated with toxic chemicals (e.g. ethidium bromide). Non-toxic gels, such as agarose, not contaminated by toxic chemicals can be discarded as municipal waste. Gel with biological agents (e.g. agar plate with microbial) **MUST NOT** be disposed of to this container.

n) SPENT OXIDIZER, ACIDIC, LAB

Oxidizer (e.g. permanganate, persulfate and perchlorate) in solution with $\text{pH} < 7$ shall be disposed of to this container.

o) SPENT OXIDIZER, ALKALI, LAB

Oxidizer (e.g. hypochlorite) in solution with $\text{pH} > 7$ shall be disposed of to this container.

p) SPENT SOIL WITH PHENOL

Soil contaminated with high concentration of phenol shall be disposed of to this container. Waste mixtures are streamed according to the major components in the wastes **EXCEPT**:

- a. Waste containing cyanide shall always go to the cyanide waste container.
- b. Organic mixtures contain halogenated compounds shall be put into halogenated solvents container even if the halogenated compounds are the minor components.

Chemical Waste Mixture	Chemical Waste Container If more than one choice, they are listed in descending preference.
Ethanol/acidified ethanol	Non-halogenated solvent or halogenated solvent
Acetic acid - large amount - small amount (< 2 L)	- Organic acid - Non-halogenated solvent
Trichloroacetic acid - solution - small amount of solid - large amount of solid	- Halogenated solvent - Dissolve in minimum quantity of an appropriate solvent (e.g. water), then to halogenated solvent - Dissolve in minimum quantity of solvent, then to organic acid
Chromium solution - Cr (VI) - Cr with oxidation state <VI	- Chromium solution - Metal solution, alkali, inorganic acid or chromium solution
Chloroform (minor component) + methanol + hexane + acetone	Halogenated solvent
Mixture with cyanide as minor component	Cyanide
Hydrofluoric acid - final concentration < 5 % - final concentration > 5 %	- Inorganic acid or hydrofluoric acid - Hydrofluoric acid
Acidified potassium permanganate solution	Acidic oxidizer

Table 1: Examples of Chemical Waste Container Selection

Attachment 6

Chemical Waste Log Sheet

Disposal of most chemical wastes to standard chemical waste containers requires filling in the chemical waste log sheets. Chemical waste log sheet is not required for chemical waste containers for fixers and developers, lube oils, organic gels, metal sludges, or soil with phenol. Chemical waste log sheets are delivered together with chemical waste containers to users by HSEO if necessary. They bear unique HSEO numbers which match with number labels on the chemical waste containers.

Fill in all the columns neatly by a pen with dark water-proof ink. Do **NOT** use pencil, fountain pen, and felt pen with water-based ink.

Write down the names and concentrations of the reactants/products/wastes in full and in block letters. Abbreviation and short form are **NOT** acceptable. Molecular formulae of the chemicals are helpful.

Write down the volume or weight of the waste being poured into the container. Since the Chemical Waste Treatment Centre does not collect chemical waste container without a duly completed and legible chemical waste log sheet, in the same manner, HSEO does not collect chemical waste container without a proper log sheet.

Whenever waste is added to a container, immediately enter the information of the new waste to the chemical waste log sheet of that container.

Attachment 7

Mercury Waste

In Hong Kong, currently there is no proper treatment or disposal method available for treating mercury. However, to minimize potential impacts to the environment, mercury wastes are collected and stored until they can be treated or disposed of by an environmentally preferable approach in future. To help the long term storage of mercury, user shall minimize the volume of the mercury waste generated as much as possible. For example, pour the mercury inside a sphygmomanometer to a rigid and sealable container of SIMILAR size and

then discard the non-contaminated metallic case, tubing, and cuff as municipal waste. For waste collection, submit a request to HSEO. Select "Others" under the "Waste Type" column and write down "mercury waste" and its approximate weight in the blank.

Unless high purity is required, contaminated mercury can be purified by simple process such as filtering or dilute acid washing. Treated mercury can be reused in apparatus such as manometer.

Waste generated in elemental mercury spill cleanup shall be minimized as much as possible. Do not use excessive amount of tissue/towel in spill control. Non-porous objects, such as beakers, bottles or trays, adhered with mercury droplets can be decontaminated by rinsing with water inside a spill tray. Then the tray is shaken gently to agglomerate the droplets. Only collect the mercury drops rather than dispose of all non-porous objects in contact with mercury. Seal spill cleanup waste in double plastic bags. Write down "mercury spill cleanup waste" in your collection request.

Attachment 8

General Procedures for Decontamination of Waste

The most consistent and effective way to decontaminate biological waste is autoclaving. Autoclaving removes any ambiguity as to whether the decontamination process has been completed. For these reasons, and to eliminate concerns for health and safety among our staff and the community, we recommend that all biological materials except materials containing radioactive materials, carcinogens or hazardous volatile chemicals be disinfected by autoclaving prior to disposal, even though Biosafety Level 1 materials do not strictly require this method of disinfection.

All laboratories generating potentially biohazardous waste need to maintain appropriate containers to dispose of, carry, and autoclave this waste. These items are available from CLS. It is expected that most of the waste generated will be disposable. For glassware and reusable items, it will be the responsibility of each laboratory to maintain separate autoclavable containers in which these materials can be autoclaved. After being autoclaved, these reusables should be rinsed before they are sent through the normal washing cycle.

For decontamination of table tops and surfaces, it is recommended that liquid decontaminating agents such as amphyl, broccal or other liquid disinfectants be used. As with the autoclave bags and containers, these items are available through the CLS stock room.

Waste which contains radioactive and/or carcinogenic or other hazardous compounds in conjunction with any biological samples should, if possible, be disinfected by chemical means, then discarded in appropriately labeled radioactive/chemical waste containers, i.e. biohazardous materials listed in addition to hazardous chemical and/or radioisotopes. This waste will be handled appropriately by HSEO. NEVER decontaminate biohazardous waste containing carcinogens, hazardous volatile chemicals, or radioisotopes by autoclaving. Contamination of both personnel and equipment may result.

Attachment 9

Handling Glassware and Sharps

1. Discard any broken glass apparatus in the appropriate sharps container (mercury thermometers should be disposed of separately as hazardous waste). Reject any glass apparatus that is damaged.
2. Never store damaged glassware in cupboards. Damaged glassware should either be sent for repair properly or disposed of in a separate labelled container for sharps disposal.
3. Use gloves when sweeping up broken glass, do not use bare hands. Pick up fine glass particles with wet paper toweling.
4. Take care in handling and disposing of drawn glass capillaries and hypodermic needles. They should be disposed of in the broken glass cartons labeled "Broken Glass Waste". Call CLS at 6884 or 6887 for new broken glass cartons collection and replacement.



Attachment 10

Handling Needles and Syringes

For the disposal of hypodermic needles and syringes, place in a puncture-proof container, autoclave if necessary, and dispose of as biological (medical) waste. Syringes should **NOT** be re-sheathed. Needles and syringes should be locked up and not left in a visible location. Call CLS at 6875 or 6876 for ordering new plastic sharp boxes.



Attachment 11

Transfer of Radioactive Materials

When any radioactive material arrives on campus, the receiving party has to notify the University Radiation Protection Officer (URPO). No radioactive material can leave campus without authorization from the Radiation Protection Officer (RPO) at the origin and also at the destination of the shipment. The user is responsible for notifying the URPO. The following information is needed for shipping radioactive materials:

1. Name of persons shipping and receiving the radioactive material.
2. Name and address of institution receiving the radioactive material along with written authorization from the RPO at the destination.
3. Desired date of transportation.
4. Mode of transportation.
5. Name of compound and radionuclide.
6. Radioactivity (Curie or Becquerel) to be shipped.
7. Physical state of compound.
8. Stock number.

For detailed information on packaging, labeling and necessary paperwork, contact the URPO.

Attachment 12

Inventory of Radioactive Material

A centralized inventory of radioisotopes will be maintained by the URPO. Each user is responsible for keeping individual records to account for the arrival, transfer, utilization and disposal of the material. A copy of this record must be submitted to the URPO at the end of each school term to update the central inventory. Standardized inventory forms may be obtained from the URPO.

Attachment 13

Radioactive Waste Management

All waste contaminated with radioactive materials must be disposed of as radioactive waste through HSEO.

HSEO will pick up radioactive waste from each lab on a regular basis and bring them to a centralized accumulation area for disposal. For materials with short half-lives, they may be stored until the activities drop below levels acceptable for disposal as municipal waste. Other materials may be disposed of by shipping back to the manufacturer or to the Hong Kong Radiation Board.

Waste containing toxic chemicals and/or biohazards must be inactivated prior to disposal as radioactive waste; however, these materials may not be autoclaved unless the volatilized radioactivity may be trapped in a filter thus preventing contamination of the autoclave.

All radioactive liquid wastes, including contaminated rinses of glassware, must be collected as radioactive waste unless approved by the URPO. Similarly, do not discard radioactive liquids down the drain since they will contaminate building plumbing, unless approved by the URPO. Sewage from the University will be monitored by the Environmental Protection Department for illegal discharge of hazardous materials.

Appropriate radioactive waste containers will be supplied by HSEO. Laboratories should segregate their radioactive waste according to radionuclide and form (see below), and tag it with a radwaste label provided by HSEO. Fill out the radwaste label accurately. Disposal decisions concerning each bag, bottle, box, etc. to be picked up are based on the information that appears in that label. Place the waste in the designated location of the laboratory for pick-up by HSEO.

Waste Categories:

1. Solid Waste

Solid waste should be packed in plastic bags. It should not contain pourable liquids or animal carcasses. Needles, Pasteur pipettes and other sharp objects should be placed in a puncture-proof sharps container to protect the waste handler and to prevent piercing the waste bag.

2. Stock Vials

Radioactive stock vials should be placed in a designated container provided by HSEO. These vials may contain small amounts of liquid.

3. Lead Shielding

Lead pegs and shielding should be separated from their plastic holders and placed in a bucket provided for lead disposal. Once the radioactive symbols have been removed or obliterated, the plastic holders may be placed in the trash if they are not contaminated. The lead may be recycled. Otherwise, it may be disposed of as a solid chemical waste at an approved landfill.

4. Liquid Waste

Liquid waste should be collected in plastic holders provided by HSEO. For radioiodine waste, use bottles containing sodium thiosulfate (0.1 M final concentration) to bind the free iodine. Shielding may be necessary. Pathogenic materials should be inactivated with an appropriate disinfectant solution prior to disposal. (Note: Do not add bleach to materials containing radioactive iodine. This will result in the release of the iodine.) Experience has shown that usually 95% of the radioactivity is disposed of as liquid waste. Aqueous liquids should have a pH between 6 and 9 and organic liquids should be segregated according to isotope and chemical name. Do not mix chemicals coming from different processes. The chemical names and percentages of all the chemical components, including solvents, should appear on the hazardous waste label.

5. Liquid Scintillation Vials

Liquid scintillation vials should be segregated by radionuclide and returned to their boxes or trays for collection. On the radwaste label, indicate the brand name of the scintillation cocktail used. This will facilitate segregation of different types of cocktails (e.g. flammable and biodegradable) by waste handlers.

6. Biological Waste

Solid biological material includes animal carcasses, solid excreta and wet bedding. Carcasses containing up to 1.85 kBq/g (0.05 mCi/g) of H-3 and/or C-14 may be disposed of without regard to its radioactivity, preferably by incineration. All other biological wastes should be placed in a specially-prepared and approved five-gallon container. These containers have a layer of vermiculite and a plastic bag containing lime. Make sure that all the biological materials are in contact with the lime. When the drum is full or not needed any more, seal the bag with tape and request a pickup by HSEO.

Attachment 14

Radioactive Decontamination

Personnel decontamination

a. External contamination:

1. Remove all suspected contaminated clothing, place in a plastic bag and seal it. While washing with a detergent, check skin for contamination with a portable survey meter or by wipe tests, depending on the isotope. Do not scrub the skin with a brush because it generates aerosols.
2. Clean skin contaminated with P-32 with household vinegar.
3. In case of contamination with free iodine, apply a paste of sodium iodide to contaminated area and let it react with the free iodine, then wash the area with a detergent. A dose of 300 mg of saturated solution of potassium iodide is recommended to prevent a thyroid burden. Report to the URPO to arrange for an iodine uptake evaluation.

b. Internal contamination:

1. Report to the URPO.

Area decontamination

1. Wear gloves and protective clothing. Start at periphery and work toward area of highest level of contamination. For surface decontamination, use soap and water and cleaners appropriate to the particular radiolabeled compounds and carrier chemicals (dilute HCL, Micro™, Alconox™, CountOff™, Radiacwash™, or other). Do not use scrub brushes which will produce aerosols and spread contamination. Survey continuously. Permit no one to resume work in the area until a survey is made and no contamination is found above background level.
2. In case of free iodine contamination, apply a paste of sodium iodide to the contaminated area and let it react with the free iodine, then wash the area with a detergent. Do not use acids when cleaning a spill containing free radioiodine because the low pH will cause more volatilization of the radioisotopes.

Report accidents/incidents involving radioactive materials to the URPO and fill out an Incident/ Accident Report Form

Attachment 15

Explanatory Notes for the Completion of the Hazard Warning Registration Forms


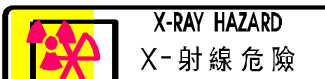
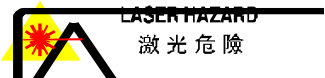

General guidelines

1. The Hazard Warning Placards are to be posted on all laboratory doors including ones without any hazardous materials or operations.
2. For the areas without hazards, the placard should state "NO SPECIAL HAZARDS" (e.g. the computer labs).
3. The placards also need to be posted on doors to any plant rooms, or store areas which hold hazardous materials or operations (such as swimming pool plant room).

Guidance notes for completing the form

1. “Number of Signs Required” refers to the number of placard to be posted. That means you will require two if your room has two different doors.
2. Please refer to Hazard Warnings and Protections Required Sections to fill in the abbreviations for the “Hazard Warnings” and “Protection Required”. Enter “NO SPECIAL HAZARD” for the rooms without hazards. The placards should not indicate any hazard which is not present in the room. Any changes in the hazard status of a room should be reported to HSEO promptly so that the placards can be changed to reflect the current state of affairs within the room.
3. Telephone numbers listed on the placards should be for emergency contacts. The “Emergency Contact Persons 1 and 2” are persons who are able to provide current information on operations within the rooms.
4. Only the office telephone number will be posted on the placard. “Home Phones” and “Other means of contact” will not be posted or otherwise disclosed. These will be kept in the Security Control Center for emergency contact purpose only.

Hazard Warnings

RM	 The sign features a yellow background with a black border. On the left, there is a red and black radiation symbol. To the right of the symbol, the text "RADIOACTIVE MATERIAL" is written in black, with the Chinese characters "放射性物質" below it.	Potential hazard in the form of unsealed radioisotopes and/or possibly contaminated equipment/objects in this area.
XH	 The sign features a yellow background with a black border. On the left, there is a red and black radiation symbol. To the right of the symbol, the text "X-RAY HAZARD" is written in black, with the Chinese characters "X-射線危險" below it.	Irradiating apparatus capable of producing x-rays is present in this area.
LH	 The sign features a yellow background with a black border. On the left, there is a red and black laser symbol. To the right of the symbol, the text "LASER HAZARD" is written in black, with the Chinese characters "激光危險" below it.	Class III or Class IV Laser present in this area.
MF	 The sign features a white background with a black border. On the left, there is a red and blue magnetic field symbol. To the right of the symbol, the text "MAGNETIC FIELD" is written in black, with the Chinese characters "磁場危險" below it.	Machines capable of producing an exposure to magnetic field, radiofrequencies and microwave radiation exceeding $1/2$ the Threshold Limit Value TLV.

RF



See Table Below

MR












See Table Below

Radiofrequency/Microwave Threshold Limit Values (TLVs)

Frequency		Power Density (mW/cm ²)	Electric Field Strength Squared (V ² /m ²)	Magnetic Strength Squared (A ² /m ²)	Field
10 kHz	to 3 MHz	100	377,000	2.65	
3 MHz	to 30 MHz	900/ <i>f</i> *	3770 x 900/ <i>f</i> ²	900(37.7x <i>f</i> ²)	
30 MHz	to 100 MHz	1	3770	0.027	
100 MHz	to 1 GHz	<i>f</i> /100	3770 x <i>f</i> /100	<i>f</i> /37.7 x 100	
1 GHz	to 300GHz	10	37,700	0.265	

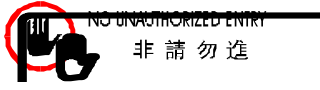
* *f* = frequency in MHz

HVT		HIGH VOLTAGE 高壓電力	≥ 600 V AC or 1.0 kV DC, or especially hazardous situation such as exposed conductors.
UV		ULTRAVIOLET LIGHT 紫外線危險	Presence of ultraviolet source in the spectral region between 180 and 400nm which is capable of emitting UV radiation of an Effective irradiance* exceeding 0.1 W /cm ² . (½ the permissible exposure for 8 hr.) This includes arc, vapor and gas discharge, incandescent and fluorescent lamps but excludes lasers. * Effective irradiance = Total irradiance weighted against the peak of the spectral effectiveness curve (270nm).
HP		HIGH PRESSURE SYSTEM 高壓裝置	Dangerous high-pressure system, e.g. pressure vessels, receiver, high-pressure gas line, especially when fragile apparatus is involved.
HVC		HIGH VACUUM SYSTEM 真空裝置	Hazard of implosion due to fracture of high vacuum vessel.
BH		BIOHAZARDS 生物危害	Biological organisms/agents which present a hazard to human health or the environment, but are unlikely to cause disease in healthy workers.
BH/ BSL2		BIOHAZARDS 生物危害	Biological organisms/agents (Risk group 2) which can cause human disease, but under normal circumstances, are unlikely to be a serious hazard to healthy workers.
CG		CARCINOGENS 致癌物質	Suspect or confirmed human carcinogen stored/used in this area.

LA	 LABORATORY ANIMALS 實驗動物	Animal holding or animal experiment area.
TS	 TOXIC SUBSTANCES 有毒物質	Large quantity of toxic substance stored/used in this area.
TG	 TOXIC GASES 有毒氣體	Toxic gases stored, used or being generated in this area.
OM	 OXIDIZING MATERIAL 助燃物品	Strong oxidizing material stored or used in this area.
EM	 EXPLOSIVE MATERIAL 爆炸性物品	Explosive or shock-sensitive material stored or used in this area.
FM	 FLAMMABLE MATERIAL 易燃物品	Flammable material stored or used in this area.
CM	 CORROSIVE MATERIAL 腐蝕性物質	Corrosives (materials that may cause severe damage on contact with living tissues) stored or used in this area.
HF	 HYDROFLUORIC ACID	Hydrochloric acid stored or used in this area.
CN	 CYANIDE SUBSTANCE	Cyanide compounds stored or used in this area.

Protections Required

NE



EP



DR



RS



FS



SG





The Hong Kong University of Science and Technology

Safety and Environmental Protection Office

Registration of Hazard Warnings (20__)

Room No. **Designation**^① **Department** **No. of Signs Required**^②

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Hazard Warnings (List the abbreviations for each applicable warning, See the list attached)

Protections Required

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Person in Charge

Name/Post	
Office/ Lab Phone (s)	
Home Phone(s) ^③ ^③	
Pager, other means of contact ^③ ^③	

Emergency Contact 1

Name/Post	
Office/ Lab Phone (s)	
Home Phone(s) ^③ ^③	
Pager, other means of contact ^③ ^③	

Emergency Contact 2

Name/Post	
Office /Lab Phone (s)	
Home Phone(s) ^③ ^③	
Pager, other means of contact ^③ ^③	

① ① Name of the room, e.g. research lab, hot lab, teaching lab.and etc.

② ② There should be one sign at each entrance.

③ ③ For Security Office only, will not be posted or otherwise disclosed.

Departmental Safety Officer

Name _____

Signature _____

Date _____



**THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNSEALED RADIOACTIVE MATERIAL
INVENTORY RECORD**

RUA No.: _____

Department: _____

Principal Investigator: _____

Location: _____

Person in Charge: _____

Phone Number: _____

Purchase Order Number	Radionuclide	Activity Purchased	Activity Reference Date	Date of Receiving	Storage Room & Location	Final Disposal Date	Remarks

I have reviewed the above records,
 the information is accurate and current.
 the information is modified as indicated above.
 Signature of responsible person: _____
 Date: _____

HSEO/RM01/Jan 09

Appendix II

Date: _____

The Hong Kong University of Science and Technology Laboratory Decommissioning Checklist (For FMO-LS)

Laboratory User Information

Faculty Member or Principal Investigator:	Department:
Room Number:	Building:

Please inform Health, Safety and Environment Office if any of following items are identified in laboratories to be vacated:

Items	Check if applicable
Chemical laboratories	
With mercury vacuum line, glove boxes, chemical refrigerators	
With explosive, pyrophoric or peroxidizable chemicals	
Biological laboratories	
With biological safety level 2 materials	
With laboratory animal	
Radiological laboratories	
With designated radiation work area, scintillation counter, radioactive materials storage cabinet, radioactive waste containers	
Nanomaterial laboratories	
With CVD, MOCVD, tube furnaces, reactor, and other experimental setups	
Laser Laboratories	
With toxic gas cylinders	

To be completed by FMO-LS

Name: _____ Tel: _____ Email: _____