Chemical Class Standard Operating Procedures

Particularly Hazardous Substances (PHS)

Print a copy and insert into your laboratory SOP binder.

Department:	Chemistry
Date SOP was written:	June 10, 2013
Date SOP was approved by PI/lab supervisor:	
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Emergency Contact:	Name: Richmond Sarpong Phone Number: 626-644-2407
Location(s) covered by this SOP:	Latimer Hall: 834, 836, 837, 838, 839, 842, 847, 849, 907

1. Purpose

This SOP covers the precautions and safe handling procedures for the use of Particularly Hazardous Substances in the Sarpong group, which include the following chemicals and their uses:

Chemical(s)	Use(s)
PHSs	1. Using Particularly Hazardous Substances as reagents.
PHS solvents	2. Using Particularly Hazardous Substances as solvents in reactions, for extractions or cleaning glassware.
PHS solvents	3. Using Particularly Hazardous Substances as solvents in column chromatography (CC) or thin layer chromatography (TLC).
Sarpong inventory chemicals covered by this SOP	See below.

Sarpong Group inventory chemicals covered by this SOP

(R)-(+)-2,3-Dihydroindole-2-carboxylic acid
(r)-styrene oxide
(S)-(-)-Indoline-2-carboxylic acid
1,1,3,3-Tetramethylurea
1,2,4-Triazole
1,2-bis(diphenylphosphino)ethane nickel (ii) chloride
1,2-dichloroethane
1,2-Epoxy-5-hexene
1,2-phenylenediamine
1,3,5-trioxane
1,3-Bis(diphenylphosphino)propanenickel(II) chloride
1,3-diphenylguanidine
1,3-Phenylenediamine
1,4-cyclohexanediene
1-bromo-2-chloroethane
1-Methyl-2-pyrrolidinone
2,3-dichloro-1-propene
2,4-dinitrobenzenesulfonyl chloride
2-aminophenol
2-bromopropane
2-Methoxyethanol
2-methyl-5-nitroaniline
2-Nitropropane
2-nitrotoluene
4,4'-bis(dimethylamino)benzophenone
4,4'-dibromobiphenyl
4-chloroaniline
5-Bromoisatoic anhydride
5-methylfurfural
9-BBN triflate solution 0.5 M in hexanes
acrylamide
allyl chloride
aniline
aniline hydrochloride
Benzamide
Benzyl Chloromethyl Ether
bis(2,4,6-trimethylpyridine)iodine(I) hexafluorophosphate
bis(triphenylphosphine)nickel(ii) chloride
boric acid
Carbon Disulfide
chloramphenicol
Chloroform
cis-1,4-Dichloro-2-butene
Cobalt chloride hexahydrate
Cobalt(II) acetylacetonate
Cyclopropylboronic acid
Diethyl azodicarboxylate
Diethylene glycol dimethyl ether
epichlorohydrin
Ethoxyethyne
Ethylhydrazine oxalate
Formamide
Gallium(III) Iodide
Glufosinate Ammonium
Glyoxal
Haloperidol
hexamethylphosphoramide
Hexamethylphosphorous triamide
Hexane
Hydrazine hydrate
hydrazine monohydrate
Hydroquinone
imidazole
Indium (III) iodide
Isobutyl nitrite
isoprene
Lead (II) bromide
Lead (IV) acetate
Lithium acetylacetonate
Magnesium methyl carbonate
N,N-Dimethylacetamide
Naphthalene
Nickel (II) acetylacetonate
Nickel (II) sulfate hexahydrate
Nickel(II) chloride
nickel(II) iodide
Nickel(II)Chloride Hexahydrate
nitrobenzene
N-methylacetamide
o-Aminoanisole
o-Phenylenediamine
Phenol

Phenolphthalein
Phenylhydrazine hydrochloride
Phenylhydrazine
phloroglucinol
Propylene oxide
Pyridinium chlorochromate
Pyrogallol
quinoline
Sodium Perborate Monohydrate
sodium tetraborate
Styrene Oxide
Tebbe reagent
Thiourea
trimethylphosphine 1M in toluene
Tris(2-methoxyethoxy)(vinyl)silane
Vinyl bromide
vinyl bromide, 1.0M in THF
Vitride(R) T reducing agent
chromium (VI) oxide
1,1-Dimethylhydrazine
2,4-Dinitroaniline
2-chloroacrylonitrile
4-aminophenol
benzenethiol
Benzyl chloride
benzyl chloroformate
Boron tribromide
boron tribromide 1 M in DCM
cis-dichlorodiamine platinum(II)
Cycloheximide
cyclohexylamine
Dimethylcarbamyl chloride
dimethyl sulfate
N,N-Dimethylsulfamoylchloride
Di-n-butyltin dichloride
Glutaraldehyde
hexafluoroacetone
Hexafluoroacetone trihydrate
Hydrazine
isopropyl chloroformate (1M in toluene)
mercury bichloride
o-Tolidine dihydrochloride
Sodium dichromate dihydrate (VI)
Potassium dichromate
(Trimethylsilyl)diazomethane, 2M in diethyl ether
1,1,2,2-Tetrachloroethane
1,1,3,3-Propanetetracarbonitrile
1,2,4-trifluoro-5-nitrobenzene
1,2-Ethanedithiol
1,3-diaminopropane
1,3-Dichloroacetone
1,3-Dicyclohexylcarbodiimide
1,3-diisopropylcarbodiimide
1,4-naphthoquinone
1,5-Difluoro-2,4-dinitrobenzene
12-Crown-4
1-cyanovinyl acetate
2,4,6-Trimethylaniline
2,4-dichlorophenol
2,6-dibromopyridine
2-acetylfuran
2-Acetylthiophene
2-amino-6-picoline
2-Bromo-5-(trifluoromethyl)pyridine
2-bromopyridine
2-chlorobenzyl chloride
2-chloroethanol
2-chloropyridine
2-Cyclohexen-1-one
2-Cyclohexenone
2-ethylacrolein
2-Ethylpropenal
2-furaldehyde
2-mercaptoethanol
2-Pyridinecarboxaldehyde
3,4-diaminopyridine
3-butyn-2-ol
3-Butyn-2-one
3-chlorophenyl isocyanate
3-chloropropionyl chloride
4-(Dimethylamino)pyridine
4-Chlorobutanyryl chloride
4-Methoxy-2-nitroaniline
5-chloro-2-nitroaniline

Acetic Acid Triethylamine 2 M 2 M
acetone cyanohydrin
Acetylferrocene
Aconitine
adiponitrile
allyl acetate
allyl alcohol
allyl chloroformate
allyl iodide
allylamine
benzeneseleninic anhydride
Benzoyl cyanide
benzyl mercaptan
Benzyltriphenylphosphonium chloride
Bis(4-nitrophenyl) hydrogenphosphate
Boron Trifluoride Ether Complex
bromoacetaldehyde diethyl acetal
Bromoacetic Acid
Butyl isocyanate
Cesium azide
Cetylpyridinium chloride
chloroacetaldehyde
chloroacetone
chloroacetonitrile
Cumene Hydroperoxide
cyanuric chloride
cyclohexyl isocyanate
Cyclopentanamine
Decaborane
Dibutyl tin dilaurate
Dibutyltin(IV) Oxide
dichlorodiphenylsilane
diethyl chlorophosphate
Dimethylchloro phosphate
Dimethyldicarbonate
Di-t-butyldicarbonate
Eaton's reagent
ethyl bromoacetate
Ethyl chloroformate
ethyl iodoacetate
Ethylphosphonic dichloride
Hexamethylditin
hydrazine sulfate
Hydrogen fluoride pyridine
Iodomethane
iron(0) pentacarbonyl
isobutyronitrile
isopropyl isocyanate
Malononitrile
mercuric cyanide
Mercuric oxide yellow
Mercury (II) oxide
mercury (II) sulfate
Mercury iodide
mercury(ii) acetate
mercury(ii) trifluoroacetate
methanesulfonyl chloride
Methyl cyanoformate
methyl vinyl ketone
methylphosphonic dichloride
molybdenum carbonyl
m-xylylenediamine
n,n'-dicyclohexylcarbodiimide
N,N'-diisopropylcarbodiimide
N,N-dimethyl-1,3-propanediamine
N,N-Dimethylphenylenediamine
o-cresol
Osmium Tetroxide
Osmium tetroxide Solution
p-Anisidine
p-Cresol
p-Dinitrobenzene
phenyl chloroformate
phenyl isocyanate
Phosphorus oxychloride
Phosphorus pentachloride
phosphorus pentoxide
phosphorus trichloride (2.0 m in dcm)
Phthalonitrile
Pivaloyl chloride
Propargyl Alcohol
Propionitrile
pyridine-2-carboxaldehyde
Selenium

sodium borate
Sodium cyanoborohydride
sodium tetraborate decahydrate
Sodium Trifluoroacetate
Strychnine
sulfuryl chloride
Tetrabutylammonium cyanide
tetramethyltin
Tetranitromethane
thallium(I) carbonate
Thallium(I) ethoxide
Thallium(III) acetate
thallium(III) nitrate trihydrate
thioglycolic acid
Titanium tetrachloride
trans-crotonaldehyde
Tributylamine
Trichloroacetyl chloride
Triethoxysilane
Trimethyl acetyl chloride
Trimethyl(phenyl)tin
Trimethylsilyl cyanide
Trimethylsilyldiazomethane
Trimethylsilyldiazomethane (2.0 M in hexanes)
Trimethylsilyldiazomethane, 2.0 M solution in hexanes
Trimethyltin azide
Trimethyltin chloride
Triphosgene
1,2-dibromoethane
Chloroform-D
Pyridinium dichromate
N-Nitroso-N-Methylurea
4-Toluenesulfonyl azide
Sodium perborate tetrahydrate
tert-butyl hydroperoxide
1,3-Dinitrobenzene
peracetic acid 32 wt % in dilute acetic acid
4-dimethylaminopyridine
Nickel peroxide

2. Physical & Chemical Properties/Definition of Chemical Group

Particularly Hazardous Substances fall into three major categories: reproductive toxins, acute toxins, and select carcinogens.

Reproductive Toxins are chemicals that affect the reproductive capabilities including causing chromosomal damage (mutations) and adverse effects on fetal development (teratogenesis).

Reproductive toxins are designated by one or more of the following H codes:

H340 May cause genetic defects

H341 Suspected of causing genetic defects

H360 May damage fertility or the unborn child

H361 Suspected of damaging fertility or the unborn child

H362 May cause harm to breast-fed children

Acute Toxins are chemicals that pose a high level of immediate health risk to individuals. Acutely Toxic Chemicals are those listed specifically in the Settlement Agreement and/or those chemical compounds with a *high* level of acute toxicity as defined by the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Categories 1 and 2:

Acute Toxicity	Category 1	Category 2
Oral (mg/kg)	≤ 5	Between > 5 and ≤ 50
Dermal (mg/kg)	≤ 50	Between > 50 and ≤ 200
Gases (ppm)	≤ 100	Between > 100 and ≤ 500
Vapors (mg/l)	≤ 0.5	Between > 0.5 and ≤ 2.0
Dusts and Mists (mg/l)	≤ 0.05	Between > 0.05 and ≤ 0.5

Acutely toxic chemicals may also have other hazardous properties in addition to acute toxicity. Safe use requires assessing all potential hazards.

Acutely toxic chemicals are designated by one or more of the following H codes:

H300 Fatal if swallowed

H310 Fatal in contact with skin

H330 Fatal if inhaled

Select Carcinogens are a category of chemicals where the available evidence strongly indicates that the substances cause human carcinogenicity. A "select carcinogen" meets one of the following criteria.

1. It is regulated by Cal/OSHA as a carcinogen.
2. It is listed under the category "known to be carcinogens" in the annual report by the National Toxicology Program (NTP).
3. It is listed under Group 1 – "carcinogenic to humans" – by the International Agency for Research on Cancer (IARC)
4. It is listed in either Group 2A or Group 2B by the IARC or under the category "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3
b. After repeated skin application of less than 300 mg/kg of body weight per week; or
c. After oral dosages of less than 50 mg/kg of body weight per day.

Select carcinogens are designated by one of the following H codes:

H350 May cause cancer

H351 Suspected of causing cancer

Cal/OSHA Regulated Carcinogens fall into a separate hazard class and have extensive additional requirements associated with them that are not covered under this procedure. The use of these agents may require personal exposure sampling based on usage. The specific Cal/OSHA regulations that govern the use of regulated carcinogens can be found at

http://www.dir.ca.gov/Title8/sb7g16a110.html
http://www.dir.ca.gov/Title8/5209.html

Some exemptions from these requirements are made for laboratory scale use; these can be found at:

http://www.dir.ca.gov/Title8/5191.html

Contact the EH&S department if there are any questions about the use of these materials.

3. Potential Hazards/Toxicity

Careful handling and stringent controls of these chemicals are essential in order to protect workers and the environment. Requirements include designating a specific location for working with these substances including labeling and warning signs for those who may enter or work in the designated areas.

Additional requirements may apply, depending on the specific chemical. Examples include particularly hazardous substances that are also highly flammable and/or reactive.

4. Engineering Controls

Use the engineering controls listed below unless other lab-specific information is included in the Protocol/Procedure section.

- A laboratory type fume hood with the sash position closed as much as possible;
- A glove box for pyrophorics and water reactive chemicals. Glove boxes may also be required for other chemicals, such as regulated carcinogens and particularly hazardous substances;
- Supplemental protective equipment like a blast shield, where appropriate, to protect from explosions when using peroxide formers, pyrophorics, water reactives, and potentially explosive chemicals.
- Laboratories and rooms where particularly hazardous substances are used shall have general room ventilation that is at negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.

5. Personal Protective Equipment

For additional information on PPE requirements, go to:
http://ccehss.berkeley.edu/section5#Personnel_Protective_Equipment_Required_in_College_Laboratories

Use the PPE listed below unless other lab-specific information is included in the Protocol/Procedure section.

Eye and Face Protection

ANSI-approved safety glasses with side shields or chemical splash goggles must be worn at all times when handling chemicals in the lab.

Skin and Body Protection

1. Gloves are required when handling hazardous chemicals.
    a. Specific glove type recommendations are provided in the Protocol/Procedure section.
    b. Inspect gloves prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Wash and dry hands after handling chemicals, before breaks, and at the end of the workday.
    c. For additional information on glove selection, go to: http://ehs.berkeley.edu/hs/63-laboratory-safety/94-glove-selection-and-usage.html
2. Lab coats are required when handling hazardous chemicals in the lab.
    a. Nomex 3A flame-resistant lab coats are required when working with pyrophorics (H250) and explosives (H200, H201, H202, H203)
    b. Flame resistant lab coats (Nomex or other material) should be worn when working with hazardous chemicals such as Category 1 or 2 flammable liquids (H224 and H225).
3. Cotton-based, non-synthetic clothing (including long pants; no skin exposed below the waist) should be worn.
4. Closed-toe and closed-heel shoes are required in the lab.

Respiratory Protection

Respiratory protection is normally not required for UC Berkeley laboratory activities. Any lab personnel considering the use of a respirator must contact EH&S for a workplace assessment. Respirator users will be provided with specific instructions if a respirator is deemed necessary by EH&S.

6. First Aid Procedures and Medical Emergencies

Notify supervisor and EH&S immediately. Follow up with a call to 510-642-9090 to report the incident.

Life Threatening Emergency, After Hours, Weekends and Holidays – Call **911** or go to the nearest emergency room. Note: All serious injuries must be reported to EH&S within 8 hours. Follow up with a call to 510-642-9090 to report the incident.

Assess the extent of danger. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible, help contaminated or injured persons. Obtain medical attention for the individual as soon as possible by calling **911**. Provide a copy of the appropriate SDS to the emergency responders or physician, as needed.

If inhaled

Move into fresh air. Go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room. If person is not breathing, call **911** and give artificial respiration. If unconscious, call **911**.

In case of skin contact

Immediately flush with flowing water for no less than 15 minutes; remove any jewelry or clothing as necessary to facilitate clearing of any residual materials. Wash off with soap and plenty of water for 15

minutes. If skin contact requires medical assistance, go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room. If this is a large or serious injury, call **911**.

In case of eye contact

Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible. Call **911**.

If swallowed

Call **911**. Do not induce vomiting unless directed otherwise by the SDS. Never give anything by mouth to an unconscious person. Rinse mouth with water. Go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room.

Needle stick/puncture exposure

Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure such as eyes, mouth and/or nose, flush the affected area for 15 minutes using an eyewash station. Go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room.

All needle stick/puncture exposures must be reported to EH&S within 8 hours. Follow up with a call to 510-642-9090 to report the incident.

7. Special Handling and Storage Requirements

Lab-specific information on handling and storage may be included in the Protocol/Procedure section.

Working alone – Certain extremely hazardous operations should not be performed if the PI or Lab Safety Contact(s) are not present. Never work alone with extremely hazardous materials/operations. See the Protocol/Procedure section below for specific prohibitions (if any) on working alone.

Areas in the laboratory where PHS are used must be identified as a "**Designated Area**" for use. PHS may only be used and stored in the designated areas. Additionally, be sure to label this area using appropriate signage – e.g., **CAUTION, DESIGNATED AREA – REPRODUCTIVE TOXINS, ACUTE TOXINS, OR SELECT CARCINOGENS MAY BE PRESENT.**

- Label waste containers containing PHS with warning labels.
- Label storage space with warning labels.
- Store non-flammable PHS within secondary containment.
- Store flammable PHS within flammable storage cabinet and designate a bottom shelf or secondary container.
- Provide secondary containment for chemicals in accordance with the ccEHS "Chemical Hygiene Plan": http://ccehss.berkeley.edu/section5#Chemical_Handling_Storage_and_Transportation

8. Chemical Spill

Spill – Assess the extent of danger; if necessary request help by calling **911** and 510-642-9090. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors from spill. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Minor Spill – In the event of a minor spill, if there is no potential for hazardous chemical exposure, report the spill to 510-642-9090 and proceed to clean it, if you are trained. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Call 510-642-9090 to report the spill to ccEHSS and for assistance.

Major Spill – Any hazardous chemical spill that involves chemical exposure, any chemical spill that due to size and/or hazard requires capabilities beyond your training, or any chemical spill that gives the perception (because of odor, for example) that there has been a hazardous release.

Call **911** and 510-642-9090 to report the spill to ccEHSS and for assistance.

9. Cleaning and Decontamination

Lab-specific information on decontamination may be included in the Protocol/Procedure section.

- Wearing proper PPE, laboratory work surfaces shall be cleaned at the conclusion of each procedure and at the end of each work day.
- Dispose of contaminated materials in accordance with hazardous waste disposal guidelines referenced below.
- Decontaminate all equipment before removing from a designated area.

10. Hazardous Waste Disposal

Label Waste

Label all containers with the label provided at:
http://ehs.berkeley.edu/hm/279-new-hazardous-waste-program-hwp.html.
See the EH&S Fact Sheet, "Hazardous Waste Management" for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

- Dispose of regularly generated chemical waste within 6 months.
- Call EH&S with questions.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at http://ucmsds.com

12. Protocol/Procedure – Particularly Hazardous Substances

Preparation	Know the location of the nearest fire extinguisher, eyewash, and safety shower before beginning work. These materials are classified as Particularly Hazardous Substances (PHS), and contact must be minimized at all times. Because of the risks associated with longer term repeated exposure. The hazards could include being suspected carcinogens, reproductive toxins, etc. Therefore, in addition to immediate exposures, extra care must be taken to prevent contamination of clothing, work surfaces, etc. when working with these materials. Many of these materials are flammable or combustible and so avoid open flames and other ignition sources. Use in the smallest practical quantities for the experiment being performed.
Chemical Storage and Disposal	**Storage:** Store away from incompatible chemicals. Keep in a tightly closed container, stored in a cool, dry, ventilated area. Store away from heat and sources of ignition. **Disposal:** All contaminated wastes shall be disposed of into waste containers specifically designated for hazardous chemical waste. Mix ONLY with compatible waste streams. Store hazardous waste containers in secondary containment. Liquid waste will be labeled appropriately and disposed of through EH&S once liquid waste container is full. **Decontamination of Equipment** Equipment that needs to be relocated (for repair or change of location etc.) must be properly decontaminated.
Lab-specific Information	Add lab-specific information not included above if needed (e.g., all work for this procedure is to take place in the designated fume hood.)

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
1. Using Particularly Hazardous Substances as reagents	2 g or less in 50 to 100 mL of solvent	All reactions using these materials must be performed in a properly operating fume hood. Blast shields must be used if the reaction has the potential to generate large quantities of gases or is strongly exothermic.	**Eye protection**: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. **Face Protection**: The need for face protection is based on the solvents used or if the reaction will be externally heated or if needed. **Hand Protection** : Confirm compatibility of glove material with material being used. General guidance: (low contact): 8 mil minimum Nitrile gloves must be used to prevent incidental contact. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Remove gloves immediately upon contamination. Wash and dry hands after use. **Hand Protection** (high contact): Extended contact with many solvents may penetrate lab gloves Use Laminate Film gloves (e.g. Ansell Barrier) for extended contact (such as spill cleanup) and for any potential contact with solutions containing highly toxic solutes. Extended contact with benzene should be avoided. Remove gloves immediately upon contamination.	Avoid the formation of dusts with solids. Carefully weigh materials as normal. Use of enclosed balance or tared method with secondary containment is recommended where feasible. Immediately move to fume hood when weighing is complete. In a properly functioning fume hood, add reagent to the reaction vessel. If the reagent is a liquid, dispense and transfer to the reaction vessel using either a syringe or pipettor.

			Clothing: Wear fire/flame resistant lab coat (100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	
Notes	Any deviation from this SOP requires approval from PI.			

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
2. Using Particularly Hazardous Substances as solvents in reactions, for extractions or cleaning glassware	up to 100 mL when used as a reaction solvent no more than 500 mL when using to clean glass-ware no more than 500 mL when using for extrac-tions	All operations using these materials must be performed in a properly operating fume hood. Blast shields must be used if the reaction has the potential to generate large quantities of gases or is strongly exothermic. Open flames and possible sparking and static electricity must be avoided.	**Eye protection**: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. **Face Protection**: The need for face protection is based on the solvents used or if the reaction will be externally heated or if needed. **Hand Protection** : Confirm compatibility of glove material with material being used. General guidance: (low contact): 8 mil minimum Nitrile gloves must be used to prevent incidental contact. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Remove gloves immediately upon contamination. Wash and dry hands after use. **Hand Protection** (high contact): Extended contact with many solvents may penetrate lab gloves Use Laminate Film gloves (e.g. Ansell Barrier) for extended contact (such as spill cleanup) and for any potential contact with solutions containing highly toxic solutes. Extended contact with benzene should be avoided. Remove gloves immediately upon contamination.	Avoid inhalation of these materials. If a rotary evaporator is used ensure it is vented in the fume hood. If it is necessary to condense the solvent, use an open cold trap system. Pressure can be built up when these solvents are used in closed reaction vessels. Adequate ventilation (e.g. pressure bubbler on Schlenk manifold, or an equilibrating balloon) must be used to prevent dangerous over pressurization. Pressure may be built up if when performing extractions. Adequate ventilation (open the valve frequently during the extraction) has to be used to prevent dangerous over pressurization. The vapor in such a process must be released in a fume hood. If heated, the reaction apparatus has to be fitted with an adequately sized condenser and an adequate

			Clothing: Wear fire/flame resistant lab coat (100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	flow of cooling water has to be provided to prevent evaporation. Cooling hoses have to be secured with hose clamps to the condenser and the outlet. When used to clean glassware, leave the cleaned glassware in the fume hood until the solvent has evaporated off.
Notes	Any deviation from this SOP requires approval from PI.			

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
3. Using Particularly Hazardous Substances as solvents in column chromatography (CC) or thin layer chromatography (TLC)	up to 50 mL when used in TLC no more than 2000 mL when using for CC	All chromatography operations using these materials must be performed in a properly operating fume hood. Open flames and possible sparking and static electricity must be avoided.	**Eye protection**: Wear ANSI approved tight-fitting safety goggles or safety glasses with side shields. **Face Protection**: Wear a face shield when handling containers that are not behind a lab hood sash or blast shield. **Hand Protection** : Confirm compatibility of glove material with material being used. General guidance: (low contact): 8 mil minimum Nitrile gloves must be used to prevent incidental contact. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Remove gloves immediately upon contamination. Wash and dry hands after use. **Hand Protection** (high contact): Extended contact with many solvents may penetrate lab gloves Use Laminate Film gloves (e.g. Ansell Barrier) for extended contact (such as spill cleanup) and for any potential contact with solutions containing highly toxic solutes. Extended contact with benzene should be avoided. Remove gloves immediately upon contamination.	Avoid inhalation of these materials. Thin Layer Chromatography: allow the plate to dry in the fume hood after removal from the development bath. Column Chromatography: collect fractions of interest and concentrate as needed. If a rotary evaporator is used for concentrating, ensure it is vented in the fume hood. If it is necessary to condense the solvent, use an open cold trap system. After use in the column, allow the solvent to evaporate from the packing material prior to proper disposal of the packing material.

			Clothing: Wear fire/flame resistant lab coat (100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	
Notes	Any deviation from this SOP requires approval from PI.			

Sarpong Group Notes on Particularly Hazardous Substances

Physical & Chemical Properties/Definition of Chemical Group

Particularly Hazardous Substances fall into three major categories: reproductive toxins, acute toxins, and select carcinogens.

Reproductive Toxins are chemicals that affect the reproductive capabilities including causing chromosomal damage (mutations) and adverse effects on fetal development (teratogenesis).

For a list of reproductive toxins, please consult the current List of Carcinogens and Reproductive Toxins per Proposition 65 http://oehha.ca.gov/prop65/prop65_list/Newlist.html.

Acute Toxins are chemicals that pose a high level of immediate health risk to individuals. They can be defined as:

1. A chemical with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to albino rats weighing between 200 and 300 g each.

2. A chemical with a median lethal dose (LD50) of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2-3 kg each.

3. A chemical that has a median lethal concentration (LC50) in air of 5000 ppm by volume or less of gas or vapor, or 50 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 g each.

Select Carcinogens are a category of chemicals where the available evidence strongly indicates that the substances cause human carcinogenicity. A "select carcinogen" meets one of the following criteria.

1. It is regulated by Cal/OSHA as a carcinogen.

2. It is listed under the category "known to be carcinogens" in the annual report by the National Toxicology Program (NTP).

3. It is listed under Group 1 – "carcinogenic to humans" – by the International Agency for Research on Cancer (IARC)

4. It is listed in either Group 2A or Group 2B by the IARC or under the category "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3
    b. After repeated skin application of less than 300 mg/kg of body weight per week; or

c. After oral dosages of less than 50 mg/kg of body weight per day.

Cal/OSHA Regulated Carcinogens fall into a separate hazard class and have extensive additional requirements associated with them that are not covered under this procedure. The use of these agents may require personal exposure sampling based on usage. The specific Cal/OSHA regulations that govern the use of regulated carcinogens can be found at

http://www.dir.ca.gov/Title8/sb7g16a110.html

http://www.dir.ca.gov/Title8/5209.html

Some exemptions from these requirements are made for laboratory scale use; these can be found at: http://www.dir.ca.gov/Title8/5191.html

Contact the EH&S department if there are any questions about the use of these materials.

Engineering Controls

- Work with particularly hazardous substances should be avoided and is not permitted if there is a reasonable likelihood of workers exceeding regulatory exposure limits.
- Chemical fume hoods used as containment areas for particularly hazardous substances must have a face velocity of 100 lfm, averaged over the face of the hood and must be certified annually.
- Laboratories and rooms where particularly hazardous substances are used shall have general room ventilation that is at negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.

Special Handling and Storage Requirements

Storage

Use unbreakable secondary containment for the storage of acutely toxic chemicals. If the materials are volatile (or could react with moisture or air to form volatile toxic compounds), containers should be in a ventilated storage area. All containers of acutely toxic chemicals should be clearly labeled with chemical composition, known hazards, and warnings for handling.

Chemicals that can combine to make toxic materials (e.g., acids and inorganic cyanides, which can generate hydrogen cyanide) should not be stored in the same secondary containment. Chemicals that have a limited shelf life need to be tracked and monitored. Chemicals that require refrigeration should be stored appropriately.

Working Alone

Certain extremely hazardous operations should not be performed if the PI or Lab Safety Contact(s) are not present. Never work alone with extremely hazardous materials/operations. See the Protocol/Procedure section below for specific prohibitions (if any) on working alone.

Areas in the laboratory where PHS are used must be identified as a "**Designated Area**" for use. PHS may only be used and stored in the designated areas. Additionally, be sure to label this area using appropriate signage – e.g., **CAUTION, DESIGNATED AREA – REPRODUCTIVE TOXINS, ACUTE TOXINS, OR SELECT CARCINOGENS MAY BE PRESENT.**

- **Label waste containers** containing PHS with warning labels.
- **Label storage space** with warning labels.
- Store non-flammable PHS within secondary containment.
- Store flammable PHS within flammable storage cabinet and designate a bottom shelf or secondary container.

13. Documentation of Training (signature of all users is required)

- Prior to conducting any work with Particularly Hazardous Substances, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the Particularly Hazardous Substances SDSs provided by the manufacturer.

I have read and understand the content of this SOP:

Name	Signature	Identifier	Date