Borhan Research Labs
Chemical Safety Training Agreement

The following training courses are required prior to working on any project in the laboratory:
• Hazardous Waste Initial Training
• Chemical Hygiene & Laboratory Safety
• Security Awareness

These training courses are available at:
http://www.orcbs.msu.edu/training/training_toc.htm

In addition, site-specific training is required for general safety considerations. This will cover:
____Eyewash location and use
____Safety shower location
____Spill kit locations
____Addition of contact information to list and location of list
____Filled out an Emergency Contact Form
____Hood use (sashes, emergency purge)
____Fire extinguisher locations
____Fire emergency alarms
____Liquid nitrogen safety
____Lab security (doors should be locked, suspicious people around the lab, etc.)
____Location of hazardous waste and medical waste disposal
____Use of appropriate safety equipment (lab coat, goggles, shoes, shields, gloves, etc.)
____Location of chemical hygiene plan and MSDS forms
____Read and signed SOP for Disposal of Reactive and Pyrophoric Chemicals
____Read and signed SOP for Handling Reactive and Toxic Compounds

• MSDS forms are available on the EHS website:
http://www.orcbs.msu.edu

• The chemical hygiene plan is available at:
http://www.ehs.msu.edu/chemical/programs_guidelines/chem_hygiene/chem_hygiene_plan/chp_full.pdf
and is available on our group website.

Signature of Person Giving Site-Specific Training_____

Printed Name of Person Giving Training_____

Date of Site-Specific Training _____

I have completed and understand all of the above site-specific and online training on the date provided. I also have access to the Chemical Hygiene Plan and MSDS forms.

Signature of Person Receiving Training_____

Printed Name of Person Receiving Training_____

Date_____

Borhan Research Labs
Standard Operating Procedure for:
Handling Reactive and Toxic Compounds

Sometimes in the course of our research it is necessary to handle extremely reactive and/or toxic compounds. Some general comments are made concerning the handling and disposal of such compounds in this SOP. If there are any questions concerning the use or disposal of any compound, procedure for carrying out a reaction, or other possible operation in the laboratory, you should consult with the research director prior to attempting the operation. At all times, chemical resistant gloves, goggles or safety glasses, and a fire-resistant lab coat will be worn when working in the laboratory.

Reactive Compounds

The ideal place to do any experiment involving particularly reactive compounds (e.g., metal alkyls, metal hydrides, alkali metals, powdered metals, pyrophoric compounds, etc.) is in a properly working dry box.

It is lab policy that all reactions involving alkyllithium reagents, P_4, metal hydrides, zinc alkyls, sodium alkyls, potassium alkyls, pyrophoric phosphines, potassium metal, and other highly reactive or pyrophoric compounds will be done in a properly working glove box. If you are considering a reaction that for some reason involves one of these compounds that must be done outside of the glove box, special permission must be obtained from the research director prior to running the reaction.

A few types of compounds will never be used in the laboratory. Perchlorates should never be brought in the lab for any reason. “Piranha solution” should never be prepared or used in our lab.

Alkyl peroxides should only be used after obtaining special permission from the research director and after studying the procedure for the safe destruction of alkyl peroxides in the lab handbook. Other potentially reactive and explosive compounds (including but not limited to alkyl azides, nitro organics, azo organics, halogenated nitrogen groups, fulminates, chlorates, perchlorates, and copper acetylides) should never be prepared without the consent of the research director and only on approved scales. All handling of these compounds should occur behind a blast shield, behind a hood sash, or in a glove box.

Aqua regia can be generated on small scales (<20 mL) for the cleaning of glassware. It should never be stored in a closed vessel and should be safely neutralized for disposal a few days after being generated. The hood where it is in use should have a sign posted saying that aqua regia is in use.

The research director should be notified before any highly reactive compound is used or generated, especially if the reaction is being carried out for the first time or if the reaction is being carried out on a scale larger than in previous experiments.

Highly Toxic Compounds

On occasion, highly toxic compounds are required for use in our chemistry. One example is thallium compounds, which are quite toxic on contact, inhalation, and ingestion. Thallium compounds should only be used in the glove box. The waste from any thallium reaction (glassware used, kimwipes, etc.) should be kept separate from other waste in plastic sealable containers (e.g., “Ziploc” bags). The sealed container is then removed from the box while wearing appropriate gloves and placed in the thallium solid waste container.

Some highly toxic compounds should never be generated, used, or brought into the laboratory under any circumstances, such as mercury alkyls, any beryllium compound, and hydrogen cyanide.

Before using or generating any toxic compound (e.g., phosgene, chlorine, fluorine), inform the research director and only carry out the reaction on approved scales using approved procedures.

I have read and understand the material in this standard operating procedure for the handling of reactive and toxic compounds. If I am using a particularly reactive compound or a particularly hazardous compound for the first time or on scales larger than I have previously, I will discuss the procedure with the research director prior to the experiment.

Signature _____

Printed Name_____

Date_____

Borhan Research Labs
Standard Operating Procedure for:
Disposal of Reactive and Pyrophoric Chemicals

A large number of the compounds that we use in our lab are extremely sensitive and reactive to moisture and oxygen, which are primarily stored in the dry box for this very reason. On occasion one may need to dispose of one of these types of compounds. If one needs to neutralize some highly reactive compound, such as Na metal, NaH, n-butyl lithium, etc., it should be done with care and following protocol.

Ideally, the compound will be loaded in a flask for neutralization in a dry box. If there are small samples of potentially reactive compounds that need to be disposed of, it is often adequate to combine similar compounds into one flask for destruction. This process should also be done in a dry box under nitrogen and should be done cautiously to insure no unexpected reactions occur. If the flask becomes warm at any time during this process, cool in a liquid nitrogen cooled cold well before proceeding with the addition.

If the compound is dry, e.g. Na or NaH, a high boiling, aprotic solvent should be added to dilute the killing agent. In addition, if the material to be killed is quite concentrated, it may be a good idea to dilute before beginning the quench. A good choice for the dilution is a high boiling and unreactive solvent, e.g., toluene. Ideally, the solution will be magnetically or mechanically stirred during the neutralization process.

Any neutralization should be done under a flow of nitrogen in a fume hood to prevent any side reaction with oxygen or moisture in the air. In cases where a very large amount of compound is being disposed of, the flask should be cooled with an ice water bath from the beginning. If the reaction becomes warm at any time, the flask should be placed in an ice water bath.

At all times, chemical resistant gloves, goggles or safety glasses, and a fire-resistant lab coat will be worn.

An example of a setup is shown below. Obviously, the size of the container will depend on the amount of material to be neutralized. A securely clamped round bottom flask could also be used. Be certain that your flask is large enough to accommodate what you are disposing of and the reagent you will be adding. The sum total of solution that you expect to have in the end will preferably be only about half your container size.

The nitrogen flow should be on a bubbler. Many of the common reagents disposed of such as Na, NaH, butyllithium, methyllithium, etc., generate a gaseous by-product. In addition, the quenching process is inherently exothermic. If the flask is not vented through a bubbler pressure can build during the additions.

All possible fuel sources in the hood (every solvent) should be under a nitrogen atmosphere. The killing agent, e.g., isopropanol, is best kept in a syringe for easy addition to the compound being disposed of. In addition, the syringe will keep the vapors of the killing agent contained. There should be no waste containers, solvent bottles, reagent bottles, etc in the hood where compounds are being disposed of. The bottle for the killing agent should never be in the hood. The syringe can be refilled in a different hood.

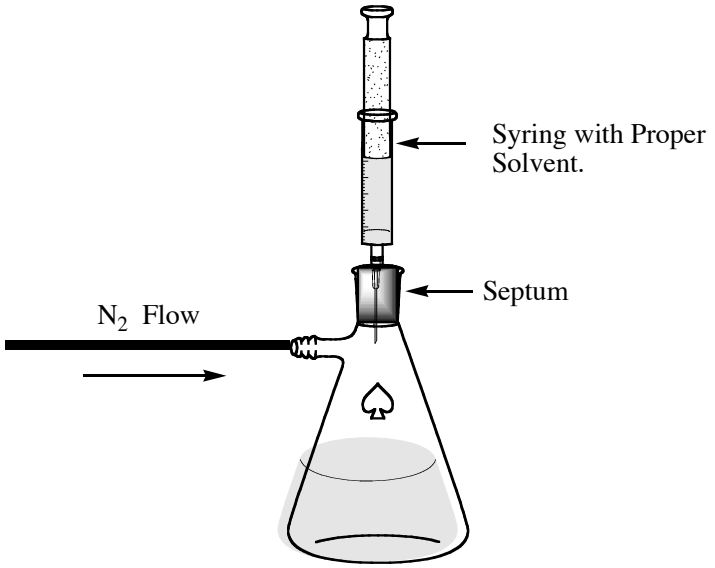
Caps, septa, etc. from the compound being neutralized may have pyrophoric material on them. They should be placed in a metal container and handled cautiously until they are known to be safe for disposal.

The proper way of neutralizing a compound is to start with small portions of isopropanol. After a portion is added, wait for reaction to cease if there is a clear indication of reaction. This is easily done

when volatile components are generated like when quenching $LiBu^n$. In other cases, it may be advantageous to alter the set up with a thermometer so that a rise in temperature can be observed. This is readily done by putting a hole in a septum with a pair of scissors to insert the thermometer; the syringe may then be put in the same septum.

Once the compound seems to be neutralized with isopropanol, this is followed by adding ethanol, methanol, and lastly water using the same protocol. It is a good idea to swirl the solution around, especially when dealing with solids like Na or K metal to make sure no oxides are covering an unreacted metal. After adding water and it doesn't react, you can dispose of the solution in a waste container.

If there are any questions concerning the procedure, they should be asked to the research director or to senior research personnel prior to starting the neutralization. If you are disposing of potentially hazardous compounds for the first time, notify the research director so that hands on training can be done.



125 mL Erlenmeyer
Filter Flask

Example set up: The flask should be stirred magnetically, tightly clamped in a hood, and the nitrogen flow should be on a bubbler. See the text for the full description.

I have read and understand the material in this standard operating procedure for the neutralization of reactive compounds.

Signature _____

Printed Name_____

Date_____

Borhan Research Labs
Biological/Biochemical Safety Training Agreement

In addition to what covered in the Chemical Safety Training Agreement, the following training courses are required prior to working in the laboratory for people involved in Biological / Biochemical projects:

• (BST) Biological Safety
• (BPI) Bloodborne Pathogen
• (MWT) Medical Waste
• (RDR) Radiation Safety

These training courses are available at: http://www.orcbs.msu.edu/training/training_toc.htm

In addition, site-specific training is required for general safety considerations.

This will cover:

____Equipment location and use
____Biological Spill kit locations
____Read and signed SOP for Biohazardous Waste
____Read and signed Site Specific Training Form

• MSDS forms are available on the EHS website: http://www.orcbs.msu.edu

Signature of Person Giving Site-Specific Training_____

Printed Name of Person Giving Training_____

Date of Site-Specific Training _____

I have completed and understand all of the above site-specific and online training on the date provided. I also have access to the Chemical Hygiene Plan and MSDS forms.

Signature of Person Receiving Training_____

Printed Name of Person Receiving Training_____

Date_____

Borhan Research Labs
Biological/Biochemical
Standard Operating Procedures

The Borhan Labs' Standard Operating Procedures for handling biomaterials, including bacterial strains and human cell lines and their waste, are included in:

i. Biological Safety Manual (available at: http://www.ehs.msu.edu/biological/programs_guidelines/biosafety_manual/Biosafety_Manual.pdf, also available on the group's website).

ii. Bloodborne Pathogens Exposure Control Plan (available at: http://www.ehs.msu.edu/biological/programs_guidelines/exposure_control_plan/ECP.pdf, also available on the group's website).

iii. Biohazardous Waste Management Plan (available at: http://www.ehs.msu.edu/biological/training/bio_waste_brochure.pdf, also available on the group's website).

You should review the above documents and familiarize yourself with the SOPs. If you are not sure about any procedure, seek advice from a senior lab member who is working on a similar topic.

I have read and understand the material in this standard operating procedure for the neutralization of reactive compounds.

Signature _____

Printed Name_____

Date_____

Borhan Research Labs
Standard Operating Procedure for:
BIOHAZARDOUS WASTE

Employees: In accordance with the Michigan Medical Waste Regulatory Act, all MSU employees who handle biohazardous waste must be trained in the proper segregation, storage, treatment and disposal of such waste. To comply with these training requirements, you must:

a. Review the general information provided in the EHS brochure (Biohazardous Waste Management Plan (available at:
http://www.ehs.msu.edu/biological/training/bio_waste_brochure.pdf, also available on the group's website).
b. Complete site-specific training with your supervisor or lab manager as outlined below.

Supervisors: It is your responsibility to assure that employees have received training regarding proper segregation, storage, treatment and disposal of biohazardous waste, and that employees comply with the practices outlined in this document and the Biohazardous Waste Management Plan. To assist you in this task, please review the following site-specific information with affected employees, checking each item as it is reviewed. Once training is completed, fill out the information at the bottom of this form with the employee

Site-Specific Practices

_____ Discussion and clarification of which wastes generated in the work area are biohazardous and how those items are to be segregated, stored, transported, treated and disposed of

_____ Review of procedures for on-site waste treatment methods (i.e. proper use of autoclave for waste decon- tamination purposes)

_____ Review of hazardous waste labeling and Pick-Up procedures as they apply to the work area (refer to the MSU Waste Disposal Guide and Biohazardous Waste Management Plan)

__ _____

Employee Name: Supervisor's Name: Department:

_____ Date of Training: _____
_____ Date of Birth: _____
_____

VERIFICATION OF TRAINING

I certify that the information in the ORCBS biohazardous waste brochure has been reviewed. In addition, site-specific training items were reviewed and understood as required by the MSU Biohazardous Waste Management Plan.

_____ _____

Supervisor/Trainer Signature - Date Employee Signature - Date

Borhan Research Labs
Standard Operating Procedure for:
Site Specific Training

	Required for:			
Required on-site training	**Chemical**	**Biological**	**Bloodborne**	**Complete**
Location and Review of Safety Protocol Guides				
Emergency Contacts	X	X	X	
Chemical Hygiene Plan	X	X	X	
MSDS	X	X	X	
Hazardous Waste Guide	X	X	X	
Standard Operating Procedures (task specific)	X	X	X	
Emergency Response Procedures	X	X	X	
Biological Safety Manual		X	X	
Biohazardous Waste Plan		X	X	
Exposure Incident Response Procedure		X	X	
Exposure Control Plan			X	
Source Protocol			X	
Inventory, Storage, Labeling, and Proper Use of:				
Chemical Storage	X	X	X	
Hazardous Chemicals	X	X	X	
Biohazardous Materials		X	X	
Location, Proper Use, and Maintenance of:				
Personal Protective Equipment	X	X	X	
Emergency Eyewash/Shower	X	X	X	
Fume Hood	X	X	X	
Compressed Gasses	X	X	X	
Chemical Spill Kit	X	X	X	
Biological Spill Kit		X	X	
Biosafety Cabinet		X	X	
Laminar Flow Hood		X	X	
Autoclaves		X	X	
Disinfectants		X	X	
Safer Sharps			X	
Waste Segregation, Storage, Transport, and Treatment				
Sharps Waste	X	X	X	
Glass Waste	X	X	X	
Solid Waste	X	X	X	
Liquid Waste	X	X	X	
Waste Tags	X	X	X	
90 day Disposal	X	X	X	
Transport	X	X	X	
Treatment		X	X	
Security				
Laboratory Security	X	X	X	
Inventory	X	X	X	

Emergency Contacts - Same as posted on door signs
Chemical Hygiene Plan - Online or hard copy in lab and present upon inspection
MSDS - know location and present upon inspection
Hazardous Waste Guide - Online or hard copy in lab and present upon inspection
Standard Operating Procedures - Online or hard copy in lab and present upon inspection
Emergency Response Procedures - Post in prominent place in lab or near phone
Biological Safety Manual - Hard copy in lab and present upon inspection
Biohazardous Waste Plan - Hard copy in lab and present upon inspection
Exposure Incident Response Procedure - Post in prominent place
Exposure Control Plan - Hard copy in lab and present upon inspection
Source Protocol - Hard copy in lab and present upon inspection
Chemical Storage - Know what types are stored where and how to label
Hazardous Chemicals - Know what types are stored where and how to label
Biohazardous Materials - Know what types are stored where and how to label
Personnel Protective Equipment - know what types, when to use, and how to maintain them
Emergency Eyewash/Shower - Know location and maintenance
Fume Hood - Know when and how to use
Compressed Gasses - Know how and when to use
Chemical Spill Kit - Location and maintenance
Biological Spill Kit - Location and maintenance
Biosafety Cabinet/Laminar Flow Hood - Location, use and maintenance including certification
Autoclaves - Location, use and maintenance including certification
Disinfectants - Location, use, concentration, MSDS, expiration and disposal
Safer Sharps - Use, annual review, and evaluation
Sharps/Glass/Solid/Liquid Waste - Location, labeling, use and disposal of container
Waste Tags - Use
90 day Disposal - which wastes fall under this law
Transport - secondary container use
Treatment - how to treat each type of waste
Laboratory Security - Aware of security plan for MSU, department policies, and lab policy
Inventory - Online or hard copy of hazardous/biohazardous material, present upon inspection

_____
(Print Employee's/Student Name)

_____
(Manager/Precept/Trainer signature - Date) (Faculty/Student/Employee Signature - Date)

I certify that the site-specific training items were reviewed and understood as required by the MSU EHS.
(This must be completed and signed at each facility the student or employee is working in)

Laboratory Specific
Standard Operating Procedures

Michigan State University Office of Radiation, Chemical & Biological Safety C124 Research Complex - Engineering East Lansing, MI 48824-1326

Date:	08-16-2013
Principal Investigator:	Babak Borhan
Room & Building:	578 S Shaw Lane Room 524
Phone Number:	X 133

Section 1:

☐ Process	☑ Hazardous Chemical	☐ Hazard Class

Section 2: Describe Process, Hazardous Chemical or Hazard Class.

Perchloric acid

Section 3: Potential Hazards.

Acute exposure effects include corrosivity to the skin and mucous membranes. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pains, and bronchitis. Repeated dermal exposure may cause sensitization dermatitis and destruction and/or ulceration of the skin. Additionally, perchloric acid mist and vapor can condense in ventilation systems to form metallic perchlorates, which can be explosive.

Section 4: Personal Protective Equipment.

To prevent injury, goggles or face shield, gloves, and lab coat must be worn when handling perchloric acid.

Section 5: Engineering Controls.

The solvent is stored in a designated perchloric acid area. The area is posted with a warning label stating "Perchloric Acid Use Only. Organic Chemical Prohibited."

All work being conducted with perchloric acid less than 72% should be conducted in a chemical fume hood. Work requiring heating of perchloric acid or concentrations exceeding 72% must be conducted in specifically designed perchloric acid hood that is equipped with a wash down system.

Eye wash and emergency shower must be in the immediate work area when handling perchloric acid.

Section 6: Special Handling and Storage Requirements.

Perchloric acid should be stored segregated from all other chemicals and inside secondary containment (such as a pyrex baking dish or plastic dish pan). It must not be stored near organic acids such as acetic acid, near bases, or near other organic or flammable material.

Use of heated Perchloric acid requires a special perchloric acid fume hood with a wash down function. When handling perchloric acid, always add acid to water, not the reverse.

Section 7: Spill and Accident Procedures.

Laboratory personnel must wear appropriate PPE prior to attempting to manage any spills involving perchloric acid.

Small spills of perchloric acid should be neutralized by applying sodium bicarbonate, sand, or dry lime. Place material in a closed container for disposal through Chemical Safety.

For larger spills of perchloric acid, contact MSU EHS at 355-0153. Note: Organic materials (bench paper, paper towels, etc.) are never to be used for decontamination of a perchloric acid spill.

Section 8: Decontamination Procedures.

Laboratory personnel must wear appropriate PPE prior to attempting to manage any spills involving perchloric acid.

Small spills of perchloric acid should be neutralized by applying sodium bicarbonate, sand, or dry lime. Place material in a closed container for disposal through Chemical Safety.

For larger spills of perchloric acid, contact MSU EHS at 355-0153. Note: Organic materials (bench paper, paper towels, etc.) are never to be used for decontamination of a perchloric acid spill.

Section 9: Waste Disposal Procedures.

Perchloric acid waste must not be mixed with any other waste. It should be pu tinto acid-resistant botles (preferably the orginigal acid container), clearly labeled, and treated as hazardous chemical waste.

All perchloric acid should be disposed of through MSU EHS Hazardous Waste Professionals at 355-0153.

Section 10: Material Safety Data Sheet Locations.

www.sigmaaldrich.com

Section 11: Protocol(s):

• Consider alternate methods and use a less dangerous acid if possible.

• Lab-specific written procedures are required (including concentration and volume, heated process requirements, etc.) and must be approved in advance by the Principal Investigator (signature required at top of customized SOP).

• Purchase perchloric in the smallest amounts practicable. Purchase in shatter-resistant containers if available (such as PVC-coated glass).

• Make sure that flammable and/or organic materials are not located in the work area.

• Hot concentrated solutions are extremely dangerous – heated perchloric acid acts as a strong oxidizing agent.

• Once work with perchloric acid is complete, decontaminate the area by wiping it down with a 10% sodium carbonate solution.