Standard Operating Procedure for Laboratory Processes

A Standard Operating Procedure (SOP) is a written set of instructions that document how to safely perform work involving hazardous materials or hazardous operations. An SOP should be written for all procedures that pose an identified potential risk to the health and safety of the laboratory personnel. Print out the completed form and keep a readily accessible hard copy in the lab (also keeping an electronic copy is highly recommended).

NOTE: For all procedures utilizing energetic, highly hazardous or toxic, pyrophoric, air/water reactive, or novel research materials or methods, multiple sources must be consulted and noted for information about potential hazards/toxicity other than the SDS and published procedures. Examples: Bretherick's , ToxNet's Hazardous Substance Data Bank, etc.

Chemical Name or Process: Handling of liquid nitrogen

Cryogenic fluids are liquids that exist at a very low temperature (below −150 °C). Common examples of cryogenic liquids are liquid nitrogen and helium. These fluids are used as coolants for various instruments and experiments.

Purpose: This standard operating procedure (SOP) is intended to provide general guidance on how to safely work with liquid nitrogen.

Potential Hazards/Toxicity:

Nitrogen and Helium are not toxic, but are simple asphyxiates.
Cryogenic fluids are materials with extremely low boiling points (i.e., less than – 150 °F). At these temperatures, tissue burns may be sustained after contact with the fluids, surfaces cooled by the fluids, or by evolving gases. The hazard is comparable to that of handling boiling water.
One special property of cryogenic liquids is that they undergo substantial volume expansion when converted to a gas phase, which can potentially lead to an oxygen deficient atmosphere where ventilation is limited.

Engineering Controls:

Use cryogenic fluids only in well-ventilated areas. Unconsciousness occurs without warning in an oxygen deficient atmosphere.

Neither nitrogen nor helium gas is toxic, but if too much oxygen is displaced by these gases, the danger of asphyxiation is very real! These gases expand their volumes by a factor of ~700 when they are evaporated and allowed to warm up to room temperature.

Personal Protective Equipment (PPE)-

Hand Protection:
Wear thermally protective gloves when working with cryogenic liquids. Gloves must be inspected prior to use.

NOTE: Consult with your preferred glove manufacturer, the (M)SDS and other sources to ensure that the gloves you plan on using are compatible with chemical(s) being used.

Refer to glove selection chart from the links below:
http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf
OR
http://www.allsafetyproducts.biz/page/74172
OR
http://www.showabestglove.com/site/default.aspx
OR
http://www.mapaglove.com/

Eye Protection :
Safety glasses or chemical splash goggles, as directed by advisor/P.I. Goggles are required whenever there is a potential for a hazardous liquid splash, as per the Chemical Hygiene Plan Sec 3.1.b

Skin and Body Protection:
Long pants, lab coat, and closed toed shoes should be worn when working with cryogenic fluids. Never allow any unprotected part of the body to touch non insulated pipes or vessels which contain cryogenic fluids. The extremely cold metal will cause the flesh to stick fast and tear when one attempts to withdraw from it. Frostbite is likely to occur.

Hygiene Measures:
Wash hands after working with the hazardous substances and when leaving the lab/shop.

Respirators may be required under any of the following circumstances:

- As a last line of defense (i.e., after engineering and administrative controls have been exhausted).
- When Permissible Exposure Limit (PEL) will or may be exceeded, or the airborne concentration is unknown.
- Regulations require the use of a respirator.
- There is potential for harmful exposure due to an atmospheric contaminant (in the absence of PEL)
- As PPE in the event of a chemical spill clean-up process

Prior to obtaining a respirator, an exposure assessment of the process or procedure must be conducted. If respiratory protection is required, then lab personnel must obtain respiratory protection training, a medical evaluation, and a respirator fit test through EH&S. This is a regulatory requirement.

First Aid Procedures for Chemical Exposures

If inhaled:
Persons suffering from lack of oxygen should be moved to fresh air. If victim is not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Get medical attention immediately.

In case of skin contact:
Remove any clothing that may restrict circulation to frozen area. Do not rub frozen parts as tissue damage may result. As soon as practical, place the affected area in a warm water bath which has a temperature not to exceed 105°F (40°C). Never use dry heat. Call a physician as soon as possible

In case of eye contact:
Flush the eyes with cool or warm water for fifteen minutes (do not use hot or cold water). Get medical attention immediately.

Special Handling and Storage Requirements

Liquid nitrogen is under pressure. Store and transport cryogenic fluids only in Dewars or cryogenic liquid cylinders designed for that particular cryogen. Cryogenic liquid dewars are to be stored in well-ventilated areas with the pressure relief valve in the opened position. Dispense of cryogenics in a well-ventilated area.

Spill and Accident Procedure

Chemical Spill Dial 911 and 756-6661

Spill – Assess the extent of danger. Evacuate the spill area. Help contaminated or injured persons. . Avoid breathing vapors. If safe, confine the spill to a small area. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Small (<1 L) – If you have training, you may assist in the clean-up effort. Small amounts of liquid nitrogen will evaporate quickly. Open doors, windows and let fresh air into the room. Use appropriate personal protective equipment and wait for complete evaporation.

Large (>1 L) – Evacuate spill area. Dial **911** and EH&S at 756-6661 for assistance. Remain available in a safe, nearby location for emergency personnel.

Medical Emergency Dial 911 or 756-6661

Life Threatening Emergency, After Hours, Weekends And Holidays – Dial 911
Note: All serious injuries must be reported to Supervisor/PI within 8 hours. Note: Any and all loss of consciousness requires a 911 call

Non-Life Threatening Emergency –

- Students: Seek medical attention at the campus Health Center M, T, Thu, Fr 8:00 am – 4:30 pm and W 9:00 am – 4:30 pm
- Emergency Medical services in the community are available at any time at hospital emergency rooms and some emergency care facilities.

All injuries must be reported to PI/Supervisor immediately and follow campus injury reporting. Follow procedures for reporting of student, visitor injury on the EH&S website at:
http://afd.calpoly.edu/riskmgmt/incidentreporting.asp

- Paid staff, students, faculty: seek initial medical attention for all non-life threatening injuries at:
  - MED STOP, 283 Madonna Road, Suite B (next to See's Candy in Madonna Plaza)
    (805) 549-8880 Hours: M-F 8a - 8p; Sat/Sun 8a - 4p
  - **After MED Stop Hours:** Sierra Vista Hospital Emergency Room
    1010 Murray Avenue (805) 546-7651, Open 24 hours

All injuries must be reported to PI/Supervisor immediately and follow campus injury reporting for employee injuries (Workmen's Comp.). Follow procedures on the EH&S website at:
http://afd.calpoly.edu/riskmgmt/incidentreporting.asp

Decontamination/Waste Disposal Procedure

For contact and inhalation exposure, see First Aid Measures above. Return container and unused product to supplier. Do not attempt to dispose of unused product.

Safety Data Sheet (SDS) Location

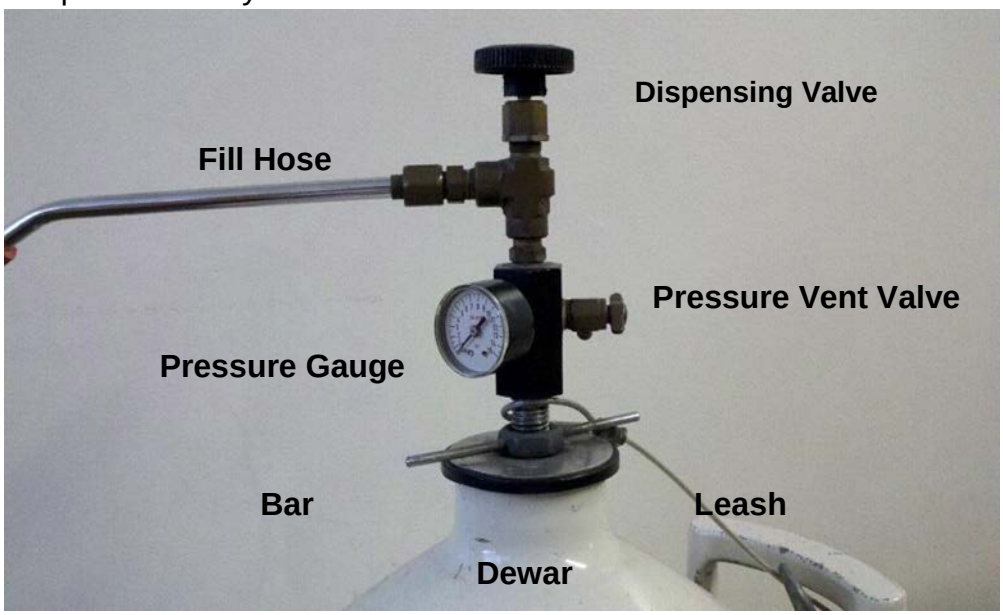
Online SDS can be accessed at: http://siri.org/msds/index.php
or MSDSOnline at: http://hq.msdsonline.com/csuedusl/Search/Default.aspx

Protocol/Procedure:

1. Dispensing liquid nitrogen from 160 liter tank or big tank into individual dewars.
   a. Dispense in an area with adequate ventilation.
   b. Fill hose and diffuser must be connected to the port labeled "liquid" on the big tank. Do not connect to the port labeled "vent".
   c. Place receiving dewar in a secure location.
   d. Open valve for the liquid port on big tank. Wear thermal gloves while holding the fill hose to direct liquid into dewar.
   e. Contents of the big tank are under pressure. Open valve slowing at first while holding the fill hose.
   f. Close valve on the big tank completely when small dewar is full.
   g. Use only a loose fitting lid to cover the small dewar otherwise pressure will build inside the container.
2. Dispensing liquid nitrogen from big tank into smaller pressurized dewars.
   a. Open the door to the loading dock to provide adequate ventilation.
   b. Vent all pressure from the small dewar by opening the pressure vent valve and/or opening the dispensing valve on the dewar's top assembly.
   c. Pressure gauge will read zero when all pressure is relieved.
   d. With the leash still secured, turn the bar counter clockwise to releases the top assembly from the dewar.

e. Once the top assembly is disengaged from the top of the dewar, the leash can be removed.
f. Set top assembly aside. Top assembly may be cold. Use thermal glove if necessary.
g. Fill hose and diffuser must be connected to the port labeled “liquid” on the big tank. Do not connect to the port labeled “vent”.
h. Place receiving dewar in a secure location.
i. Open valve for the liquid port on big tank. Wear thermal gloves while holding the fill hose to direct liquid into dewar.
j. Contents of the big tank are under pressure. Open valve slowing at first while holding the fill hose.
k. Close valve on the big tank completely when small dewar is full.
l. Place top assembly in dewar and secure the leash before proceeding.
m. Hold the top assembly securely in place while turning the bar in clockwise direction.
n. Be sure top assembly is secure. Reposition and retighten if necessary.
o. Close pressure vent valve and/or dispensing valve.
p. It will take 20 to 30 minutes for the pressure to build up enough for the small dewar to dispense.

Top Assembly of Small Pressurized Dewar



3. Handling of cryogenic liquids in dewars for use in laboratory procedure
   a. Always use only dewars designed to hold cryogenic liquids in the laboratory
   b. Do not cap or cover the dewar tightly
   c. Caution must be used when transporting dewars in the lab, wear thermal gloves and avoid spilling
   d. Do not leave openings to cold dewars wide open to the atmosphere for any longer than is absolutely necessary for the manipulations required for transferring liquids. The temperature of liquid nitrogen at atmospheric pressure is -196°C and of liquid helium is -269°C. Air (and its contents) will condense into the dewar and can cause blockages that are potentially dangerous and that will almost certainly interfere with some aspect of the liquid transfer or with the operation of the instrument in the long run. The freezing point of liquid oxygen is -183°C, i.e., above that of these cryogenic fluids. The collection of liquid oxygen into these colder liquids is an explosion hazard!

   e. Do not attempt to dispose of remaining cryogenic liquid. Return unused liquid in a dewar to the stockroom.

Large 160 lb Nitrogen Dewar

NOTE:

Any deviation from this SOP requires approval from PI.

Date: **P.I. or Supervisor:**

Documentation of Training (signature of all users is required)

- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year.
- Training must be administered by PI or Lab Manager to all personnel in lab prior to start of work with particularly hazardous substance or newly synthetic chemical listed in the SOP.
- Refresher training will need to be provided when there is a change to the work procedure, an accident occurs, or repeat non-compliance.

I have read and understand the content, requirements, and responsibilities of this SOP:

Name	Signature	Date