



Chemical Spill Response Guideline

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1. Introduction

A chemical spill is defined as the uncontrolled release of a hazardous chemical, either as a solid, liquid or a gas. Chemical spills at Keck Graduate Institute may occur in a variety of worksites, from research & teaching laboratories, to facilities operations. The challenges related to dealing with chemical spills will vary with the type and volume of chemical involved. Chemical spills in laboratories generally involve small volumes of a potentially large number of chemicals.

Regardless of the type or quantity of hazardous chemical involved, all worksites must implement measures to reduce the potential for spills and have a plan for responding to chemical spills. This document describes generic methods for preventing chemical spills, responding to spills of low or moderate hazard and information on reporting and addressing higher hazard chemical spills at Keck Graduate Institute.

2. Roles and Responsibilities

2.1. Chemical Safety Officer

- Implement measures to prevent potential spills of hazardous materials.
- Develop “site specific” spill response procedures where controlled products are used or stored that present a special risk upon exposure.
- Appoint Chemical Spill Team members; and a Team Captain
- Provide support to the Chemical Spill Team.

2.2. The Worker

Under the OH&S Act, the worker has an obligation to protect their own health and safety and that of other workers present while they are working. The worker is also expected to cooperate with their employer for the purpose of protecting their health and safety and that of other workers. Specifically, these responsibilities include:

- Take all necessary steps to minimize the chance of spills when working with chemicals (see **3. Spill Prevention**).
- Cooperate with their supervisor, the CSO, and the Chemical Spill Team to implement a chemical spill program in their area.

2.3. The Supervisor or Principal Investigator

Supervisors and Principal Investigators when involved in the supervision of staff members, students, post doctoral fellows or others are responsible for performing the duties of the employer specified under the Act as designated representatives of the University. Specifically, these include:

- Ensuring that an adequate number of persons are trained in chemical spill response for their specific area.
- Provide site-specific training for their area.
- Ensuring there is sufficient and appropriate spill response supplies in their area.
- Take all necessary steps to minimize the chance of spills when working with chemicals (see **3. Spill Prevention**).
- Cooperate with the CSO and the Chemical Spill Team to implement a chemical spill program in their area.

2.4. The Chemical Spill Team and Team Captain

- Provide assistance in response to chemical spills. The extent to which the spill team and other personnel respond to chemical spills will vary with policy. The Spill Team Captain will coordinate response and summoning of additional response personnel, and will be available after hours to provide assistance in the event of a spill.
- Provide “site-specific” training to lab members who work with chemicals and will potentially be involved in chemical spill / emergency response situations.
- Regularly inspect labs to ensure that spill kits are available and that supplies are relevant to the chemicals being handled in the area for which the spill kit is designated for use.
- Maintain records regarding inspections conducted, training conducted and spill kit maintenance.

3. Spill Prevention

The first step in chemical spill response is to prevent the spill from happening in the first place. The worksite should be examined to identify measures that can be taken to minimize the risk of a chemical spill occurring. These measures can be identified during regular worksite safety inspections.

Chemical spills occur during five types of activities; storage, transport, transfers, usage and disposal.

3.1. Storage

- Ensure shelving units are sturdy, and not overcrowded with containers. Shelves used for chemical storage should be securely fastened to the wall or floor to provide added stability.
- Ensure chemicals are stored within easy reach of everyone in the lab, and no higher than eye level. Large bottles and containers should be stored as close to floor level as possible.
- Do not store chemical containers directly on the floor where they might be knocked over and broken, unless they are in approved safety cans or still in their original shipping carton and packing.
- Do not store chemical containers on top of flammable storage or acid storage cabinets.
- Minimize the number of chemicals and size of containers stored in the lab. For commonly used chemicals (i.e. acids, solvents), a good rule of thumb is to keep quantities in the lab to either a single bottle or a one-week supply, whichever is less.
- Ensure that lighting and ventilation is adequate in the storage area.
- Regularly inspect chemicals in storage to ensure there are no leaking or deteriorating containers. Some items to note:
 - Keep the outside of containers clean and free of spills and stains.
 - Check that caps and closures are secure and free of deformation. Use only screw caps on chemical containers in storage; foil, Parafilm™, corks or other plugs are not acceptable.
 - Ensure that metal containers are free of rust, bulges or signs of pressure buildup.
- Do not store chemicals in unsuitable containers or containers made of incompatible material (eg: no HF in glass containers).
- Do not store incompatible chemicals together (e.g. acids with bases). Chemicals must be stored by hazard category and not alphabetically (except within a hazard group).
- Purchase solvents in containers with a plastic safety coating.

- Ensure that all gas cylinders are securely fastened and upright.

3.2. Transport

- When transporting large, heavy or a multitude of containers use a cart suitable for the load with high edges or spill trays that will contain any spills or leaks. Two people should be involved when transporting large amounts of chemicals.
- Carry glass containers in bottle carriers or another leak resistant, unbreakable secondary container.
- Use a gas cylinder handcart when transporting large gas cylinders. Ensure cylinder is securely strapped to the cart.
- Comply with the California DOT and Transportation of Dangerous Goods Regulations when transporting hazardous material on public roads. See internet links below for specific regulations.

<http://www.chp.ca.gov/publications/pdf/chp800c.pdf>

<http://www.fmcsa.dot.gov/safety-security/hazmat/complyhmregs.htm#hm>

[DOT's Office of Hazardous Materials Safety](#): (800) 467-4922
For assistance classifying shipments

http://hazmat.dot.gov/rules/98_3971.htm

3.3. Decanting

- When transferring chemicals between containers, pay careful attention to the size of the receiving container to prevent overfilling it.
- When transferring liquids from large containers, use pumps, siphoning (not initiated by mouth) or other mechanical means instead of pouring.
- Use spill containment trays to catch leaks and spills when transferring liquids.
- When transferring flammable liquid from drums, ensure that both the drum and receptacle are grounded and bonded together to avoid an explosion initiated by a static electric spark.

3.4. Handling & Use

- In laboratories, work in a fume hood whenever possible.
- When setting up and working with laboratory apparatus:
 - Inspect laboratory glassware for cracks or defects before using it.
 - Secure flasks and beakers to prevent them from tipping over.
 - Do not stage experiments below heavy objects which might fall on them. Ensure the work area is free of unnecessary clutter.
 - Select equipment that has a reduced potential for breakage (e.g. Pyrex).
 - Replace mercury with alcohol thermometers or other alternate type of temperature measuring device.
- When planning experiments, anticipate possible accidents and provide controls to deal with problems that may occur.

- If you must work alone, ensure the working alone protocol addresses chemical spill response as part of the emergency procedures
- Check gas cylinder valves and gas tubing for leakage before use.
- If possible, keep cylinders of highly toxic or corrosive gases in a fume hood or other ventilated enclosure.
- Ensure you have access and know the location of a suitable chemical spill kit before you start working with chemicals.

3.5. Disposal

- Do not mix incompatible wastes together to avoid uncontrolled chemical reactions.
- Properly identify the contents of all waste containers to avoid inappropriate disposal.
- Leave at least 20% air space in bottles of liquid waste to allow for vapor expansion and to reduce the potential for spills due to overfilling.
- When not in use, keep waste containers securely closed or capped. Do not leave funnels in waste containers.
- Dispose of waste on a regular basis; do not allow excess waste to accumulate in the work area.

4. Spill Response Preparation

Emergency preparedness is an important element of a chemical spill plan. When worksites are prepared for chemical spills, fewer errors are made and there is a reduced risk to persons, property and the environment. The essential elements of spill response preparation are; training, hazard information, proper equipment, and written procedures as described below.

4.1. Training

24 HAZWOPER Training Certification is coordinated by the CSO and supported by KGI administration to interested individuals who wish to serve two years on the KGI Chemical Spill Team. The Designate(s) then use this to support spill response efforts and to assist laboratory specific training to individuals.

This training includes, guidelines for emergency response, review of laboratory specific chemical spill response plan development, instruction in spill cleanup techniques, and review of hazards found in the work area (chemical, physical, biological) which may be of concern during chemical spill response.

4.2. Hazard Information

Information on the chemical hazards present at the worksite must be kept up-to-date and readily available. Sources of information include Material Safety Data Sheets, signs, Chemical Inventory, container labels, posters, and reference books. The worksite supervisor, PI and CSO are responsible for ensuring that this information is readily available to worksite personnel.

4.3. Equipment

The Chemical Spill Team is responsible for ensuring that an adequate supply of spill response equipment is maintained in each laboratory as well as a Master Spill Kit which is located in the autoclave room in building 535 and the small autoclave room in building 517. The equipment required includes; first-aid equipment, personal protective equipment, spill cleanup supplies.

4.4. Procedures

The procedures given in **Section IV (4) of KGI'S Chemical Hygiene Plan** provide general guidance for responding to chemical spills and **Appendix B** of this document includes a flow chart summarizing the actions which will be taken. A copy of this procedure should be made available to personnel at all worksites at KGI.

5. Spill Response Guides

Spill Response Guide No. 1: Flammable Liquids

Flammable liquids have **flash points below 37.8°C**, evaporate quickly, and within a short period of time can reach high vapor concentration. Some common examples of flammable liquids include ethanol, methanol, hexane, diethyl ether, and toluene. Larger spills of flammable liquids may require a response by the fire department if vapor concentration exceeds the lower explosion limit (LEL). **A spill of more than 500 mL is an emergency** that requires area evacuation and notification of the **Safety Manager Jasmine Yu (7-8698) or Facility Supervisor Natalie Barnard (7-0339)**. Spills of less than 500mL can be cleaned-up by local personnel who are adequately trained and have the proper spill response equipment available. If this is the case, proceed as follows:

- 1) If spill absorbent is available in the immediate area, dike around the spill (**see Step 6 below**) if it is safe to do so. This will prevent the spill from spreading further.
- 2) Immediately extinguish any open flames and, and isolate and evacuate the spill area.
- 3) If the area's ventilation system recirculates the air throughout the building, call the **Facility Helpline (7-0144) or Facilities Supervisor Natalie Barnard (7-0339)** to have the ventilation shut down to prevent the spread of vapor throughout the building. In addition, close any open doors to also help prevent the spread of vapors.
- 4) Assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 5) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. **Gloves as recommended by MSDS or glove manufacturer.**
 - b. Splash goggles or face shield.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
 - e. Half mask air-purifying respirator with **organic vapor or combination** cartridges, or as **otherwise recommended by the MSDS or respirator manufacturer.**
- 6) If not already done, dike around the spill using spill absorbent or spill pillows. Do not use paper towels to absorb the spill since this increases the rate of evaporation and vapor concentration of the liquid.
- 7) Carefully cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.

- 8) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 9) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 10) Remove and bag personal protective equipment for cleaning or disposal.
- 11) If the ventilation system has been shut down, contact **Facility Helpline (7-0144)** or **Facilities Supervisor Natalie Barnard (7-0339)** to have it restarted.

Once the spill has been cleaned up, the area should not be reentered until it has been purged of all remaining vapor. In the absence of air monitoring equipment, wait at least **1 hour** before reentering the area.

Spill Response Guide No. 2: Combustible & Other Nonflammable Organic Liquids

Combustible liquids (e.g. mineral spirits) have **flash points above 37.8°C but below 93.3°C** and are not fire hazards at room temperature. The principal hazard from non-flammable, volatile liquid spills is exposure to the vapor by inhalation or skin absorption. **A spill of more than 1 litre is an emergency** that requires area evacuation and notification of the **Facilities Supervisor Natalie Barnard (7-0339)**, or **Safety Manager Jasmine Yu (7-8698)**. Spills of less than 1 litre can be cleaned up by local personnel who are adequately trained and have the proper spill response equipment available. If this is the case, proceed as follows:

- 1) If spill absorbent is available in the immediate area, dike around the spill (**see Step 6 below**) if it is safe to do so. This will prevent the spill from spreading further.
- 2) Immediately extinguish any open flames, and isolate and evacuate the spill area.
- 3) If the area's ventilation system recirculates the air throughout the building, call **Facility Helpline (7-0144)** or **Facilities Supervisor Natalie Barnard (7-0339)** to have the ventilation shut down to prevent the spread of vapor throughout the building. In addition, close any open doors to also help prevent the spread of vapors.
- 4) Assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 5) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. **Gloves as recommended by MSDS or glove manufacturer.**
 - b. Splash goggles or face shield.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
 - e. Half mask air-purifying respirator with **organic vapor or combination** cartridges, or **as otherwise recommended by the MSDS or respirator manufacturer.**
- 6) If not already done, dike around the spill using spill absorbent or spill pillows. Do not use paper towels to absorb the spill since this increases the rate of evaporation and vapor concentration of the liquid.

- 7) Carefully cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.
- 8) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Save for disposal as hazardous waste.
- 9) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 10) Remove and bag personal protective equipment for cleaning or disposal.
- 11) If the ventilation system has been shut down, contact **Facility Helpline (7-0144)** or **Facilities Supervisor Natalie Barnard (7-0339)** to have it restarted.

Once the spill has been cleaned up, the area should not be reentered until it has been purged of all remaining vapor. In the absence of air monitoring equipment, wait at least **1 hour** before reentering the area.

Spill Response Guide No. 3: Acid Spills

The principal concern is the corrosive effect of these substances. Dilute solutions irritate the skin, while concentrated solutions can result in burns and also react violently with water

Hydrofluoric acid can penetrate deeply and damage underlying tissue. **Note that hydrofluoric acid spills require special response procedures. If you work with hydrofluoric acid, you must have a site specific safe work procedure, that includes spill and emergency response procedures.**

A spill of more than 1 litre of liquid or 500g of solid acid is an emergency that requires area evacuation and notification of the **Facility Helpline (7-0144)**, **Facilities Supervisor Natalie Barnard (7-0339)**, or **Safety Manager Jasmine Yu (7-8698)**. **All spills of concentrated hydrofluoric acid are emergencies** and require outside assistance. Spills of less than 1 litre / 500g can be cleaned up by local personnel who are adequately trained and have the proper spill response equipment available. If this is the case, proceed as follows for a **liquid acid spill**:

- 1) If spill absorbent is available in the immediate area, dike around the spill (**see Step 6 below**) if it is safe to do so. This will prevent the spill from spreading further.
- 2) Isolate & evacuate the spill area.
- 3) If the spilled chemical is volatile, and the area's ventilation system recirculates the air throughout the building, call the **Facility Helpline (7-0144)**, **Facilities Supervisor Natalie Barnard (7-0339)**, or **Safety Manager Jasmine Yu (7-8698)** to have the ventilation shut down to prevent the spread of vapor throughout the building. In addition, close any open doors to also help prevent the spread of vapors.
- 4) Assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 5) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer**.
 - b. Splash goggles or face shield.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or TyvekTM coveralls.

- e. Half mask air-purifying respirator with **acid gas or combination** cartridges, or **as otherwise recommended by the MSDS or respirator manufacturer.**
- 6) If not already done, dike around the spill using spill absorbent or spill pillows. Ideally, use spill absorbent that contains a mild neutralizing agent such as sodium carbonate (soda ash)
- 7) Carefully cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.
- 8) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 9) Check the pH of the spill area. If it is less than pH6, then neutralize with a dilute solution of 5% sodium bicarbonate (baking soda).
- 10) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 11) Remove and bag personal protective equipment for cleaning or disposal.
- 12) If the ventilation system has been shut down, contact **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)** to have it restarted.

Once the spill has been cleaned up, the area should be free of any acid fumes or vapors. However, if odors or irritation is still noted, isolate the area and wait at least **1 hour** before reentering.

For a **solid acid spill**:

- 1) Isolate the spill area, and assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 2) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. **Gloves as recommended by MSDS or glove manufacturer.**
 - b. Safety glasses or goggles.
 - c. Lab coat.
 - d. Half mask air-purifying respirator with **N95 or greater protection** particulate filter, or **as otherwise recommended by the MSDS or respirator manufacturer.**
- 3) If necessary, slightly moisten the solid, to minimize dust production. Use water, or if the material is water reactive, another inert liquid (e.g. ethylene glycol).
- 4) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 5) Remaining solid acid residue may be neutralized using a dilute solution of sodium bicarbonate (baking soda). Check the pH of the spill area; the final pH should be between pH 6 and pH 10. Use spill absorbent or spill pillows to absorb the neutralized residue.
- 6) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 7) Remove and bag personal protective equipment for cleaning or disposal.

Spill Response Guide No. 4: Alkali & Base Spills

Like acids, the principal concern is the corrosive effect of these substances. Dilute solutions irritate the skin, while concentrated solutions can result in burns. Concentrated alkali compounds can penetrate deeply and damage underlying tissue.

A spill of more than 1 litre of liquid or 500g of solid alkali or base is an emergency that requires area evacuation and notification of the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Spills of less than 1 litre / 500g can be cleaned up by local personnel who are adequately trained and have the proper spill response equipment available. If this is the case, proceed as follows for a **liquid alkali or base spill**:

- 1) If spill absorbent is available in the immediate area, dike around the spill (**see Step 6 below**) if it is safe to do so. This will prevent the spill from spreading further.
- 2) Isolate and evacuate the spill area.
- 3) If the spilled chemical is volatile, and the area's ventilation system recirculates the air throughout the building, call the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)** to have the ventilation shut down to prevent the spread of vapor throughout the building. In addition, close any open doors to also help prevent the spread of vapors.
- 4) Assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 5) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer**.
 - b. Splash goggles or face shield.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
 - e. Half mask air-purifying respirator with cartridges/filters **as recommended by the MSDS or respirator manufacturer**.
- 6) If not already done, dike around the spill using spill absorbent or spill pillows. Ideally, use spill absorbent that contains a mild neutralizing agent such as sodium carbonate (soda ash)
- 7) Carefully cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.
- 8) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 9) Check the pH of the spill area. If it is greater than pH10, then neutralize with a dilute solution of 5% citric acid.
- 10) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 11) Remove and bag personal protective equipment for cleaning or disposal.

- 12) If the ventilation system has been shut down, contact **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)** to have it restarted.

Once the spill has been cleaned up, the area should be free of any alkali fumes or vapors. However, if odors or irritation is still noted, isolate the area and wait at least **1 hour** before reentering.

For a **solid alkali or base spill**:

- 1) Isolate the spill area, and assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 2) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer.**
 - b. Safety glasses or goggles.
 - c. Lab coat.
 - d. Half mask air-purifying respirator with **N95 or greater protection** particulate filter or **as recommended by the MSDS or respirator manufacturer.**
- 3) If necessary, slightly moisten the solid, to minimize dust production. Use water, or if the material is water reactive, another inert liquid (e.g. ethylene glycol).
- 4) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 5) Remaining solid alkali or base residue may be neutralized using a dilute solution of 5% citric acid. Check the pH of the spill area; the final pH should be between pH 6 and pH 10. Use spill absorbent or spill pillows to absorb the neutralized residue.
- 6) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 7) Remove and bag personal protective equipment for cleaning or disposal.

Spill Response Guide No. 5: Mercury Spills

Elemental mercury and mercury compounds are toxic by inhalation and in some cases, absorption through the skin. Although mercury evaporates slowly, in areas of poor ventilation the vapor concentration will increase over time and become a chronic or acute health hazard.

Spills in excess of 30mL are emergencies that require area evacuation and notification of the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Spills of less than 30mL can be cleaned up by local personnel who are adequately trained and have the proper spill response equipment available. If this is the case, proceed as follows for a mercury spill;

- 1) Isolate and evacuate the spill area.
- 2) Assemble spill team members and the spill response kit outside the spill area.
- 3) Don the appropriate personal protective equipment. Depending on the scale of the spill, this can include:
 - a. Nitrile gloves.

- b. Safety glasses or splash goggles.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
 - e. Half mask air-purifying respirator with **mercury vapor** cartridges.
- 4) Using a razor blade, scrapper or similar tool, gently push small droplets of mercury together and remove them using a hand-held mercury aspirator or disposable pipette. Do not use a household vacuum cleaner since this will disperse mercury vapor throughout the room.
 - 5) Pipette the aspirated mercury into a labeled glass waste container. Shine a flashlight on the surface to identify small mercury droplets that escape into cracks and crevices.
 - 6) Spread a commercial mercury amalgam mix over the contaminated surface after all visible mercury droplets have been removed. Sweep up mercury amalgam using a small brush and dispose of it into a labeled glass waste container. Take care not to break up any mercury droplets. Alternately, wipe the surface using a mercury absorbent cloth (e.g. Mercon wipes) or suppressant and dispose of it into a labeled clear, plastic bag.
 - 7) Send all mercury and contaminated material for disposal as hazardous.
 - 8) Remove and bag personal protective equipment for cleaning or disposal.

Spill Response Guide No. 6: Oxidizer Spills

Oxidizing agents can ignite organic solvents and combustible materials. They are also skin and respiratory irritants. Examples include concentrated hydrogen peroxide, and permanganate, chlorate, nitrate and dichromate compounds. **Spills in excess of 1 litre of liquid or 500 grams of solid oxidizer are emergencies** and require area evacuation and notification of the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Spills of less than 1 litre / 500g can be cleaned up by local personnel who are adequately trained and have the proper spill response equipment available. If this is the case, proceed as follows for a **liquid oxidizer spill**:

- 1) If spill is available in the immediate area, dike around the spill (**see Step 5 below**) if it is safe to do so. This will prevent the spill from spreading further.
- 2) Isolate and evacuate the spill area.
- 3) Assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 4) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer**.
 - b. Splash goggles or face shield.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
 - e. Half mask air-purifying respirator with cartridges and/or filters **as recommended by the MSDS or respirator manufacturer**.
- 5) If not already done, dike around the spill using spill absorbent or spill pillows. Remove or moisten with water any combustible affected by the spill.

- 6) Carefully cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.
- 7) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 8) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 9) Remove and bag personal protective equipment for cleaning or disposal.

For a **solid oxidizer spill:**

- 1) Isolate the spill area, and assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 2) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer.**
 - b. Safety glasses or goggles.
 - c. Lab coat.
 - d. Half mask air-purifying respirator with **N95 or greater protection** particulate filter or **as recommended by the MSDS or respirator manufacturer.**
- 3) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Send them for disposal as hazardous waste.
- 4) If there is still oxidizer residue left in the spill area, neutralize with dilute 5% sodium thiosulfate solution. Use spill absorbent or spill pillows to absorb the neutralized residue.
- 5) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 6) Remove and bag personal protective equipment for cleaning or disposal.

Spill Response Guide No. 7: Highly Toxic Materials Spills

Highly toxic chemicals include those with high acute systemic toxicity, and substances with chronic toxic effects such as carcinogens, reproductive or developmental (embryotoxins, teratogens) toxins, and mutagens. Also included in this category are compounds that can easily produce toxic products. For example, cyanide and sulfide salts produce toxic hydrogen cyanide and hydrogen sulfide, respectively, in the presence of acids. **In general, spills of more than 100mL of liquid or 50g of solid of these substances are emergencies** and require area evacuation and notification of the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Spills of less than 100mL / 50g can be cleaned up by local personnel who are adequately trained and have the proper spill response equipment available. **These chemicals, however, should always be evaluated on an individual basis.** Proceed as follows for a **liquid spill:**

- 1) If spill absorbent is available in the immediate area, dike around the spill (**see Step 5 below**) if it is safe to do so. This will prevent the spill from spreading further.

- 2) If the spilled chemical is volatile, and the area's ventilation system recirculates the air throughout the building, call the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)** to have the ventilation shut down to prevent the spread of vapor throughout the building. In addition, close any open doors to also help prevent the spread of vapors.
- 3) Isolate the spill area and assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 4) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer.**
 - b. Splash goggles or face shield.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
 - e. Half mask air-purifying respirator with cartridges and / or filters **as recommended by the MSDS or respirator manufacturer.**
- 5) If not already done, dike around the spill using spill absorbent or spill pillows
- 6) Cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.
- 7) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 8) Remove any remaining residue using minimal detergent and water. Absorb this wash water using spill absorbent or spill pillows, and dispose of as hazardous waste as in **Step 7 above**.
- 9) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 10) Remove and bag personal protective equipment for cleaning or disposal.
- 11) If the ventilation system has been shut down, contact **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)** to have it restarted.

For a **solid spill:**

- 1) Isolate the spill area, and assemble spill team members and the spill response kit outside the spill area. **Obtain and read the MSDS** for the substance to determine the hazards associated with it and any special precautions that will need to be taken.
- 2) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer.**
 - b. Safety glasses or goggles.
 - c. Lab coat.
 - d. Half mask air-purifying respirator with **N95 or greater protection** particulate filters, or cartridges and/or filters **as recommended by the MSDS or respirator manufacturer.**
- 3) Slightly moisten the solid, to prevent the spread of dust. Use water, or if the material is water reactive, another inert liquid (e.g. ethylene glycol).

- 4) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 5) Remove any remaining residue using minimal detergent and water. Absorb this wash water using spill absorbent or spill pillows, and dispose of as hazardous waste as in **Step 4 above**.
- 6) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 7) Remove and bag personal protective equipment for cleaning or disposal.

Spill Response Guide No. 8: Low Hazard Material Spills

Low hazard materials are those with no appreciable health hazard when encountered in quantities typical for University work sites. These include such solid materials as sodium chloride, calcium chloride, and liquids such as ethylene glycol, oils, and most paints. **In general, all spills of these materials may be cleaned up by local personnel unless there are other mitigating circumstances** that require outside assistance, area evacuation and notification of the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. If this is not the case, proceed as follows for a **liquid spill**:

- 1) If spill absorbent is available in the immediate area, dike around the spill (**see Step 4 below**) if it is safe to do so. This will prevent the spill from spreading further.
- 2) Move outside the spill area. **Obtain and read the MSDS** to confirm that the material is of low hazard and can be cleaned up safely following this procedure.
- 3) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer**.
 - b. Safety Glasses or Splash goggles.
 - c. Shoe covers or rubber boots.
 - d. Lab coat or Tyvek™ coveralls.
- 4) If not already done, dike around the spill using spill absorbent or spill pillows
- 5) Cover the spill area with spill absorbent or spill pillows, starting at the outside and working inward.
- 6) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 7) Remove and bag personal protective equipment for cleaning or disposal.

For a **solid spill**:

- 1) Move outside the spill area. **Obtain and read the MSDS** to confirm that the material is of low hazard and can be cleaned up safely following this procedure.
- 2) Don the appropriate personal protective equipment. Depending on the scale of the spill and properties of the spilled substance, this can include:
 - a. Gloves **as recommended by MSDS or glove manufacturer**.
 - b. Safety glasses or goggles.

- c. Lab coat.
- 3) If necessary, use water to lightly moisten the solid, to minimize the spread of dust.
- 4) Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- 5) Mop the affected area using detergent and water. Dispose of this water to the sanitary sewer.
- 6) Remove and bag personal protective equipment for cleaning or disposal.

Spill Response Guide No. 9: Air & Water Reactive Material Spills

These materials are particularly hazards, since they will rapidly react with water and/or air to produce toxic products, and in many cases are also pyrophoric and may spontaneously ignite in the presence of water and/or air. Typical examples of water and air reactive materials include the alkali metals, metal hydrides and strong reducing agents such as sodium borohydride. **All spills of air & water reactive materials are emergencies** and require area evacuation and notification of **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. If a spill of a **liquid reactive material** occurs;

- 1) Isolate the spill area.
- 2) If an inert spill absorbent such as dry sand or kitty litter is available in the immediate area, dike around the spill if it is safe to do so. This will prevent the spill from spreading further.
- 3) Evacuate the area and, if not already done so, contact the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Meet emergency responders and provide information on the nature, extent and exact location of the spill.

For a **solid spill**:

- 1) Isolate the spill area.
- 2) If an inert spill absorbent such as dry sand or kitty litter is immediately available in the area, immediately smother the spilled material if it is safe to do so. For reactive metals (e.g. sodium, potassium), a Class D fire extinguisher may be used.
- 3) Evacuate the area and, if not already done so, contact the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Meet emergency responders and provide information on the nature, extent and exact location of the spill.

Spill Response Guide No. 10: Compressed Gas Leaks

Compressed gas leaks can be roughly divided into two categories. The first are those leaks which occur away from the cylinder in gas lines, tubing, or apparatus. These, once detected, can generally be stopped by closing the main cylinder valve. The second are those leaks that occur at the cylinder itself, and that cannot be stopped by closing the cylinder valve. Similarly, in some cases, it may not be possible to close a cylinder valve due to age or poor condition of the valve. **All leaking gas cylinders are an emergency**

if the leak cannot be stopped by closing the cylinder valve. Leaks of oxygen, flammable gas, or toxic gas are especially dangerous. The following procedure should be followed:

- 1) If a leak is suspected, perform a leak test with a commercial leak detection solution or a non-reactive, detergent solution. If the leak is detected or is obvious, proceed to **Step 2**.
- 2) If the leak cannot be stopped by closing the cylinder valve, and it is **an inert atmospheric gas** (e.g. nitrogen, carbon dioxide, etc) clear the affected area and/or floor. If the leak is of a **flammable, toxic, or corrosive gas** and is outside of a ventilated enclosure that will contain the gas, immediately activate the building fire alarm system and evacuate the building.
- 3) If not already done so, contact the **Facility Helpline (7-0144), Facilities Supervisor Natalie Barnard (7-0339), or Safety Manager Jasmine Yu (7-8698)**. Meet emergency responders and provide information on the nature, extent and exact location of the leak.

6. Reporting Chemical Spill Incidents

All chemical spills and gas releases must be reported in writing to the CSO. The report should include the date, time, location, description of the spill (e.g. type and quantity), personnel injuries or exposures, equipment damage, escape of material (e.g. into sewers or bodies of water), witnesses, and persons involved in supervision and clean-up of the spill. Use the **Keck Graduate Institute Incident/Near Miss Report Form** (see CSO for the form). The report should be submitted to the CSO within 72 hours of the spill occurring regardless of how minor it might seem. **The purpose of this reporting procedure is not to place blame, but to identify measures that may prevent similar incident.**

Appendix A: Chemical Spill Kits

Spills kits can be assembled from individual parts or suitable spill kits may be purchased from most chemical or safety supply companies. If you do choose to purchase a commercial kit, however, ensure that it contains all the necessary items as listed below. In addition, note that most commercial spill kits and the lists below are generic; it is important that spill kits be tailored to meet the specific spill control needs of each lab, work area, or department.

1) Small Chemical Spill Kit

A small chemical spill kit should be available in each lab or work area that uses chemicals. It can be used for immediate response to most spills, and to clean up small, low hazard spills that may occur and do not require specialized personnel protective equipment or spill control supplies. Although most small spill kit components are common items found throughout the lab, there must be a consolidated spill kit for emergency use. Keck Graduate Institute has placed a small chemical spill kit in each laboratory that works with chemicals. As items are depleted it is the responsibility of each PI to replace the items, the kit will be checked periodically by the CSO to ensure that proper spill kit materials are maintained.

2) Large / Building Chemical Spill Kit

KGI has one large Chemical Spill Kit per buildings 517 and 535. The spill kits contain PPE and spill cleanup supplies to compliment the smaller worksite kits, and as backup supplies for outside responders.

3) Mercury Spill Kit

All areas that work with elemental mercury or mercury containing equipment (e.g. thermometers) must have a mercury spill kit available. The following list includes only those items specific to cleaning up a mercury spill, and must be used in conjunction with other items from a large / departmental spill kit.

- Mercury clean-up supplies (ex: Merconwipes™, Merconvap™, amalgamating powder, etc)
- Mercury aspirator, disposable pipettes & bulbs, or similar equipment.
- Razor blades or scrapers.
- Plastic, zip-lock bags, flashlight and Mercury Vapor Respirator Cartridges



Appendix B: Keck Graduate Institute Chemical Spill Response Flowchart.

