**LABORATORY ORIENTATION**

**Objectives:** To introduce you to NPS science facilities and equipment, including an overview of safety guidelines.

**Procedure:** To be completed before laboratory work begins:

1. Read and sign safety overview. Bring a signed photocopy to class.

2. Review the Chemical Hygiene Plan.

An introduction to lab facilities and equipment will be led by the laboratory manager.

**SAFETY**

Students are expected to be aware of the possible hazards in and around the laboratory. The guidelines below should be followed:

1. General laboratory safety and hygiene will be practiced at all times in the laboratories.

 a. Keep the laboratory area clean: clean-up after you are done. A dirty / messy lab

poses a hazard to everyone.

 b. Use appropriate safety equipment as required:

 i. Face shields

 ii. Eye protection

 iii. Ear protection

 iv. Aprons

 v. Gloves

 c. Exercise good judgment. If you don’t know, ask!

2. Material Safety Data Sheets (MSDS) give information about the hazardous materials in a

given room; they are posted on the doors of each room. It is expected that each student will

read the appropriate MSDS for the materials that will be used, and ask questions about fume hoods, protective equipment, and chemical usage. Copies of MSDS are available upon request from staff members.

3. Know your surroundings! Know the location of the following:

 a. Safety shower and eyewash

 b. First aid kit

 c. Fire extinguisher

 d. Telephone

4. Notify staff member immediately of any:

 a. Potential dangers

 b. Accidents and spills

 c. Injuries (no matter how minor). If you have any questions regarding safety or lab procedures, ask a staff member immediately. (Better to know and be safe, than naïve and be dead or injured.) You are ultimately responsible for your safety as well as your fellow students.

PLEASE COMPLETE THE FOLLOWING:

Having read the safety guidelines above and those contained in the Laboratory Chemical Hygiene Plan, I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (print your name), am fully aware of the safety guidelines of the laboratory I am working in.

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**LABORATORY CHEMICAL HYGIENE PLAN (CHP)**

FOREWORD: The purpose of this document is to provide operating instructions for all personnel involved in laboratory chemical operations to ensure personnel safety, health, and environment protection.

**GENERAL PRINCIPLES FOR WORK WITH LABORATORY CHEMICALS**

1. All practices should be oriented toward minimizing exposure to all chemicals. This should include, but is not limited to:

 a. Plan laboratory sequences to require the least number of chemical handlings and mixings.

 b. Whenever possible, mix and handle chemicals in a fume hood, otherwise, in a well-ventilated, non-confined space with open windows. Never perform chemical operations in a confined space.

 c. As a cardinal rule, direct skin contact with all chemicals should be avoided. Utilize appropriate Personal Protective Equipment (PPE) to include as a minimum gloves and eye goggles.

 d. Mix and handle the least amount of chemicals necessary for the operation to be performed.

 e. Keep containers covered and properly stored when not in use. Containers of mixed chemicals should be covered, but not tightly. If a mixture evolves a gas, pressure will build up in a tightly sealed container, causing it to rupture.

2. Avoid underestimation of risks, even for substances which present no known specific risks. One should always assume that a chemical mixture will be more toxic than its most toxic component, and that all substances of unknown toxicity are toxic.

3. Utilize the maximum available ventilation. Whenever possible, mix and use chemicals mixtures under a fume hood, with the door at or below the opening height which provides 100 fpm air velocity. Always record in the fume hood log book the date, type and quantity of chemicals mixed. If use of a fume hood is not possible, mix and use chemicals in a space with open windows. Never mix or use chemicals in a confined space. Attempt to keep chemicals at the lowest possible temperature, by avoiding direct sunlight and warm surfaces. This will reduce the rate evaporation into the atmosphere.

4. Familiarity with this CHP is an integral and ongoing aspect of the duties of every professor, student, and employee of the Mechanical and Astronautical Engineering Department. The plan is not a periodic or one-time effort. The provisions of this plan apply equally to academic teaching laboratories, individual thesis and research activities, and operational use of chemicals.

5. Under no circumstances will Permissible Exposure Limits (PEL) established by OSHA or Threshold Limit Values (TLV) established by ACGIH be exceeded. If there is any suspicion that PEL or TLV is being approached or exceeded, a request for exposure monitoring will be submitted to the NPS Chemical Hygiene Officer (CHO).

**CHEMICAL HYGIENE RESPONSIBILITIES**

1. Laboratory Manager has responsibility within Department for compliance with NPS CHP.

 a. Ensures subordinate workers receive and comply with training provided by CHO.

 b. Ensures that prescribed PPE is available in working order.

 c. Receives and complies with training provided by CHO.

 d. Ensures that subordinate workers are aware of and comply with CHP requirements and other instructions and policies that govern chemical use.

 e. Conducts periodic inspections of procedures and facilities to ensure compliance with CHP.

 f. Remains aware of current instructions governing chemical usage by reading instructions and policies disseminated by CHO.

 g. Follows recommendations of CHO and Industrial Hygienist in establishing PPE requirements and facility configuration.

2. Research Professor is responsible for compliance with CHP in his/her research laboratory.

 a. Ensures that individual students and research associates are properly educated and motivated in CHP, HAZMAT, safety and health procedures prior to permitting laboratory activities to begin.

 b. Seeks assistance of laboratory technician, or laboratory manager, when uncertain of proper course of action.

 c. Assists students in writing an MSDS for chemical mixture creations.

3. Laboratory Technician is responsible to be knowledgeable of CHP, HAZMAT, safety and health practices as promulgated in the Department.

 a. Orients class laboratory sections on procedures and practices to be followed.

 b. Observes individual practices in laboratories and makes on-the-spot corrections where necessary.

 c. Provides assistance when requested.

 d. Reports instance of willful violations to laboratory manager.

 e. Ensures that PPE and spill materials are available in laboratory spaces.

 f. Maintains a written record of laboratory safety orientations provided.

4. Thesis Student or other Laboratory Worker is responsible for complying with verbal and written instructions, and posted notices in the Lab areas.

 a. Will not undertake any laboratory operations until having read this CHP and been properly trained by Laboratory Technician or Research Professor on specific actions to be conducted.

 b. Seeks assistance from qualified personnel when uncertain of correct course of action.

**THE LABORATORY FACILITY**

1. Laboratories in operate in facilities provided by the Department of the Navy and the Naval Postgraduate School.

2. Facilities will be reviewed for compliance with OSHA, NAVOSH, and other applicable standards by the NPS CHO, Public Works, and BUMED Industrial Hygienist. Chemical handling facilities will be designed such that:

 a. Appropriate general ventilation is designed with air intakes and exhausts located so as to avoid intake of contaminated air.

 b. Storage facilities are properly constructed and ventilated.

 c. Storage facilities will not have open drains to the sanitary sewer.

 d. Chemical handling facilities will have laboratory hood and sinks available.

 e. Available safety-equipment such as eyewashes and drench showers may be prescribed by

competent authority.

 f. Hazardous chemical wastes will be collected and labeled in containers provided by the Department, and turned into the NSA Monterey Environmental Coordinator for disposal.

3. Maintenance:

 a. Facilities will be maintained in a clean and professional manner.

 b. Facilities and equipment will be inspected at intervals prescribed by competent authority to ensure proper functioning of equipment and facilities.

 c. Operations will be suspended in areas with inoperable safety equipment until repairs are affected.

 d. Work conducted in labs will be appropriate to facilities of lab, as approved by the CHO and Industrial Hygienist.

 e. If a substantial change in procedures or chemical usage is planned, it will be checked and cleared with the CHO and IH prior to implementation.

 f. Ventilation system performance will be checked by the Industrial Hygienist.

**COMPONENTS OF THE CHP**

1. Basic rules and procedures are included as a separate section (E).

2. Chemical procurement, distribution, and storage:

 a. Procurement. Prior to initiating an order, local inventories will be checked to ensure that the chemical is not already on hand. Procurement will only be done in coordination with the Department HAZMAT representative, and through the AUL Approval Process, if needed. No container should be accepted which is not in good condition and properly marked with chemical name and manufacturer's name. An MSDS for each chemical will be on hand prior to receiving the chemical.

b. Storerooms. Incompatible materials will be segregated. Storage areas will have sufficient ventilation to prevent accumulation of fumes. Storage will have lock and key security.

 c. Distribution. When chemicals are hand carried, it should be done in an unbreakable bucket. Avoid personnel elevators and congested areas.

 d. Laboratory Storage. Amounts kept in the laboratory should be as small as practicable. A six-month supply should be the maximum. Avoid exposure to heat and sunlight. Avoid storage on open bench tops and other areas subject to bumping. On-hand inventories will be maintained current in all locations at all times.

3. Environmental Monitoring. Environmental monitoring will be conducted at such times as prescribed by competent authority such as the CHO, Industrial Hygienist, or the Monterey Bay Unified Air Pollution Control District.

4. Housekeeping, Maintenance, and Inspections:

 a. Cleaning. Floors should be cleaned regularly and kept free of spills and hazardous conditions at all times.

 b. Inspections. Inspections will be conducted quarterly and records maintained for one year. Informal inspection and correction of deficiencies will be an ongoing and continuous process by all personnel.

 c. Maintenance. Facilities and equipment will be maintained in a safe, functional condition. Inspections of safety equipment such as eyewashes and showers will be performed at intervals prescribed by competent authority.

 d. Passageways. Passageways will not be used to store items. Access to exits, emergency equipment, and control panels must never be blocked.

5. Medical Program:

 a. The CHO, IH, and and Code OOK/OSHE will monitor reported occupational exposure and assist in scheduling employees for occupational health screening through the Presidio in Monterey.

 b. Laboratory Manager will report occupational exposure of employees to CHO.

 c. First Aid. First aid will be provided by the NPS and Monterey Fire Departments. First aid supplies will not be kept or administered in each Department.

6. Personal Protective Equipment (PPE)

 a. Researchers must be trained on the type of PPE effective for the chemicals they work with. The following personal protective equipment will be readily available in or near laboratory areas where chemical operations are performed:

 i. Protective eye goggles

 ii. Protective gloves

 iii. Eyewash and body shower

 iv. Fire extinguisher

 v. Fire alarm

 vi. Telephone

 b. Respirators. Respirators will only be used by individuals properly enrolled in the NPS Respirator Program Process.

7. Records

 a. Accidents will be promptly reported to Code OOK (safety@nps.edu).

 b. Chemical inventory lists will be kept in storage locker and kept continuously current. “Quantity on hand" will be updated at the time of addition or usage. Chemical inventory list will be sent monthly to Code OOK or uploaded to chemical management database.

 c. Records of training, orientation, and instruction given will be emailed to Safety@nps.edu and/or uploaded to the safety management website, and retained for five years.

8. Signs and Labels

 a. An emergency contact phone list will be posted in each laboratory area.

 b. All containers will be labeled to identify contents in accordance with requirements.

 c. Signs depicting location of other safety facilities such as eyewashes, showers, fire extinguishers, and PPE, shall be posted in each laboratory area.

 d. Refrigerators and freezers will be labeled either "FOOD ONLY" or "NO FOOD".

 e. Post any sign necessary to advice of precautions, procedures, or any other special circumstance to be observed.

9. Spills and Accidents

 a. The NSA Monterey/NPS Spill Response Plan Flyer will be posted in areas of chemical usage.

 b. Researchers are only to clean up spills of chemicals they are specifically trained in, and not more than 500 ml.

 b. ALL accidents, incidents and near accident/incidents will be reported and analyzed to determine how to prevent the recurrence of such events.

10. Information and Training

 a. Aim: To ensure that all individuals using laboratory are adequately informed about work procedures, risks, and actions to be taken in the event of an accident.

 b. Personal Protection: Every worker and user of laboratory facilities will be trained to know the location and corrective use of the right type of personal protective equipment.

 c. Safety training orientations shall be given to each class laboratory section prior to the commencement of laboratory operations. The professor will be responsible to ensure that this training is conducted prior to allowing laboratory operations to begin.

 d. Thesis students will receive a safety training orientation on procedures to be accomplished prior to undertaking operations. The professor will be responsible to ensure that this training is conducted prior to allowing research operations to begin.

 e. Frequency of Training: General training will be presented by the CHO and HCM&M at prescribed intervals, to HAZMAT representatives, principal investigators, and leadership.

 f. Literature: The Material Safety Data Sheets (MSDS) for each chemical used will be readily available in the laboratory area. Equipment operating manuals and other relevant information will be available in the laboratory area.

 g. Records of training and orientation will be retained for five year.

11. Waste Disposal Program.

 a. Aim: To ensure that laboratory hazardous wastes create minimal harm to personnel and the environment.

 b. All personnel handling chemicals must be fully familiar with NSA Monterey INST 5090.3 and comply with all aspects of same, by coordinating with their HAZMAT rep.

 c. Excess chemical stocks (uncontaminated) will be identified to Code 00K. Excess chemicals will be kept in the original manufacturer’s container and in the correct segregated storage.

 d. Laboratory chemical wastes will be collected in accordance with NSAMINST 5090.3, labelling and storage requirements must be met.

 e. No chemical stock may be disposed of by any means other than turn-in, without written permission from Code 00K and NSAM ENV Division.

**BASIC STANDARD OPERATING PROCEDURES FOR WORKING WITH CHEMICALS**

1. General Rules. The following rules apply to essentially all laboratory chemical operations:

 a. Accidents and Spills:

 i. Eye Contact: Immediately flush eyes with fresh water for 15 minutes and obtain medical attention.

 ii. Ingestion: Drink large amounts of water and obtain medical attention.

 iii. Skin Contact: Immediately flush the area with water and remove any contaminated clothing. Seek medical attention for any persistent symptoms.

 iv. Clean Up: Promptly clean up spills in accordance with NPS spill clean-up policy. It is expected that most spills will be small in size (500 mL or less) and can be easily contained by immediate use of absorbent material available in the laboratory space. Contaminated absorbent material will be turned in, in accordance with the same procedures as any other hazardous waste. Prior to commencing any liquid chemical operation, each laboratory user must ensure that a container of absorbent material is available in the laboratory. If it is not, the user will request a laboratory worker or the supervisor to provide one.

 b. Avoidance of Routine Exposure. Avoid unnecessary exposure to chemicals by any route. Never smell or taste chemicals. Open and vent containers under a fume hood. Inspect all gloves and PPE prior to use. Do not allow release of toxic substances into hot or cold rooms, which contain re-circulated air, or into confined spaces.

 c. Choice of Chemicals. Use only the minimum amount of chemicals appropriate for experiment and equipment being used.

 d. Eating and Drinking. Avoid eating, drinking, chewing gum or applying cosmetics in areas where chemicals are present. No smoking is permitted inside any building. Food and chemicals will not be jointly stored in any cabinet, refrigerator, or other facility.

 e. Equipment and Glassware. Handle and store glassware carefully to avoid damage. Never use damaged lab equipment. Whenever possible, stopper glassware loosely to avoid the buildup of positive/negative pressures and the possibility of

explosion/implosion. Where this possibility exists, shield the container. Use equipment only for its intended purpose.

 f. Exiting. Wash exposed skin areas when leaving the laboratory.

 g. Horseplay. All types of horseplay and practical jokes, which may startle or distract a person using chemicals, are strictly forbidden.

 h. Mouth Suction. Never use mouth suction to start a siphon.

 i. Personal Apparel. Confine loose clothing and long hair at all times. Solid top shoes should be worn at all times. Sneakers, sandals, and perforated top shoes should not be worn in the laboratory. Lab coats must be worn.

 j. Personal Housekeeping. The work area should be kept orderly and uncluttered at all items. Close containers not in use. Label containers and equipment. Put away equipment at the completion of the operation or at the end of the day.

 k. Personal Protective Equipment. Laboratory coats and Eye protection will be worn by all persons in the laboratory when chemical operations are being conducted. Gloves of the correct protection material will be worn at any time chemicals are being handled. Other PPE will be worn, as specified. PPE will be cleaned and stored after each use. Respirators will only be used in strict compliance with the NPS Respirator Program.

 l. Planning. Prior to undertaking any new or significantly changed operation, a memo of particulars will be submitted to the CHO via the Laboratory Manager to ensure that appropriate safeguards are in place.

 m. Unattended Operations. Student interns may never work unattended. Unattended operations or NPS students should be avoided whenever possible, particularly when overflow, overheating is a possibility. Working with acutely toxic, silane gas areas, or with pyrophoric materials must always be through a buddy system. Leave lights on, with an appropriate sign on the door, and provision for necessary containment.

 n. Use of Hood. Use the hood whenever possible for operations which might result in release of vapors or dust. Always use the hood when working with highly volatile substances, which have a TLV of 50 PPM or less (information available from MSDS). Always work with the hood at the lowest feasible opening height. Minimize storage of materials under the hood.

 o. Vigilance. Every individual should always be alert to unsafe conditions and either correct them immediately or report them to a professor, technician, or the laboratory manager.

 p. Waste Disposal. All waste disposals will be conducted in accordance with NSAM 5090.3, Hazardous Waste Program.

2. Working with Allergens and Reproductive Hazards

 a. Allergens. Always use gloves and avoid skin contact with allergens. Wash exposed skin areas upon completion of work.

 b. Reproductive Toxins. Staffa nd students of childbearing age will not handle or use Reproductive hazard chemicals without prior training through Code 00K, eSAMs, and the IH..

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity (CMCHAT). Example: Hydrofluoric Acid.

 a. Aim: To minimize exposure by any route using all reasonable precautions.

 b. Applicability: These precautions apply to all CMCHAT when used at NPS.

 c. Location: Use and store CMCHAT only under lock and key control. Mix and use only in a properly functioning fume hood.

 d. Personal Protection: Always avoid skin contact by use of gloves and long sleeves. Always wash hand and arms after working with CMCHAT.

 e. Records: Record date, user and amount in fume hood log book.

 f. Prevention of spills and accidents: Be prepared for a spill at all times. Ensure that specialized spill absorbent material is readily at hand prior to commencing operations. Ensure at least two people are present at all times CMCHAT is being used. Use only the minimum amount necessary. Mix and utilize in unbreakable plastic containers whenever possible, on trays or absorbent mats. If a major spill occurs, comply with NPS Emergency Spill Procedures.

 g. Waste: Dispose of waste and contaminated material in strict accordance with NSAM 5090.3

4. Work with Chemicals of High Chronic Toxicity (CHCT)

 a. Identify. Check MSDS for Toxicity Information: Moderately toxic LD50 of 500-5,000 mg/kg; very toxic LD50 of 50-500 mg/kg, extremely toxic LD50 of 5-50mg/kg and supertoxic LD50 <5mg/kg).

 b. Access: All transfers and work with CHCT's will be conducted only in areas of strictly controlled access in either a hood or a glove box. All storage will be under lock and key. Operations with CHCT will not be left unattended.

 c. Approvals: No CHCT will be used until approval is obtained from the CHO, through the chain of command. User will submit location, quantity and frequency of use.

 d. Notify all employees of the particular hazards associated with this work.

 e. Minimize contact with these chemicals by any route of exposure (inhalation, skin contact, mucous membrane contact or injection).

 f. Work only in a properly operating chemical fume hood or glove box.

 g. Decontaminate work surfaces after completing procedures.

 h. Remove all protective clothing before leaving the area and decontaminate it or if disposable, place it in a plastic bag, label and secure it. Call EH&S for disposal.

 i. Wash hands and any exposed skin before exiting the work area.

 j. Establish an emergency plan for procedures involving highly toxic chemicals.

 k.Do not conduct normal laboratory work in the designated area until decontaminated.

**GENERAL SAFETY RECOMMENDATIONS**

The above chemical hygiene procedures are solely oriented toward the prevention of toxic exposure, and

are by no means all-inclusive laboratory safety procedures. Additionally, all other workplace safety

policies are applicable including the following:

 1. Electrical Safety

 2. Back Injury Prevention

 3. Fire Safety

 4. Hearing Conservation

 5. Mishap Investigation and Reporting

 6. Sight Conservation

 7. Machine Guarding

 8. Gas Free Engineering

 9. Machine Sources of Ionization Radiation

**MATERIAL SAFETY DATA SHEETS (MSDS)**

Manufacturer-specific MSDS will be physically available in each area where chemicals are used. Prior

to using any chemicals, laboratory users will read the MSDS for each chemical to be used, paying

particular attention to:

 1. Health Hazard Data

 2. Fire and Explosion Hazard Data

 3. Reactivity Data

 4. Spill or Leak Procedures

 5. Precautions to be taken in Handling and Storage - In circumstances where the laboratory user

creates a unique chemical mixture, the user shall be responsible for creating a MSDS for the

mixture. Blank MSDS formats are available from a Laboratory Technician.

**ONLINE CHEMICAL MANAGEMENT SYSTEM**

Ensure chemical users are trained in the procedures and hazard labelling information provided through the online NPS chemical management system, once this is active.