Portable High-Throughput Integrated Laboratory Identification System (PHILIS-2)

PHILIS Laboratory Safety and Chemical Hygiene Plan

Revision: 1

Reference 29 CFR 1910.1450

Occupational Exposure to Hazardous Chemicals in Laboratories

May 2, 2024

PHILIS

Revision History

Revision	Name	Date	Description of Change
A	Crystal Stitzer	04/02/2021	Development of plan
0	Crystal Stitzer	04/18/2022	Program Issue
1	Crystal Stitzer	02/16/2023	Annual Review

DOCUMENT REVIEW / REVISION FORM

Document Name:	**Safety and Chemical Hygiene Plan**		
Purpose: *(Review or Revise)*	*Document #:*	*Rev. #:* *(Being Reviewed or Revised)*	*Origination / Release Date:*
Annual Review	N/A	0	09/06/2022
Requested by:	Julia Capri	Date:	02/16/2023

New Document Revision Date:	**05/02/2024**	**New Document Revision #:** *(If Applicable)*	**1**

For *Revision*: Summary of Revisions (specify sections)

Attachments	Removed CWA Sample Receipt and Screening Long Form (form archived); subsequent attachments renumbered
Attachments	Replaced Full Service Fume Hood Ventilation Survey Form (form archived) with HS-031 Fume Hood Ventilation Survey Form
Attachments	Removed Bench Top Fume Hood Ventilation Survey Form (form archived); subsequent attachments renumbered
Attachments	Updated all forms to current release
List of Acronyms	Added RSDL Reactive Skin Decontamination Lotion
Whole Document	Minor updates
Section 7.2	Added Fume Hood Ventilation Survey Instructions
Section 5.10 & 13.0	Added wording for clarification that when providing a description of the CWA decon solution waste to a waste transporter, do not label as CWAs. Classify the decon solution waste as "Corrosive Hazardous Waste, D002" if waste is at least 20% aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5. Classify the decon solution waste as "Industrial Waste" if pH is less than 12
Section 12.2	Added, "Scan staff member with the AP4C for clean confirmation prior to them leaving with medical responders"

For *Review*: Comments

Julia Capri
Program Manager Approval — May 2, 2024 Date

Quality Assurance Manager Approval — May 2, 2024 Date

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LIST OF ACRONYMS

µECD	Micro Electron Capture Detector
ACGIH	American Conference of Governmental Industrial Hygienists
AEGL	Acute Exposure Guideline Levels Limit
AM	Agent Manager
ANSI	American National Standards Institute
ASZM-TEDA	Activated Carbon, Impregnated with Copper, Silver, Zinc, Molybdenum, and Triethylenediamine
CAIRA	Chemical Accident/Incident Response and Assistance
CAO	Chemical Agent Operator
CBC	Chemical Biological Center
CBRN	Chemical, Biological, Radiological, Nuclear
CHO	Chemical Hygiene and Health & Safety Officer
CHP	Chemical Hygiene Plan
COC	Chain of Custody
CPR	Cardiopulmonary Resuscitation
CWA	Chemical Warfare Agent
DOT	Department of Transportation
DSHP	Dilute Solution Hygiene Plan
EAP	Emergency Action Plan
EC	Emergency Coordinator
ECD	Electron Capture Detector
ERLN	Emergency Response Laboratory Network
FEMA	Federal Emergency Management Agency
FGA	Fourth Generation Agents (Novichok; A-series)
GC	Gas Chromatography
GHS	Globally Harmonized System
H&S	Health and Safety
HAZCOM	Hazard Communication
HAZWOPER	Hazardous Waste Operations and Emergency Response Standard
HEPA	High-Efficiency Particulate Air
HMIS	Hazardous Materials Identification System
HWSA	Hazardous Waste Storage Area
ICS	Incident Command System
IDLH	Immediately Dangerous to Life and Health
JHA	Job Hazard Assessment
LC	Lead Chemist
LC	Liquid Chromatography
LIMS	Laboratory Information Management System
LLNL	Lawrence Livermore National Laboratory
mCi	Millicuries

MS	Mass Spectrometry
NELAC	National Environmental Laboratory Accreditation Conference
NFPA	National Fire Protection Association
NRC	National Response Center
NRC	Nuclear Regulatory Commission
OSHA	Occupational Health and Safety Administration
PAL	Performance Analytical Laboratory
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PHILIS	Portable High-Throughput Integrated Laboratory Identification System
PM	Program Manager
PPE	Personal Protective Equipment
PPM	Parts Per Million
RSDL	Reactive Skin Decontamination Lotion
SAA	Satellite Accumulation Area
SDS	Safety Data Sheet
SLA	Sample Login Area
SOP	Standard Operating Procedure
SPA	Sample Preparation Area
STEL	Short Term Exposure Limit
TIC	Toxic Industrial Chemicals
TLV	Threshold Limit Values
UD	Ultra-Dilute Concentration
VOC	Volatile Organic Compound

1.0 INTRODUCTION

Portable High Throughput Integrated Laboratory Identification System (PHILIS) units are mobile laboratories designed to provide support for consequence management during an emergency response event of national significance. Analytical support may be provided for site characterization, verification of decontamination procedures, recovery, and clean confirmation activities. Specific analytical capability includes Chemical Warfare Agents (CWAs), Fourth Generation Agents (FGAs), Toxic Industrial Chemicals (TICs), Opioids, and other chemical hazards. The PHILIS program provides on-site laboratory resources capable of meeting data quality objectives that are defendable in a court of law, to support the US Environmental Protection Agency's (EPA's) NELAC accredited Environmental Response Laboratory Network (ERLN) to respond to CWA attacks and other emergency environmental incidents.

The laboratory units are mobile assets for the Emergency Response Laboratory Network (ERLN), and are stationed in Edison, NJ and Castle Rock, CO, to provide nationwide coverage in the event of a terrorist attack. They can be requested to mobilize within 2 hours of notification, as needed to support the EPA Office of Emergency Management (OEM) operations. These units may participate in EPA exercises, interagency exercises, and trans-boundary activities in foreign countries. In addition, they may be deployed to Superfund sites to perform environmental analysis at the request of EPA Regional Offices.

This Chemical Hygiene Plan (CHP) was developed in response to the federal Occupational Health and Safety Administration (OSHA) regulation, Occupational Exposures to Hazardous Chemicals in the Laboratory (29 CFR 1910.1450), commonly referred to as the "Laboratory Standard."

The purpose of the CHP is to provide guidelines to protect laboratory staff working in the PHILIS units located at Castle Rock, CO, and Edison, NJ, from the potential health and physical hazards of the chemicals and hazardous conditions they encounter in laboratory operations. A CHP is defined as a written program which sets forth procedures, equipment, personal protective equipment (PPE), and work practices that can protect employees from the health hazards presented by hazardous chemicals used in laboratory functions. Components of the CHP must include standard operating procedures (SOP) for safety and health, criteria for the implementation of control measures, measures to ensure proper operation of engineering controls, provisions for training and information dissemination, permitting requirements, provisions for medical consultation, designation of responsible personnel, and identification of particularly hazardous substances.

All laboratory personnel must be made aware of the CHP. New employees are required to review the CHP and receive safety training before beginning work with hazardous chemicals. The CHP is always available to all laboratory workers. Additional guidance and background information may be provided by the PHILIS Health & Safety Manager/Chemical Hygiene Officer and/or as referenced.

2.0 SCOPE AND APPLICATION

The PHILIS laboratory functions include a diverse listing of environmental samples requiring analytical (instrumentation) analysis that typically contain low concentrations of hazardous or particularly hazardous materials that may pose a health or safety risk to laboratory personnel. The analytical processes include sample receipt and preparation (e.g., sample extraction), which involve methods that use concentrated hazardous materials (e.g., flammable, toxic solvents) that pose a significant hazard if not used in a safe manner. It is necessary that such hazards be controlled through prudent practices and engineering controls as outlined in the CHP.

The CHP includes elements of OSHA's Hazard Communication Standard (29 CFR 1910.1200), which addresses hazardous chemicals outside of laboratory functions. The CHP is a subset of the PHILIS Health & Safety (H&S) Plan. Both the PHILIS CHP and H&S Plan are prepared in conjunction with the requirements cited in the CSS Corporate Health & Safety Manual, OSHA 29 CFR 1910, and consensus guidelines for laboratory related functions.

The CHP's primary focus is on PHILIS Castle Rock and Edison laboratory operations engaged in conventional environmental samples using approved EPA methods. Example EPA methods are those in the SW-846 series for sample preparation liquid chromatography/mass spectrometry (LC/MS), gas chromatography (GC), electron capture detector (ECD) and GC/MS analysis for water, soil, sediment, and air samples. FID and hydrogen generator safety have been reviewed. The CHP includes additional safety requirements associated with laboratory analysis of environmental samples suspected of containing Chemical Warfare Agents (CWAs), Fourth Generation Agents (FGAs), Toxic Industrial Chemicals (TICs), and other potential hazards.

3.0 ROLES AND RESPONSIBILITIES

3.1 Program Manager

The Program Manager (PM) has overall responsibility for ensuring that all PHILIS work is performed in accordance with all established H&S procedures. Specific responsibilities include:

- Oversight and direction, including enforcement, to ensure compliance with local, state, and federal regulations and policy requirements of the EPA and CSS for the environment and H&S.
- Provides the resources and motivations to allow program staff, the Lead Chemists (LCs), and employees to comply with the CHP and all PHILIS and CSS H&S policies.
- Ensures that all project plans and operations include timely interface with H&S.
- Ensures systems are in place for communicating with the program staff, facility managers, LCs, and all others on their H&S responsibilities.
- Interfaces with EPA project coordinators for providing necessary resources and direction in implementation of the CHP and all other PHILIS environmental and H&S aspects.

3.2 Chemical Hygiene Officer (PHILIS Health & Safety Manager)

The Chemical Hygiene Officer (CHO) is responsible for the H&S of PHILIS laboratory operations, along with designated staff members serving as alternate CHO's for their respective locations. The CHO also serves as the CWA Chemical Agent Hygiene Officer. The CHO is responsible for the following:

- Develops an H&S training plan specific to PHILIS laboratory functions.
- Provides consultation for safe work practices and control measures in laboratory operations.
- Develops and maintains the PHILIS H&S procedures and guidelines.
- Conducts a semi-annual H&S audit of laboratory operations.
- Investigates accidents and chemical exposures.
- Acts as a liaison between CSS, the EPA, and regulatory bodies for laboratory safety issues.
- Maintains records of training, employee concerns, H&S corrective actions, incident reports, exposure monitoring, medical examinations, OSHA Injury/Illness recordkeeping, and all internal and external H&S reviews.
- Conducts a hazard assessment/risk analysis of all new lab operations and chemical agents, and the handling of contaminants prior to their use as documented in the Chemical/Biological Hazard Assessment and Communication Form (ATTACHMENT A) and Hazard Risk Assessment Form (ATTACHMENT B). The hazard assessment/risk analysis ensures that special requirements are followed for Particularly Hazardous Substances.
- Implements the medical surveillance program in accordance with CSS H&S policies and OSHA requirements.
- Reviews and updates the CHP on an annual basis.
- Oversees the dry run/pre-operational review with the LC prior to new or major changes to CWA operations.
- Performs accountability audits of CWA primary standards including security measures.

3.3 Lead Chemist

The Lead Chemist (LC) is responsible for the following:

- Ensures laboratory workers understand how to work with chemicals safely by providing chemical and procedure-specific training in conjunction with the CHP and other training requirements cited by CSS.
- Conducts or assigns a monthly inspection of routine laboratory operations and facilities using the Laboratory Monthly Self-Assessment/Inspection Form (ATTACHMENT C), and inspections as required in the CWA Sample Receiving, Handling, and Disposal Protocol.
- Provides laboratory workers with appropriate engineering controls and PPE needed to work safely with hazardous materials. Ensures such equipment is used correctly.
- Conducts periodical safety meetings which address safety program status, corrective actions, and staff recommendations for improving laboratory safety.
- Conducts an incident investigation of all accidents including reported near-miss incidents, spills, non-conformance with regulatory and policy requirements and reported chemical exposures exceeding CHP guidelines. See Incident Reporting Form (ATTACHMENT D).
- Ensures the timely submittal of the Particularly Hazardous Substance Use Approval Form (ATTACHMENT E) and submits them for approval to the CHO before using any particularly hazardous substance or performing a significant hazardous procedure without approved control measures. Maintains a chemical inventory. See Chemical Inventory Form (ATTACHMENT F).
- Ensures that laboratory personnel receive their medical surveillance evaluation, respirator fit testing, HAZWOPER, HAZCOM, and other required medical monitoring and training.
- Conducts a dry run pre-operational review prior to initial CWA operation and upon a major change to procedures, equipment, or personnel.
- Ensures that the Physical Security Plan requirements are met.
- Coordinates delivery of CWA standards from LLNL and coordinates with field personnel for receipt of CWA environmental samples.
- Assures that full background information, including field screening results of environmental samples, are provided and reviewed for the safety of the PHILIS staff prior to receipt of samples as outlined in the CWA Sample Receiving, Handling, and Disposal Protocol.

3.4 Laboratory Staff (Chemists and Chemical Technicians)

The laboratory staff are responsible for the following:

- Review the CHP prior to performing laboratory functions.
- Follow H&S procedures and laboratory practices as outlined in the CHP and other program documents.
- Report all incidents including occupational injuries/illness, near-miss accidents, and non-conformance with the CHP to the LC.
- Ensure that engineering controls, work practices, and PPE are used as directed.

3.5 Agent Manager

The Agent Manager (AM) is responsible for ensuring the accurate accountability of the CWA reference materials, from receipt and storage of the primary materials through usage and disposal. The following tasks are the responsibility of the AM:

- Serves as the primary contact for CWA regulatory compliance and as team leader for compliance surveys, audits, and inspections by other bodies.
- Ensures accurate accountability of CWA reference materials from receipt through disposal. Maintains the security and integrity of stored and in-use primary CWA solutions at all times.
- Signs courier forms for receipt of CWA material, completes the PHILIS Chain of Custody (COC) Form (ATTACHMENT G), and accompanies the CWA solutions until they are secure in the laboratory.
- Performs checks for each working day of accountability records and housekeeping in the PHILIS laboratories (Note: A "working day" is defined as any day where CWA materials are removed from secured storage).
- Prepares monthly agent inventory reports and performs and documents quarterly accountability audits.
- Serves as backup for coordinating CWA primary solution delivery in case the LC is not available.
- Holds the keys (primary lock and key entry requirement) to the CWA standard storage refrigerator. In the absence of the AM, the LC is responsible for managing the keys to the refrigerator.

3.6 Chemical Agent Operators

A Chemical Agent Operator (CAO) is anyone that works directly with dilute agent solutions or unknown samples that may contain agents. CAOs must be properly trained and certified to perform SOPs where they will be using CWA solutions. The following tasks are the responsibility of the CAO:

- Performs all chemical agent laboratory operations using only the current and approved SOPs for which operator certification has been completed.
- Conducts all operations strictly in accordance with the provisions of the EPA Dilute Solution Hygiene Plan (DSHP), SOPs, and all applicable regulations, manuals, and directives. Any improvements or modifications must be formally approved by laboratory management before changes to the original SOP operations or procedures can be implemented.
- Observes receipt of chemical agent materials at the receiving area (e.g., loading dock), and transports the material to the laboratory storage or processing area.
- Documents the preparation, transfer, and disposal of dilute agent standards in the Laboratory Information Management System (LIMS) Standard Preparation Module and the CWA Accountability Log.
- Ensures all chemical solutions are properly labeled and stored; this also includes good housekeeping practices within the work area and maintaining the security and integrity of the CWA solutions at all times.
- Tracks the current location of all CWA standards that are used for analysis. This includes documentation of material transfer and use at other laboratories.
- Maintains security for CWA standards at all times, whether stored or in use. Maintains the numerical combination to the keypad or keys to the entry system (secondary lock and key entry requirement) on the standard storage refrigerator.
- Receives chemical agent orientation, safety training, and complies with the accountability procedures.
- Informs their supervisor of any factors that may compromise the safe operation of the CWA program.
- Reports any accidents, incidents, hazardous conditions, or unusual circumstances to the LC, AM, and/or the CHO. Any event that could potentially cause or result in exposure or injury within the designated laboratory areas must be reported. See Employee Safety Suggestion Form (ATTACHMENT H).
- Uses PPE required by the CHP and SOPs in the prescribed manner.

4.0 CHEMICAL AND HAZARD IDENTIFICATION

4.1 General

All chemicals pose hazards based on their inherent chemical and physical properties, and most importantly the manner of use and whether effective control measures are incorporated in their use. Always reference chemical safety data sheets (SDSs) prior to chemical work.

Particularly Hazardous Substances are defined by OSHA to include select carcinogens, reproductive toxins and substances that have a high degree of acute toxicity (such as CWAs). Additionally, highly flammable and unstable chemicals are also considered "Particularly Hazardous."

- Particularly Hazardous Substances Listing. OSHA-regulated carcinogens or potential carcinogens as listed in Subpart Z of the OSHA standards are as follows:

asbestos	4-Nitrobiphenyl	alpha-Naphthylamine
Methyl chloromethyl ether	3,3'-Dichlorobenzidine (and its salts)	bis-Chloromethyl ether
beta-Naphthylamine	Benzidine	4-Aminodiphenyl
Ethyleneimine	beta-Propiolactone	2-Acetylaminofluorene
4-Dimethylaminoazobenzene	N-Nitrosodimethylamine	Vinyl chloride
Inorganic arsenic	Cadmium	Benzene
Coke oven emissions	1,2-dibromo-3-chloropropane	Acrylonitrile
Ethylene oxide	Formaldehyde	Methylenedianiline
1,3-Butadiene	Methylene Chloride	

NOTE: Typically, in concentrations > 1%. See CHO for additional guidance on diluted carcinogens.

Reproductive toxins include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

High acute toxicity chemicals include any chemical that falls within any of the following categories:

- A chemical with a median lethal dose (LD50) of 50 milligrams (mg) or less per kilogram (kg) of body weight when administered orally to certain test populations.
- A chemical with an LD50 of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) to certain test populations.
- A chemical with a median lethal concentration (LC50) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentrations and/or conditions are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

In addition to the above health hazards, all CWAs are considered "Particularly Hazardous Substances."

Chemicals which pose physical properties deemed to be "Particularly Hazardous" would include those with a National Fire Protection Association (NFPA) IA classification (FP<73^{o}F BP<100^{o}F), or any material which is unstable (e.g., pyrophoric, forms peroxides, highly reactive or polymerizes).

4.2 Safety Data Sheets and Labeling

Primary chemical hazard identification is obtained through the manufacturer's Safety Data Sheet (SDS) and the hazard label on each chemical container. The following are guidelines regarding SDSs and labeling:

- SDSs contain specific inherent chemical and physical properties of a chemical and guidelines in the safe management of the chemical for the user's application. It is imperative that the user review the SDS and perform a follow-up assessment to safely use the chemical.
- SDSs will be available in the mobile labs in a binder and/or file folder.
- Manufacturer's labels with hazard warnings must be maintained on the container in a legible manner. Hazard warning information may include a combination of affected target organs and a hazard rating label system such as the National Fire Protection Association (NFPA), Hazardous Materials Identification System (HMIS), and Globally Harmonized System (GHS). Chemical containers must have an expiration date.
- If a chemical is transferred to another container for storage, the new container will need to be labeled with the name of the product, the chemical constituents, and the hazard warnings as noted from the original sample container. Laboratory processing containers do not require hazard labeling if used within the work shift by a single individual.
- The CHO will prepare a Chemical Hazard Assessment and Communication Form (ATTACHMENT A) and/or a Hazard Risk Assessment Form (*ATTACHMENT B*) for each chemical or contaminant, detailing specific hazard information related to its manner of use and required control measures.

4.3 Hazard Communication and Labeling Guide

The Hazard Communication & Labeling Guide will only be used as a quick reference to the general hazard warnings as listed on NFPA labels, HMIS labels, and the new GHS international standard. GHS stands for the Globally Harmonized System of Classification and Labeling of Chemicals. Any hazard classification and rating system is based on the intrinsic properties of the chemical and does not include the important aspect of how the chemical is used.

Developed by the United Nations, the premise of the GHS is that existing chemical classification and labeling systems, such as the OSHA Hazard Communication Standard, "should be harmonized in order to develop a single, globally harmonized system to address classification of chemicals, labels and safety data sheets (formerly MSDS)." The GHS rating system differs significantly from NFPA and HMIS to standardize the numerous ratings used globally with a more comprehensive system. The following are the rating categories:

- Physical hazards, such as flammability
- Health hazards: Acute toxicity/lethality (based on LD50 or LC50 values for dermal, oral, and inhalation routes of exposure), skin sensitization, skin corrosion/irritation, serious (permanent) eye damage/irritation
- Acute aquatic toxicity (new and non-OSHA required)

One of the many changes that may lead to confusion is the GHS numerical hazard rating scale which is opposite that of NFPA and HMIS. The following table, using flammability as an example, indicates that the GHS highest rating is a "1" whereas HMIS and NFPA would be a "4." The same scheme would apply to the health hazard criteria.

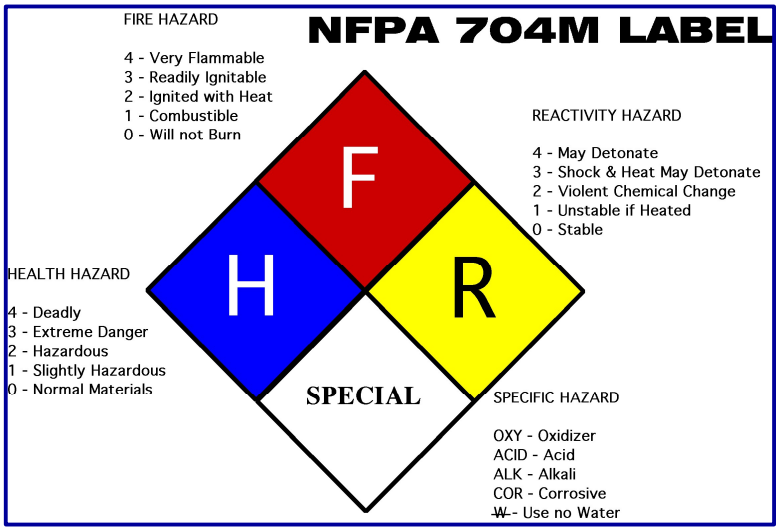
Flammability Criteria	**GHS Category**	**NFPA 704 Rating**	**HMIS**
Flash point < 73°F(23°C) and initial boiling point<100°F(37.8°C)	1 or 2	4	4
Flash point < 73°F(23°C) and initial boiling point> 100°F(37.8°C) and Flash point > 73°F(23°C) and < 100°F(37.8°C)	2 or 3	3	3
Flash point ≥ 100°F(37.8°C) and < 200°F (93.4°C)	3 or 4	2	2
Flash point > 200°F(93.4°C) and will burn in air when exposed to a temperature of 1500°F(815.5°C) for a period of 5 min.	None	1	1

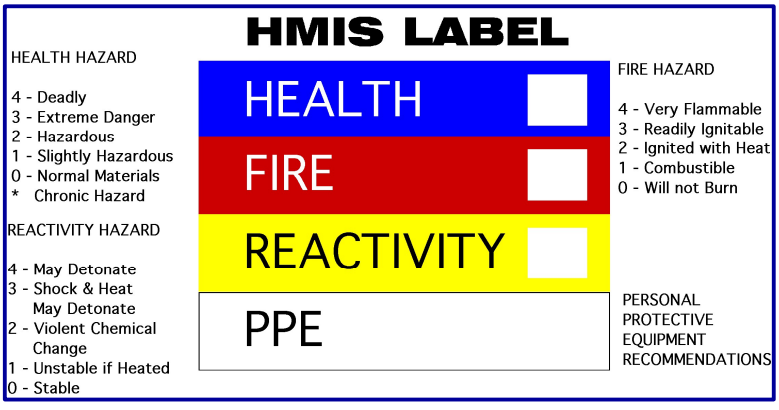
The newer hazard classification scheme of the GHS may not replace the numerous current definitions used in the United States alone, which include the following regulatory and consensus standards listed in the following table for flammability only:

Flash Point	**<20°F(-7°C)**	**20°F(-7°C) - 100°F(38°C)**	**100°F(38°C) - 140°F(60°C)**	**140°F(60°C) - 150°F(66°C)**	**150°F(66°C) - 200°F(93°C)**
OSHA	Flammable	Flammable	Combustible	Combustible	Combustible
ANSI	Extremely Flammable	Flammable	Flammable < 141 F	Combustible	Combustible
RCRA (EPA)	Ignitable	Ignitable	Ignitable		
DOT	Flammable	Flammable	Flammable < 141 F	Combustible	Combustible
CPSC	Extremely Flammable	Flammable	Combustible	Combustible	
NFPA 30 (for Storage)	Class I	Class I	Class II	Class III	Class III

4.4 Classification of Hazards

Hazard Description	Hazard Warning
Cryogenic	Causes frostbite burns to skin and eyes
Corrosive	Causes chemical burns to eyes, skin, and/or respiratory tract
Irritant	Causes irritation to the eyes, skin, and/or respiratory tract
Toxic	Toxic if swallowed
Toxic	Toxic if swallowed or absorbed through skin
Oxidizer	Gives off oxygen when heated
Carcinogen	Either known or suspected of causing cancer
Combustible	Ignites if heated
Flammable	Easily ignited by spark or flame
Nuisance Dust	Considered a non-toxic nuisance dust
Cardio-toxic	Affects heart rhythm
Pressure	Compressed gas under pressure
Respiratory Hazard	May cause lung damage if inhaled
Potential Sensitizer	Repeated exposure may cause allergic reactions
Explosive	Explosive
Reproductive Toxin	Known to be a reproductive toxin
Temperature	Heated material - hot water, steam





4.4.1 GHS Pictograms and Signal Words

Physical Hazards: Explosive	Usage
	• Unstable explosives • Explosives, divisions 1.1, 1.2, 1.3, 1.4, • Self-reactive substances and mixtures, types A, B • Organic peroxides, types A, B

Flammable	Usage
	• Flammable gases, category 1 • Flammable aerosols, categories 1, 2 • Flammable liquids, categories 1, 2, 3 • Flammable solids, categories 1, 2 • Self-reactive substances and mixtures, types B, C, D, E, F • Pyrophoric liquids, category 1 • Pyrophoric solids, category 1 • Self-heating substances and mixtures, categories 1, 2 • Substances and mixtures, which in contact with water, emit flammable gases, categories 1, 2, 3 • Organic peroxides, types B, C, D, E, F

Oxidizing	Usage
	• Oxidizing gases, category 1 • Oxidizing liquids, categories 1, 2, 3 • Oxidizing solids, categories 1, 2, 3

Compressed Gas	Usage
	• Compressed gases • Liquefied gases • Refrigerated liquefied gases • Dissolved gases

Corrosive 	**Usage** • Corrosive to metals, category 1
no pictogram required	**Usage** • Explosives, divisions 1.5, 1.6 • Flammable gases, category 2 • Self-reactive substances and mixtures, type G • Organic peroxides, type G
Health Hazards **Toxic** 	**Usage** • Acute toxicity (oral, dermal, inhalation), categories 1, 2, 3
Corrosive 	**Usage** • Skin corrosion, categories 1A, 1B, 1C • Serious eye damage, category 1

Irritant	**Usage**

	• Acute toxicity (oral, dermal, inhalation), category 4
	• Skin irritation, categories 2, 3
	• Eye irritation, category 2A
	• Skin sensitization, category 1
	• Specific target organ toxicity following single exposure, category 3
	  ○ Respiratory tract irritation
	  ○ Narcotic effects
	Not used
	• with the "skull and crossbones" pictogram
	• for skin or eye irritation if:
	  ○ the "corrosion" pictogram also appears
	  ○ the "health hazard" pictogram is used to indicate respiratory sensitization

Health Hazard	**Usage**
	• Respiratory sensitization, category 1 • Germ cell mutagenicity, categories 1A, 1B, 2 • Carcinogenicity, categories 1A, 1B, 2 • Reproductive toxicity, categories 1A, 1B, 2 • Specific target organ toxicity following single exposure, categories 1, 2 • Specific target organ toxicity following repeated exposure, categories 1, 2 • Aspiration hazard, categories 1, 2
no pictogram required	**Usage** • Acute toxicity (oral, dermal, inhalation), category 5 • Eye irritation, category 2B • Reproductive toxicity – effects on or via lactation
Environmental Hazards **Environmentally Damaging**	**Usage**
	• Acute hazards to the aquatic environment, category 1 • Chronic hazards to the aquatic environment, categories 1, 2
no pictogram required	**Usage** • Acute hazards to the aquatic environment, categories 2, 3 • Chronic hazards to the aquatic environment, categories 3, 4

4.4.2 Transport Pictograms

Class 1: Explosives	Usage
 Divisions 1.1–1.3	Explosives • Division 1.1: Substances and articles which have a mass explosion hazard • Division 1.2: Substances and articles which have a projection hazard but not a mass explosion hazard • Division 1.3: Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard Note • The asterisks are replaced by the class number and compatibility code
Division 1.4	**Usage** Explosives • Substances and articles which are classified as explosives, but which present no significant hazard Note • The asterisk is replaced by the compatibility code
Division 1.5	**Usage** Explosives • Very insensitive substances which have a mass explosion hazard Note • The asterisk is replaced by the compatibility code incomplete
Division 1.6	**Usage** Explosives • Extremely insensitive articles which do not have a mass explosion hazard Note • The asterisk is replaced by the compatibility code

Class 2: Gases	Usage
 Division 2.1	Flammable gases • Gases which at 20 °C and a standard pressure of 101.3 kPa: • are ignitable when in a mixture of 13 per cent or less by volume with air; or • have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. Note • The symbol, number and border line may be shown in white instead of black
Division 2.2 	**Usage** Non-flammable non-toxic gases • Gases which: o are asphyxiant – gases which dilute or replace the oxygen normally in the atmosphere; or o are oxidizing – gases which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does; or o do not come under the other divisions Note • The symbol, number and border line may be shown in white instead of black
Division 2.3 	**Usage** Toxic gases • Gases which: o are known to be so toxic or corrosive to humans as to pose a hazard to health; or o are presumed to be toxic or corrosive to humans because they have an LC50 value equal to or less than 5000 ml/m3 (ppm).

Classes 3 and 4: Flammable liquids and solids

Class 3

Usage

Flammable liquids

- Liquids which have a flash point of less than 60 °C and which are capable of sustaining combustion

Note

- The symbol, number and border line may be shown in white instead of black

Division 4.1

Usage

Flammable solids, self-reactive substances and solid desensitized explosives

- Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances which are liable to undergo a strongly exothermic reaction; solid desensitized explosives which may explode if not diluted sufficiently

Division 4.2

Usage

Substances liable to spontaneous combustion

- Substances which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire

Division 4.3

Usage

Substances which in contact with water emit flammable gases

- Substances which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities

Note

- The symbol, number and border line may be shown in white instead of black

Other GHS transport classes	Usage
 Division 5.1	Oxidizing substances • Substances which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material
Division 5.2 	**Usage** Organic peroxides • Organic substances which contain the bivalent –O–O– structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals Note • The symbol and upper border line may be shown in white instead of black
Division 6.1 	**Usage** Toxic substances • Substances with an LD50 value ≤ 300 mg/kg (oral) or ≤ 1000 mg/kg (dermal) or an LC50 value ≤ 4000 ml/m3 (inhalation of dusts or mists)
Class 8 	**Usage** Corrosive substances • Substances which: o cause full thickness destruction of intact skin tissue on exposure time of less than 4 hours; or o exhibit a corrosion rate of more than 6.25 mm per year on either steel or aluminum surfaces at 55 °C

Non-GHS transport pictograms

The following pictograms are included in the UN Model Regulations but have not been incorporated into the GHS because of the nature of the hazards

Class 6.2
Infectious substances

Class 7
Radioactive material

Class 9
Miscellaneous dangerous substances and articles

4.4.3 GHS Signal Words and Hazard Statements:

Signal Words: Signal words indicate the relative level of hazard severity assigned to a GHS hazard class and category. "Danger" or "Warning" are often used to emphasize a hazard. Some lower level hazard categories do not use signal words. Only one signal word corresponding to the most severe hazard class should be used on a label.

Hazard Statements: Standard phrases assigned to a hazard class and category that describe the nature of the hazard. An appropriate statement for each GHS hazard should be included on the label for products possessing more than one hazard.

5.0 STANDARD OPERATING PROCEDURES

5.1 Chemical Procurement

The decision to procure a chemical will be a commitment to handle and use the chemical properly from initial receipt to ultimate disposal. The following procedures refer to all chemicals for laboratory use, regardless of how the chemicals are procured:

- The Chemical/Biological Hazard Assessment/Inspection Form (ATTACHMENT A) will be provided to the CHO when there is a need for new chemicals to be procured. Chemicals or samples containing contaminants listed as Particularly Hazardous Substances will require a thorough review with submittal of a Particularly Hazardous Substance Use Approval Form (ATTACHMENT E).
- Information on proper handling, storage, and disposal will be known to all involved personnel prior to the use of the chemical. Chemicals utilized in the laboratory will be appropriate for the ventilation system.

- All chemicals will be received in a central location. Personnel who receive chemical shipments will be knowledgeable of the proper procedures for receipt. Chemical containers will not be opened without accompanying labels, SDSs, and packaging in accordance with all applicable regulations. All chemical containers must be dated when received and opened. Peroxide forming chemicals (e.g., ethyl ether) will require labeling for date of receipt and date when opened, having a recommended storage limit not to exceed 1 year, or as recommended by the manufacturer in addition to peroxide testing, every 6 months.
- Procurement of chemical agent standards will follow the instructions outlined in the CWA Sample Receiving, Handling, and Disposal Protocol.

5.2 Chemical Storage

The following procedures refer to chemical storage:

- Received chemicals will immediately be moved to the designated storage area. Large glass containers will be placed in individual rubber or plastic secondary carrying containers or shipping containers during transport.
- The designated storage area will have good lighting. Large bottles will be stored at or near ground level. A tray will be used under all stored chemicals to serve as secondary containment. The storage area will include approved NFPA flammable storage cabinets. The type and volume of stored flammables in the flammable cabinet or in open areas will be maintained in accordance with NFPA requirements.
- Flammable and combustible storage requirements (NFPA 30 & 45)
- Flammable Liquid - a liquid with a flashpoint below 1000F
- Class IA - flashpoint below 73ºF and boiling point below 100ºF
- Class IB - flashpoint below 73ºF and boiling point above 100ºF
- Class IC - flash at or above 73ºF and below 100ºF
- Combustible Liquids - a liquid having a flash point at or above 100ºF.
- Class II Combustibles - Flashpoint at or above 100ºF and below 140ºF
- Class III Combustibles - Flashpoint at or above 140ºF
- Subclass IIIA - flashpoint at or above 140ºF and below 200ºF
- Subclass IIIB - flashpoint at or above 200ºF
- Cabinets

  Not more than 120 gallons of Class I, Class II, and Class IIIA liquids may be stored in a storage cabinet. Of this total, not more than 60 gallons may be Class I and II liquids. Not more than three such cabinets (120 gallons each) may be located in a single fire area except in an industrial area.

- Containers

Maximum allowable capacity of containers and portable tanks

Container	1A	1B	1C	II	III
Glass or approved plastic	1 pt	1 qt	1 gal	1 gal	1 gal
Metal (Other than DOT drums)	1 gal	5 gal	5 gal	5 gal	5 gal
Safety Cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal drums (DOT specifications)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal

- Open Lab or Inside Buildings Storage (Outside of an Approved Flammable Storage Cabinet or Room)

  Flammable and/or combustible liquids should be kept to the minimum necessary for the work being done. Maximum quantity permitted is 25 gallons of Class 1A and 120 gallons of 1B, 1C, II, or III liquids.

- Chemicals will be segregated by hazard classification and compatibility. The following is a general listing of incompatible chemicals. Not all incompatible substances are shown:

CHEMICAL	KEEP OUT OF CONTACT WITH
Acetic acid	Chromic acid, Nitric acid, Hydroxyl compounds, Ethylene glycol, Perchloric acid, Peroxides, Permanganates
Acetylene and monosubstituted acetylenes	Group IB and IIB metals and their salts, Halogens, Halogenating agents
Alkali and alkaline earth carbides, hydrides, hydroxides, metals, oxides, peroxides	Water, Acids, Halogenating organic compounds, Halogenation agents, Oxidizing agents
Ammonia, anhydrous	Mercury, Chlorine, Calcium hypochlorite, Iodine, Bromine, Hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, Metal powders, Flammable liquids, Chlorates, Nitrites, Sulfur, Finely divided organic or combustible materials
Aniline	Nitric acid, Hydrogen peroxide
Azides, inorganic	Acids, Heavy metals and their salts, Oxidizing agents
Bromine	Same as for chlorine
Carbon, activated	Calcium hypochlorite, All oxidizing reagents
Chlorates	Ammonium salts, Acids, Metal powders, Sulfur, Finely divided organic or combustible materials
Chromic acid	Acetic acid, Naphthalene, Camphor, Glycerin, Turpentine, Alcohol, Flammable liquids in general
Chlorine	Ammonia, Acetylene, Butadiene, Butane, Methane, Propane (or other petroleum gases), Hydrogen, Sodium carbide, Turpentine, Benzene, Finely divided metals
Chlorine dioxide	Ammonia, Methane, Phosphine, Hydrogen sulfide
Copper	Acetylene, Hydrogen peroxide
Cumene hydroperoxide	Acids, Organic or inorganic
Cyanides, inorganic	Acids, Strong bases

CHEMICAL	KEEP OUT OF CONTACT WITH
Flammable liquids	Ammonium nitrate, Chromic acid, Hydrogen peroxide, Nitric acid, Sodium peroxide, The halogens
Fluorine	Isolate from everything
Hydrocarbons (butane, propane, benzene, gasoline, turpentine, etc.)	Fluorine, Chlorine, Bromine, Chromic acid, Sodium peroxide
Hydrocyanic acid	Nitric acid, Alkali
Hydrofluoric acid, anhydrous	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, Chromium, Iron, Most metals and their salts, Alcohols, Acetone, Organic materials, Aniline, Nitromethane, Flammable liquids, Combustible materials
Hydrogen sulfide	Fuming nitric acid, Oxidizing gases
Iodine	Acetylene, Ammonia (aqueous or anhydrous), Hydrogen
Mercury and its amalgams	Acetylene, Fulminic acid, Ammonia (aqueous or anhydrous), Nitric acid, Sodium azide
Nitrates, inorganic	Acids, Reducing agents
Nitric acid	Acetic acid, Aniline, Bases, Chromic acid, Chromates, Hydrocyanic acid, Metals, Permanganates, Reducing agents, Sulfides, Sulfuric acid, Flammable liquids, Flammable gases
Nitrites, inorganic	Acids, Oxidizing agents
Organic acyl halides	Oxidizing agents, Bases, Organic hydroxy and amino compounds
Organic anhydrides	Bases, Organic hydroxy and amino compounds
Organic halogen compounds	Group IA and IIA metals
Organic nitro compounds	Strong bases
Oxalic acid	Mercury and its salts, Silver and its salts
Perchloric acid	Acetic anhydride, Bismuth and its alloys, Alcohol, Paper, Wood
Phosphorus	Oxidizing agents, Oxygen, Strong bases
Phosphorus pentoxide	Alcohols, Strong bases, Water
Potassium	Carbon tetrachloride, Carbon dioxide, Water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (also see Chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerin, Ethylene glycol, Benzaldehyde, Sulfuric acid
Silver	Acetylene, Oxalic acid, Tartaric acid, Ammonium compounds
Sodium	Carbon tetrachloride, Carbon dioxide, Water
Sodium peroxide	Ethyl or methyl alcohol, Glacial acetic acid, Acetic anhydride, Benzaldehyde, Carbon disulfide, Glycerin, Ethylene glycol, Ethyl acetate, Methyl acetate, Furfural
Sulfides, inorganic	Acids
Sulfuric acid, concentrated	Bases, Potassium chlorate, Potassium perchlorate, Potassium permanganate (or compounds with similar light metals, such as sodium, lithium), Water

- Mineral acids must be separated from flammable and combustible materials. Separation is defined by NFPA 49 as storage within the same fire area but separated by as much space as practicable or by intervening storage from incompatible materials.
- Acid-resistant trays will be placed under bottles of mineral acids.
- Acid-sensitive materials and other incompatibles such as cyanides and sulfides will be separated from acids or protected from contact with acids.
- When chemicals are taken from the storage area, they will be placed in an outside rubber or plastic secondary container for transport to user's location.

- Storage of chemicals at the lab bench or other work areas is best limited to those amounts necessary for one operation or shift. The container size will be the minimum convenient.
- The amounts of chemicals, including hazardous waste generated at the lab bench, will be as small as is practical.
- Chemical storage will be inspected monthly and documented on the Laboratory Monthly Self-Assessment/Inspection Form (ATTACHMENT C). The inspection will determine whether any corrosion, deterioration, or damage has occurred to the storage facility as a result of leaking chemicals.
- Gas cylinders will be properly stored and handled in conjunction with the PHILIS SOP H-S-006 Compressed Gas Cylinder Safety Handling and Use. Refer to 49 CFR Part 173.301 General requirements for shipment of compressed gases and other hazardous materials in cylinders, UN pressure receptacles and spherical pressure vessels.
- Cylinders must have safety caps installed unless they are currently in use. The PHILIS Operator's Manual describes the containment mechanisms for compressed gas cylinders if the labs are in transit.
- After connecting regulators to the compressed gas cylinders, a leak check should be performed to ensure that all connections are sound. Consult the PHILIS Operator's Manual for full details.
- Gas cylinders must be transported to and from the trailers using the appropriate equipment (e.g., a 4-wheeled cart equipped with a cylinder belt strap or chain or similar equipment). The cylinder must be capped (regulator removed) during transport.
- Prior to removing or loading cylinders into the trailer storage racks, loosen the hardware designed to keep the cylinder in place. When done, return this hardware to its original position.
- Do not remove the identification and inventory tags from any cylinder.
- Do not store compressed oxygen tanks with hydrogen tanks. Hydrogen and oxygen must be stored in separate compartments.
- Leak check the cylinder, transport line, and associated connections after installing a regulator to the gas cylinder. Fix any leaks immediately.
- Close the cylinder's main valve whenever the gas is not in use.
- Place caps on the cylinders when the vehicle is being readied for travel to a new location.
- Any transport of hazardous material pressurized cylinders is required to be transported with the metal safety cap installed during transport. However, pressurized (non-toxic) gases, which include Helium, are allowed for manifolding and without any relief valves during transport. There does not appear to be any special DOT requirements forbidding charging the lab instruments with Helium during transport. However, whenever there is not an urgent need for continued purging instruments with Helium, the transport of all gas cylinders should be cap and fully secure during transport.

- Manifolded cylinders must be supported and held together as a unit by structurally adequate means. Each cylinder must be equipped with an individual shutoff valve that must be tightly closed while in transit. Manifold branch lines must be sufficiently flexible to prevent damage to the valves that otherwise might result from the use of rigid branch lines. Each cylinder must be individually equipped with a pressure relief device, except pressure relief devices on manifolded horizontal cylinders that are mounted on a motor vehicle or framework may be selected as to type, location, and quantity according to the lowest marked pressure limit of an individual cylinder in the manifolded unit. The pressure relief devices selected for the manifolded unit must have been tested. Pressure relief devices on manifolded horizontal cylinders filled with a compressed gas must be arranged to discharge unobstructed to the open air. In addition, for Division 2.1 (flammable gas) material, the pressure relief devices (PRDs) must be arranged to discharge upward to prevent any escaping gas from contacting personnel or any adjacent cylinders. Valves and pressure relief devices on manifolded cylinders filled with a compressed gas must be protected from damage by framing, a cabinet or other method.
- An inventory of chemicals (non-CWA) will be performed quarterly using the Chemical Inventory Form (ATTACHMENT F). The CWA primary standards will be inventoried and accounted for during CWA standard preparation and storage as outlined in the CWA Sample Receiving, Handling, and Disposal Protocol.
- All reference environmental standards and samples will be refrigerated according to their temperature requirements with secondary containment and the means to prevent tipping, such as using a vial rack for storing vials. A laboratory safe refrigerator is required for flammable materials requiring refrigeration. The maximum storage in the mobile labs should not exceed weekly usage of the standards and samples or the amount required for mobilization.

5.3 Chemical Handling

Each laboratory employee is provided training, education, and resources, and will develop and implement work habits consistent with this CHP to minimize personal and coworker exposure to the chemicals in the laboratory. Work habits are based on the realization that all chemicals inherently present hazards in certain conditions. Exposure to all chemicals will be minimized. See Hazardous Chemical Laboratory Safety Form (ATTACHMENT N).

The following general precautions will be followed for the handling and use of all chemicals:

- Skin contact with all chemicals will be avoided with additional protection provided for chemicals and CWAs that may be absorbed through the skin (section 5.5 provides information on PPE to be worn to prevent skin contact when handling chemicals).
- After handling chemicals, all employees must wash areas of exposed skin prior to leaving the laboratory or immediately upon contact with the chemical.
- Any chemical mixtures are assumed to be as toxic as their most toxic component.
- Substances of unknown toxicity are assumed to be toxic.

- Laboratory employees must be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure. All potential exposure situations require incident reporting with notification to the CHO and PM.
- In all cases of chemical exposure, no more than ¼ of the OSHA Permissible Exposure Limits (PEL) or the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists (ACGIH) will be exceeded unless respiratory protection is worn with the approval of the CHO.
- Designated engineering controls and safety equipment in the laboratory must be utilized and inspected daily prior to their use and during the monthly laboratory inspection. The CHO will conduct periodic inspections of these controls and equipment.
- Specific precautions will be implemented based on the toxicological characteristics of individual chemicals as deemed necessary by the CHO and listed in the chemical hazard summary forms.
- Chemical hazard control measures and the CWA Sample Receiving, Handling, and Disposal Protocol will be followed for exposure prevention when handling CWAs and FGAs.

5.4 Laboratory Equipment and Glassware

Each employee will keep the work area clean and uncluttered. At the completion of each workday or operation, the work area will be thoroughly cleaned, and all equipment properly cleaned and stored.

In addition, the following procedures apply to the use of laboratory equipment:

- All laboratory equipment must be used only for its intended purpose.
- All glassware must be handled and stored with care to minimize breakage. Broken glassware will be immediately disposed of in a designated and labeled sharps box or broken glass container.
- All evacuated glass apparatus must be shielded to contain chemicals and glass fragments should an implosion occur.
- Waste receptacles must be clearly identified.
- All laboratory equipment must be inspected on a periodic basis and replaced or repaired, as necessary. During repair, Lockout/Tagout procedures should be used to protect laboratory and maintenance employees.
- Laboratory equipment contaminated with CWAs or other hazardous substances must be free of any contamination prior to any maintenance work performed on the equipment.

5.5 Personal Protective Equipment

PPE requirements are dependent upon the type of hazards and work tasks to be performed when working with chemicals in the laboratory.

- Safety glasses with side shields meeting American National Standards Institute (ANSI) Z87.1 are required when working in laboratories, except where no laboratory operations or activities are performed. Contact lenses are allowed in the laboratory. If needed, CSS will provide prescription safety glasses at no cost to the employee.
- Chemical goggles and/or a full-face shield will be worn during chemical transfer and handling operations whenever there is a splash hazard.
- Sandals and open-toed shoes are prohibited while working in the laboratories. Non-permeable shoes (e.g., Leather) or shoe covers must be worn during chemical operations.
- Disposable lab coats are provided and must be worn in the laboratory during chemical operations.
- Appropriate chemical-resistant gloves must be worn at all times when there may be skin contact with chemicals. Bare hands are not to be used to retrieve or touch anything that is in any hood. Disposable nitrile gloves are acceptable for routine laboratory analytical functions. Double disposable nitrile gloves are required for handling CWA and FGA standards and samples with frequent change out (every 20 minutes).
- Outer black nitrile gloves are to be worn when working in the hood with CWA and FGA standards and samples. Black nitrile gloves are to stay in the hood behind the red demarcation line, placing them in a decon solution in the hood after removal.
- Using outer black nitrile gloves while working with CWAs and FGAs acts as a visual indicator that the gloves may have come in contact with a CWA or FGA and need to be treated in a decon solution prior to disposal. For this purpose, black nitrile gloves should not be used for activities outside the hood.
- PPE donning when working with CWA and FGA standards and samples, TICs, or other particularly hazardous substances with the potential for skin absorption and/or chemical burns:
    - Don a disposable Tyvek lab coat.
    - Don Tyvek sleeves (optional if using a long-sleeved Tyvek lab coat).
    - Select an appropriate size of nitrile gloves and inflate them to check for leaks.
    - Don a pair of inner nitrile gloves.
    - Don a pair of outer black nitrile gloves. Black extended cuff nitrile gloves can be worn to overlap the Tyvek sleeves.
    - Use duct tape to seal the Tyvek sleeves and inner gloves if not using extended cuff gloves. Duct tape may still need to be used with extended cuff gloves.
    - Raise hands above head to ensure there is no exposed skin between the gloves and the sleeves.

  - Remember to wear safety glasses with side shields and non-permeable shoes and/or shoe covers.
  - Nitrile gloves must be replaced every 20 minutes, after each operation, if there is any known glove contamination, or if they are compromised in any other manner during the operation.
- PPE doffing when working with CWA and FGA standards and samples, TICs, or other particularly hazardous substances with the potential for skin absorption and/or chemical burns:
  - Remove outer black nitrile gloves, remove tape and Tyvek sleeves. Place in the decon bleach solution in the hood. Carefully remove these items as if they were contaminated. Cutting the tips of the gloves and adding a weight is recommended, allowing for the items to rest better in the decon solution.
  - Remove pair of inner nitrile gloves, cautiously rolling gloves to discard.
  - Remove disposable Tyvek lab coat and discard.
  - Wash hands with soap and water after removing PPE.
- Refer to manufacturers' glove permeation rates prior to glove selection.
- Thermal-resistant gloves are worn for operations involving the handling of heated materials and exothermic reaction vessels. Thermal-resistant gloves are constructed from non-asbestos materials and will be replaced when damaged or deteriorated.
- Cut-resistant gloves are required for handling any sharp objects, including handling broken glassware or handling equipment with sharp edges.
- Respiratory protection is not required for routine laboratory analysis. Respirator usage will comply with the OSHA Respiratory Protection Standard, 29 CFR 1910.134, and will be approved by the CHO. The MSA Ultra-Elite full face with CBRN cartridge respirators are used as a precautionary measure for work with hazardous chemicals that may exceed one-fourth of the ACGIH or OSHA short term exposure limit (15 minutes) or 8-hour time weighted average. Disposable respirators for use with non-toxic exposure, such as nuisance odors or dust, are acceptable with employee acknowledgment of the limitations of use. Laboratory employees that may need to use a respirator will be fit-tested on an annual basis. Visually inspect respirators for good working condition before use.
- Each chemist is provided an ILC Dover SCape CBRN30 Air Purifying Emergency Escape Respirator for use when working with chemical agents. They are required to keep this respirator within arm's length during chemical agent work. This escape respirator is easy to deploy - within 30 seconds they can have the hood over their heads and be walking to the exit, making this style of respirator most desirable in a mobile laboratory environment. The SCape respirator provides up to 30 minutes of protection.
- Each chemist is also assigned an MSA Ultra-Elite CBRN full face respirator. This respirator will be worn when cleaning up a chemical agent spill, or when handling unknown samples or samples that are received in suspicious or damaged containers.

- All PHILIS laboratory staff receive annual refresher training for SCape and MSA Ultra-Elite CBRN full face respirators as part of the respiratory protection program. Staff assigned an MSA Ultra-Elite CBRN full face respirator receive initial and annual respirator fit testing.
- A PPE hazard risk assessment must be conducted for new or non-routine laboratory operations that have not been addressed in the CHP, using the Chemical Hazard Assessment and Communication Form (ATTACHMENT A) and/or Hazard Risk Assessment Form (ATTACHMENT B).
- Mobilization for support of environmental operations requires a specific PHILIS H&S hazard review, with follow-up requirements for control measures, including training prior to initiating activities.
- Specific examples of PPE required or recommended for common PHILIS work tasks:

PPE Selection by Routine Laboratory Work Task

Personal Protective Equipment (PPE)	Specific Use	Special Instructions
Gloves Disposable nitrile Single	Routine lab operations-liquids & solids of low to moderate toxicity CWA secondary working standards-analysis task General cleaning-non-hazardous	
Gloves Disposable nitrile Double	Handling CWA and FGA primary standards and samples Working with chemicals that can be readily absorbed through the skin Particularly Hazardous Substances Cleanup of small spills Fume hood air filter replacement	Frequent glove change (20-minute usage)
Gloves Heat-resistant	Handling hot objects such as from power source equipment, ovens, hot glassware	
Gloves Cut-resistant	Removing/handling equipment with sharp edges; ASZM-TEDA ventilation filters, cutting glass tubing, cleanup of broken glass, thin metal plates	Some cases leather gloves are adequate
Glasses with safety side shields	All chemical work	Safety goggles over prescription glasses acceptable
Neck/hood cover Disposable Tyvek -covers full head and neck	High chemical hazard unlikely for routine PHILIS lab functions	Optional-CWA, FGA work
Face shield	Potential splash; transfer of liquids to another container, flying hazards (cutting/grinding)	
Lab coat Disposable Tyvek	Routine lab operations	
Shoe covers Disposable Tyvek	Cleanup of minor liquid spills on floors, prevent transfer of contamination	CAUTION! Large size shoe covers can be a trip hazard
Steel-toed shoes	Moving heavy and/or awkward objects; cylinders, heavy-duty filters (ASZM-TEDA), equipment	
Hearing protection	Close proximity to excessive noise; generators (~<10 ft from source)	
Respiratory Protection PHILIS MSA Full face Ultra-Elite with CBRN canister	See Respiratory Protection SOP. Example manageable spill clean-up, temporary chemical hood failure, removal of fume hood exhaust filters, screening of samples	
Respirator, dust respirator	Nuisance vapors (prevent odors) or dusts at airborne concentration well below exposure limits, e.g., sweeping floor, transfer/pouring obnoxious odor chemicals	
Adverse weather gear e.g., waterproof raincoat and hood, boots, winter gear	Mobilization-weather conditions	Preference is orange color if activity is involved during a vehicle breakdown

5.6 Personal Work Practices

The following are guidelines for personal work practices in the laboratory.

- The LC must ensure that each employee knows and follows the rules and procedures established in the CHP and CSS Policies and Procedures for H&S.
- All employees must remain vigilant against unsafe practices and conditions in the laboratory and will immediately report such practices and/or conditions to the LC. The LC must correct unsafe practices and or conditions promptly.
- Long hair and loose-fitting clothing will be confined close to the body to avoid being caught in moving machine/equipment parts.
- Eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present is prohibited. Hands must be thoroughly washed prior to performing these activities.
- Mouth suction for pipetting or starting a siphon is prohibited.
- Do not smell or taste any chemicals.
- Encourage safe work practices in coworkers by setting the proper example. Horseplay is strictly forbidden.
- Seek information and advice from knowledgeable persons, standards, and codes regarding the hazards present in the laboratory. Operations, equipment, and protective measures must be planned accordingly.
- Use engineering controls in accordance with Section 7.
- Inspect PPE prior to use and wear appropriate protective equipment as procedures dictate and when necessary to avoid exposure.

5.7 CWA Sample Receiving, Handling, and Disposal Protocol

This protocol defines required procedures for receiving environmental samples and primary standards that may contain CWAs. PHILIS primarily works with materials at ultra-dilute concentrations (UD-CWA) up to 10 mg/L (ppm). This document identifies procedures for shipment coordination, accountability, material handling, and waste disposal. Follow this CWA Sample Receiving, Handling, and Disposal Protocol for FGA work.

CWA target analytes at the 10 mg/L concentration level for standards (UD-CWA), are not lethal, but can cause adverse health effects (blisters and adverse nervous system reactions). Since the concentration of CWA analytes in samples are potentially unknown, sample handling techniques require increased precautions with stringent engineering and PPE control measures, including strict hygiene practices.

PPE required for CWA standards and samples (Refer to Section 5.5):

- Safety glasses with side shields or safety goggles.
- Disposable Tyvek laboratory coats with sleeves.
- Non-permeable closed toed shoes.
- Long pants.
- Gloves - double nitrile disposable gloves. Use black nitrile gloves as outer nitrile gloves (frequent change out required of outer black gloves; the maximum usage of the outer nitrile gloves is 20 minutes of direct work).
- Respiratory protection is required to be available for manageable spill response and in the case of detecting high CWA vapor in receiving CWA samples.

Other examples of safety supplies and related materials (See ATTACHMENT R Laboratory Safety Equipment & Supplies Checklist):

- Availability of DuoDote Auto injectors (3 available for each laboratory staff member working with nerve agent).
- Transport system as a tertiary containment with sorbent for transporting the CWA samples and standards between laboratory vehicles.
- Decontamination & spill control materials including commercial bleach (tested for 5-6% sodium hypochlorite content), spray bottle with bleach, absorbent lab pads or mats, and acid/base neutralizing chemicals (e.g., sodium bicarbonate).
- Decontamination container consisting of a 5-gallon plastic pail with screw cap containing less than 20% of the container volume with liquid commercial bleach which is stored inside the CWA hood. Upon completion of CWA work, spent materials are placed in the decontamination container and soaked in the bleach.
- Non-hazardous material waste bags or containers-used for general lab trash and disposal of disposable PPE that was not potentially contaminated.
- Rack for supporting sample-containing vials.
- Hazard Communication postings/signs:
- Vehicles - “Authorized Personnel Only”, “CWA-UDA Workspace.”
- Hoods, instrumentation - “CWA-UDA Workspace.”
- Poster (Inside Vehicles) - Symptoms & Administering DuoDote.
- Personnel decontamination solution (liquid soap and tap water).
- Digital camera to document deliveries.
- PHILIS Primary Standard Accountability Form (ATTACHMENT J).
- Monitoring equipment:

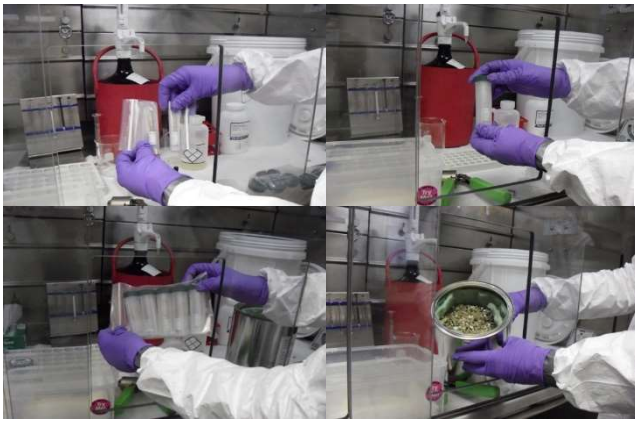
- AP4C; preferred monitoring for airborne and surface contamination. Any sample that may have a vapor component requires head space monitoring using the AP4C monitor or equivalent monitoring for detecting CWA vapors conducted in the hood.
- For surface wipe sampling, M8 paper for concentrated CWA contamination and surface wipe sampling (SOP L-S-100) for low level contamination.
- Drager pump & detector tubes for organic solvent spills.
- Hypochlorite test kit or Potassium iodide (KI) starch paper to determine bleach chlorine content for decontamination.
- Complete Laboratory Safety Equipment & Supplies Checklist (ATTACHMENT R) with all items in compliance prior to receiving samples or reference standards.

In order to reduce risk to PHILIS laboratory personnel, adequate hazard information is required for all incoming samples and standards prior to laboratory acceptance. The following list details requirements for the receipt and analysis of CWA standards and environmental samples:

- EPA Office of Emergency Management representatives will audit and approve PHILIS facilities for handling CWA standards or environmental samples.
- Samples of air, water, solids, and wipes will be analyzed using approved standard operating procedures (SOPs). No biological and/or radioactive contaminated substances will be accepted for analysis. Only air samples collected on an adsorbent tube will be accepted unless a grab gas/vapor sample is determined to be of a UD-CWA concentration based on field estimates and/or approved by the PHILIS Chemical Hygiene Officer (CHO).
- An EPA Office of Emergency Management approved supplier (e.g., LLNL) will provide a COC Record and Condition of Sample Receipt form with the CWA standards. The maximum concentration for each CWA standard is 10/5 ppm in 1 ml flame sealed ampoules for all primary CWA standards (not always flame sealed). The receiving facility will validate the receipt and condition of the agent with follow-up correspondence to the sender. Chemical agents will be identified with an estimated concentration range for environmental samples and a certified concentration profile of the reference standard by the sender prior to acceptance. This includes proper sample size based on the target analyte(s), the analytical method and the reporting requirements as determined by the LC.
- The CWA material supplier must provide an SDS prior to transport of new materials.
- Laboratory staff will be trained in the health and safety requirements for CWA handling. Staff must demonstrate safe handling of CWA samples in a required dry-run evaluation or equivalent review for assigned tasks prior to the acceptance of samples.
- A site-specific plan will be developed for safe handling and analysis of the samples and standards, including procedure review, needed resources, required control measures, etc. This plan will be reviewed by project staff prior to processing CWA agents.
- All necessary resources, including safety required items, will be prepared for use prior to any CWA operations, including receiving primary standards or samples.

- Background information of environmental samples and field sampling team screening results must be provided to PHILIS for review prior to acceptance of the samples.
- Environmental samples or reference standards must have proper labeling and packaging and should not possess suspect contamination on any outer or internal package surface or any evidence of damaged packaging. Sample transport containers must possess undamaged custody seals/tamper-evident bags.
- Field information describing any symptoms and other indicators of potential increased hazard associated with the submitted samples must be reported to the PHILIS laboratory prior to submittal. Hazard information and field screening results will be documented on COC form(s) that must accompany all samples submitted to the laboratory. No environmental samples or standards will be accepted without COC documentation unless pre-approved by PHILIS Program Manager.
- A follow-up inspection and pre-screening of the samples and reference standards will be conducted by PHILIS staff prior to laboratory processing.
- If samples do not meet acceptance criteria, then the sample provider/customer will be notified immediately to determine the disposition of the samples, unless otherwise noted on the receiving documentation.
- The LC will request and coordinate the delivery of the CWA standards and interface with the supplier of the CWA standards/samples to assure adequate safety of the PHILIS team. In the absence of the LC, the AM will coordinate transport of the reference standards and/or CWA environmental samples. In the event that both LC and AM are absent, delivery of CWA reference standards or samples will not be accepted. Additionally, unannounced or unscheduled shipments of CWA materials or samples will not be accepted.
- The LC or AM signs receipt and COC documentation for receipt of the reference standards or samples. If the material received includes CWA standard(s), the LC/AM must accompany the CWA standard(s) until they are logged and placed in the designated refrigerated secure storage area. The AM may also serve as CAO being specifically assigned for CWA standard receipt, including accountability. The LC or a designated back-up CAO may receive CWA reference material in the absence of the AM.
- The field sampling team is responsible for proper packaging of environmental samples. PHILIS will perform pre-screening prior to packing/transport.
- PHILIS packaging and transport of environmental samples to an EPA Regional Laboratory or Contract Laboratory will follow the following guidelines:
- Standards and samples will be transported by FedEx overnight with priority next day delivery after determination by the CHO for proper hazardous material transport classification for International Air Transport Association (IATA) Dangerous Goods, using Limited Quantities designation. Sample wipes would not be typically considered a hazardous material.

- Transport of 1 ml standards provided by LLNL or where PHILIS standards are provided to another site are required to be in a flame sealed (not always flame sealed), amber, glass ampoules or in its original vial, wrapped in zip lock bags and placed in a plastic centrifuge tube. The centrifuge tube is then placed in a zip lock bag and placed in a tamper-evident tape seal paint can with adsorbent material. A plastic lock ring is on the paint can (when samples are received from LLNL, not when shipped by PHILIS). The paint can is placed in a shipping box with the COC and other documents. All packaging will be conducted in an approved CWA designated hood. The following are pictures describing the packaging process:



- Environmental samples should be packaged as follows by the field sampling team prior to handing the samples over to the PHILIS laboratory staff (primary responsibility):
  - Sample jars are the preference for liquid and solid containers. Wipe samples, such as gauze, Millipore or Whatman paper, can be placed in a glass jar or vial. Each sample container must be properly labeled with the common chemical name or IUPAC nomenclature.
  - The sample jar must be labeled with the sample identification and date collected at a minimum.
  - The exterior of the sample jars should be wiped clean and dried, if necessary. The sealed sample jars and vials must be placed in a polyethylene bag (one sample per bag), and the bag should be sealed.
  - The samples in the individual polyethylene bags are placed in a U.S. DOT-approved fiberboard box or cooler (shipping container) which has been lined with a large polyethylene bag or plastic sheeting.
  - The shipping container must be packed with enough noncombustible, absorbent, cushioning material to minimize the possibility of sample jar breakage, and to absorb any material that may have leaked. If there are multiple sample jars or vials, there must be sufficient cushioning material between them to prevent breakage if the shipping container is dropped or severely shocked.
  - If maintenance of the samples at 4°C is necessary, wet or blue ice must be placed into two sealable polyethylene bags which must be sealed and placed in the shipping container. Additional absorbent material may be added, if necessary.

- If dry ice is used, it should be limited to 4 pounds or less per shipping container. Use of more than 4 pounds of dry ice requires that the container must be vented to allow for escape of carbon dioxide gas. It is recommended to use a dry ice shipping container.
- The COC Record, completed by the field sampling team, must be placed in a polyethylene bag which must be sealed and taped to the inside of the shipping container lid. The COC Record should contain any pertinent information about the sample including field screening results.
- The shipping container must be closed and sealed with duct or strapping tape.

- Guidelines required when receiving shipments of standards or environmental samples:
  - Upon arrival, all shipping containers must be inspected/screened and documented using the Hazardous and CWA Sample Screening Form (ATTACHMENT I). Also refer to CWA Sample Acceptance and Processing Checklist Form (ATTACHMENT M). The sample receiving officer assures that containers are sealed and show no evidence of tampering. Packaging and sample containers must contain COC seals to ensure sample integrity during handling and transport. During the initial inspection of each shipping package/container, damaged containers are not allowed into the SPA to prevent contamination. Damaged and leaking containers will immediately be placed in proper containment. The CHO and LC will be notified immediately of any package defects, lack of documentation (e.g., COC form) and other non-compliance issues or concerns. The sample receiving officer inspecting the shipping containers must protect themselves and coworkers, equipment and the loading dock receiving area from contamination. All sample/standard receipt procedures must use the "buddy system" utilizing a second person trained in these procedures who will observe activities from a safe location. During sample check-in, one CAO handles the samples while the other buddy handles the paperwork. This prevents possible contamination of the paperwork with the CWAs or other analytes.
  - The sample receiving officer opens the shipping container and handles log-in of the material. Documentation (certificates, COCs) is removed from the shipping container and placed in an area free of contamination. Uncontaminated packaging material, including Styrofoam spacers and ice pack(s) from shipping containers will be kept in the transport container and double bagged in polyethylene bags, labeled as "non-hazardous waste," and disposed of as routine non-hazardous waste.
  - If the CWA reference packaging material is contaminated, the sample receiving officer will notify the CHO and Lead Chemist for follow-up instructions. The AM notifies the supplier of any discrepancies with documentation in the PHILIS Primary Standard Accountability Form (ATTACHMENT J).
  - Vials are placed in plastic containers with press seal lids, and then placed in secondary containment plastic trays inside the reference material refrigerator. Paper towels are used to cushion the glass vials.

- Handling of reference standards and samples in the laboratory:
  - Reference standards or environmental samples that are transported outside of the PHILIS laboratory unit must be always stored at minimum in tertiary containment. Outer black nitrile gloves are to be used during fume hood work and are not to be used during the transport of standards and samples on foot between laboratories and storage. Single layer nitrile gloves may be used for this step.
  - CWA primary standards (10 mg/L) usage must be tracked for each 1 mL or greater volume in the PHILIS Primary Standard Accountability Form (ATTACHMENT J).
  - All handling and transfers of samples and standards are documented in the LIMS database. The accountability of CWA standards will be manually recorded in a CWA Standard Material Accountability logbook containing the information included in the PHILIS Primary Standard Accountability Form (ATTACHMENT J). CWA inventory is recorded weekly using OP-012 Ampule Inventory Checklist.
  - When working with DoD agent, inventories will be conducted when the primary custodian changes and anytime accountability is questioned. Periodic and change of primary custodian physical inventories will be performed in the presence of a disinterested third-party witness (a staff member who has no other accountability responsibilities for the DoD accountable chemicals being inventoried and reported for a specific custodian). Change of custodian inventories will also include the incumbent primary custodian. The physical inventory will be reconciled with the stock record, the previous physical inventory, and custodial records for all transactions since the date of the previous physical inventory. Additional security procedures can be found in the PHILIS Physical Security Plan, including key/combination lock access controls and the Unescorted Access Program (UAP).
  - CWA reference materials or environmental samples are stored in a locked refrigerator and secured area (locked warehouse caged area and mobile lab units) that is designated for CWA materials only. The designated refrigerators will be identified and posted for type of contents, CWA reference standards or environmental samples. Chemical agent not in use must be returned to storage at the end of the day.
  - Labels on agent vials must not be removed or defaced until the container is empty, decontaminated, and ready for disposal. If labels are accidentally removed, then this must be noted in the CWA Accountability Notebook and the AM notified.
  - All items on the CWA safety checklist must be confirmed prior to beginning any work with the CWA standards or samples.

- At no time during hood usage with chemical agent material handling will the breathing zone of the user break the lower edge of the plane of the hood sash. CWA glass ampoules will only be uncapped in CWA laboratory fume hoods. Fume hoods will be equipped with spill trays and have audible and visual alarms to warn of low flow. Containers of prepared decontamination solution will be located in the fume hood during handling of CWA materials. When uncapped, CWA vials will be supported by a vial rack or other physical support to prevent tipping.
- Once CWA reference standards or environmental samples are safely stored, the AM notifies the LC that the reference standards are safely stored, and the operation has been completed. The information is also noted on the HAZCOM Status Board.
- Once samples have been logged into the Laboratory Information Management System (LIMS) database and comply with all preliminary screening limits, they may be moved using triple containment to sample storage by a CAO.

5.8 CWA Sample Receiving Procedure

Below are the procedures for receiving CWA samples:

- A field sampling team representative must notify the LC prior to submitting samples for laboratory analysis. Samples must be pre-screened to determine the potential levels of toxic contaminant, and the screening results provided on the COC Forms (ATTACHMENT G) that accompany the samples to the labs.
- Upon initial acceptance, the packaged samples are received in the warehouse where the outer package is inspected. The delivery vehicle must remain at the facility while the outer package is inspected. The vehicle is released after samples are found to be free of any leakage/contamination. The package is moved to the SPA or approved alternate area where the samples are removed from the original package or container in a designated CWA laboratory hood. If necessary, a repeat of the initial inspection is conducted. The accompanying documentation (COC form and certificates), preservation, and shipping conditions are documented in the LIMS/Element database and by manual entry into the Sample Receipt Form.
- If there is any evidence of package damage, incorrect labeling or leakage, the sample receiver must contact the CHO and LC prior to further handling. Absorbent pads will be placed on and around any potential leakage. Additional PPE, such as respiratory protection may be required as determined by the CHO if airborne CWA is detected or expected.

- Sample containers are visually inspected in their original outer packaging for damaged contents and/or evidence of leaks in a designated outdoor area. Opening of sample packaging will be conducted in the SPA or designated area with proper confinement, ventilation, and other control measures. Sample inspection and screening results will be documented on the Hazardous and CWA Sample Screening Form (ATTACHMENT I) in accordance with SOP-L-P-001. A visual inspection and wipe test will be conducted using the M8 Paper Screen Procedure for liquid surface contamination or using the AP4C liquid probe attachment to determine if a liquid or potential surface contamination is present. Air monitoring will be conducted using the AP4C to screen for any CWA vapor leaks from the transport container and upon opening the container following placement in an approved laboratory hood.
- All handling and transfers of samples are documented in the LIMS database.
- Custody of samples during processing within PHILIS laboratories is documented in LIMS, in the Laboratory COC log.
- The flow of sample receiving and processing will be performed in the manner outlined in the Summary of CWA Standards and Samples Receipt and Handling Protocol.
- Prior to and at the end of a workday when conducting CWA activities, a safety check will be conducted using the CWA Pre-operational laboratory safety and supplies checklist. The checklist will be kept in a file for verification of operational compliance.
- All CWA-related activities will be noted on the HAZCOM status board outside of the laboratory units to include activity, involved staff, start/completion time, location, and other information to keep the laboratory staff aware of CWA activities.

5.9 Procedures for Cleanup of Spilled CWA Materials

Procedures for cleanup of spilled CWA materials are discussed below.

- In the event of an in-hood spill of 10 mL or less, spray the area with 5-6% commercial bleach solution using a spray bottle. Operators will use double nitrile gloves and carefully blot the decontamination solution/spill material with absorbent lab paper towels/pads. Contaminated absorbing pads are placed in the hood decontamination waste container as solid waste. The spill area is treated again with bleach solution, rinsed with water and wiped dry with laboratory tissue/absorbent pads. Pads and wipes are to be placed in the decontamination containers containing 5-6% sodium hypochlorite solution in the hood.
- Following spill clean-up, operators will dispose of used PPE into decontamination containers that contain 5-6% sodium hypochlorite solution (non-diluted bleach).
- The CAOs will report the spill and circumstances leading to the event to the CHO. Any losses of CWA material will be recorded in the CWA Accountability Notebook and the AM and LC will be notified. Corrective action will be implemented to eliminate potential for recurrence. CAIRA reporting procedures will be followed.

- In case of larger CWA ultra-dilute spills in the hood (10 ml or greater) or any CWA spills outside of the hoods, place absorbing pads over the spill to contain/absorb the spill, exit the area and notify the Emergency Coordinator (EC) and CHO to determine additional requirements for cleanup. Large CWA liquid spills require the non-diluted commercial (5-6% sodium hypochlorite) bleach applied directly to the spilled liquid. The requirements in Section 12 of the Chemical Hygiene Plan will be implemented for all manageable solvent and CWA spills.
- In the event of a loss of engineering controls (ventilation, hood alarms, or abnormal functions), all personnel are to immediately evacuate the CWA lab unit, and if considered safe, close all CWA containers and hoods.
- If suspected or actual direct contact or exposure to CWA occurs, use the Exposure Incident Response Kit, wash skin immediately with soap and copious amounts of water as directed in CHP Section 12.2 Contaminated Personnel. Persons assisting the affected staff member will be protected by wearing proper PPE as necessary to prevent cross-contamination.
- If a staff member experiences any nerve agent symptoms they must exit the lab area and notify others to assist in emergency actions. Emergency actions include following instructions for administering DuoDotes based on the observed symptoms. In all cases, emergency medical services must be notified immediately. Additional measures may be needed, including decontaminating the staff member with follow-up placement of clean disposable clothing on them as necessary.

Decontamination of CWA contaminated surfaces and equipment will use a sodium hypochlorite (bleach) solution as follows:

- The decontamination solution for spills is commercially available 5-6% sodium hypochlorite. Upon receipt, test bleach for 5-6% sodium hypochlorite content and place an expiration date of 6 months on bleach containers. In-use decontamination (decon) solution should be replaced after 90 days. Containers will be labeled with purchase and preparation date of the decon solution.
- Treat a contaminated surface with the 5-6% bleach for decontamination, followed with soap & water cleanup. Dispose of waste including gloves, wipes, primary or secondary standards, and other CWA waste material in decontamination containers with bleach solution.
- Test the decon bleach solution using a hypochlorite test kit or potassium iodide (KI) starch paper. Presence of residual available chlorine will indirectly indicate that CWA agent was consumed. Follow up with wipe sample test of the surface to verify effective surface decontamination.

5.10 Disposal of CWA Containing Materials

Disposal of CWA primary and secondary standards and environmental standards potentially containing CWAs will be disposed of as follows:

- Primary and secondary CWA standards will be carefully poured into the designated decon solution waste container located in the CWA hood with adequate volume of the 5-6% commercial bleach.
- Environmental samples are required to be returned to the sampling organization. If environmental samples are to be disposed of as waste, then they will be added to the waste container in the CWA hood with adequate volume of 5-6% bleach.
- Solid and liquid waste generated from CWA analytical processes, spills or disposal of standards are placed in fresh commercial bleach solution (5-6% sodium hypochlorite) for at least 24 hours in a lab hood to neutralize/deactivate chemical agent. Verification of the neutralization process is conducted by testing the waste solution with a Hypochlorite Test Kit or KI starch paper, indicating presence of free chlorine (all organic substances have been destroyed). When providing a description of the decon solution waste to a waste transporter, do not label as CWAs. Classify the decon solution waste as "Corrosive Hazardous Waste, D002" if waste is at least 20% aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5. Classify the decon solution waste as "Industrial Waste" if pH is less than 12.

5.11 Summary of Chemical Agent Standards and CWA Sample Receipt and Handling Protocol

All requests for standards are provided through the PHILIS PM, to PHILIS Project Officer. If the request is related to refurbishing the inventory, the CWA Ordering Form and Inventory Tracking Document must be provided with the request. Project Officer will coordinate with the reference standard supplier, LLNL/CBC for preparation/shipment. LLNL/CBC will send an advance notice when the standards will be shipped and packaging details. LLNL/CBC packaging will include the 1.0-1.2 ml vial of standard placed in a baggie inside a plastic container inside a Ziploc bag. The Ziploc bag is placed inside a tamper-evident tape-sealed metal can containing an absorbent material within a small cardboard box. The packaging system used is DOT-approved. The LC will track the FEDEX priority shipment to assure timely delivery. The standard chemical agent concentrations are 10ppm/2000 ppm respectively. Additional amounts of standards may be authorized by EPA Emergency Management. All laboratory work with chemical agent will be performed using the buddy system.

5.12 Standard Requirements for Handling Chemical Warfare Agent Standards or Environmental Samples:

- Compliance with PHILIS CHP.
- PPE requirements: Double nitrile gloves with black outer nitrile gloves (extended cuffs recommended and/or duct tape sleeve to inner glove), disposable Tyvek lab coat, Tyvek sleeves, and safety glasses with side shields. An escape respirator needs to be within arm's reach of staff working chemical agent and available for quick donning. Face shields are optional except where splash hazards exist or contamination is possible. Long pants and non-permeable shoes or shoe covers must be worn when working with CWAs.
- Wash hands and other areas potentially affected by CWA contact prior to leaving the lab area.
- Buddy system (one person with "dirty hands" and one with "clean hands") will be employed at all times.
- Spill cleanup materials will be available.
- CWA accountability is required for all transfers or spills greater than 1 uL.
- Any abnormal events (e.g., spillage> 10ul inside hood, > 1 ul outside of hood) requires work to stop and notification of the LC and CHO prior to continuing.
- Pre-safety and end-of-day verification checklist completion required.

5.13 Chemical Warfare Agent Receiving and Analysis Flow Chart

PHILIS Edison receives LLNL standards at their facility and immediately places them unopened in a safe to hold awaiting delivery to destination site. At this time, PHILIS Edison is not permitted to run any CWA analysis at their Edison facility. All CWA work is taken out to a field or demonstration location. Edison does not receive any samples at their facility. Samples are sent to deployment site. The following is an example step-by-step process used at PHILIS Castle Rock. CWA Standards Receipt Processing:

- LC briefing of all staff for CWA planned activity. "Clean Hands" and "Dirty Hands" positions are assigned. AM on standby. CAO updates status board of planned operation. Required PPE gathered and fume hood prepared with necessary supplies including decon solution.
- Direct FedEx (enter side gate, Malibu Street) to proceed to back of building-E side or SW corner, right side of building, near Door I or H. The delivery truck should be followed on the security cameras.
- Request the FedEx driver to remain in the parking lot until completion of the initial visible screen of outside container (looking for wet spots). If wet spots are observed, don MSA CBRN respirator, scan using the AP4C, and blot with M8 paper. If the M8 paper turns dark green, yellow, or red there could be a potential for contamination.

- Quarantine the vehicle or area if there is any concern about a potential contamination. If a positive response with screening tests is indicated, then wipe samples will be collected and tested for confirmation. Should positive confirmation on a wipe be determined then EPA COR will be notified to assume control of the investigation. Notify LLNL. Quarantine is lifted only after the area of concern has been cleared.
- If visual screening is acceptable, AM signs the courier form and releases the FedEx driver. Remove packing slip before placing package in fume hood.
- Once PHILIS is in possession of the CWA standards, the standards will not be left unsecured.
- CAO takes the package into the SPA, and places the package in Hood E behind the 8-inch demarcation line, witnessed by the AM. The package is set beyond the 8-inch demarcation line, establishing a boundary between "contaminated" and "decontaminated" areas. "Clean Hands" times the 20 minute outer nitrile glove changeout for "Dirty Hands."
- CAO "Dirty Hands" performs the initial screening of the inner container with the AP4C and "Clean Hands" serves as an observer; primarily a visual check for damage, leakage, broken seal, etc. of the outside of the container. The AP4C is wiped with bleach before passing back to "Clean Hands." Kimwipes and a bleach squirt bottle work well for wiping items down with bleach.
- If wet spots are observed inside the package blot with M8 paper (e.g., if a cooler and ice packs were used for shipping due to outside temperatures blot condensation inside cooler with M8 paper). If no contamination is detected remove inner container and wipe with bleach.
- If there is any indication of leakage (coloration, observed liquid, broken glass), the package with contents can be placed in a secondary container with follow-up notification of LC, CHO, and notification of LLNL by the LC. The AM prepares all paperwork to return to LLNL, including the COC and material condition form and any other LLNL forms. Copies are required for Castle Rock with a copy provided to PHILIS CHO. Rather than returning the package, contents may be documented and placed in decon solution (e.g., if a broken vial is found document and place in decon solution). Notify LLNL and EPA COR.
- CAO opens the next layer of packaging, removing each standard one by one wiping the outer container with bleach and placing the vials in the vial rack on the contaminated side of the demarcation line.
- CAO announces the standard's ID information to the AM who records the information in on the accountability notebook sheet. Repeat for each vial.
- AM enters information into LIMS, prepares labels with Element's identification number, along with the expiration date and who prepared the standard solution.
- AM creates label for each vial. "Clean Hands" passes labels to CAO.
- CAO adds label to each vial and places vial back in the vial rack.

- CAO places vial rack in a lock-n-lock which is placed in another lock-n-lock with follow-up placement in the designated 5-gallon screw top container for AM transport to secure storage.
- The 5-gallon bucket containing the standards is placed on SPA step platform under railing to prevent walking down the steps with the standards, transport to the locked warehouse refrigerator.
- CAO wipes down the area with bleach, then removal of outer gloves and placing outer gloves in decon container.
- If different standards are involved and not as a mixture in one vial, separate containment is recommended if secondary standards preparation will be conducted at different times, thus different transfers to the SPA. Labeling of the containment container is required.
- The container in the bucket is then removed from the bucket and placed in the secure refrigerator in the cage.
- CAO and AM remove gloves and disposable lab coats and place them in non-hazardous waste bag (assumed non-contaminated) and replaces with new gloves and lab coat.
- All personnel wash hands, forearms, and any other areas that may have had contact with CWAs.
- End of day safety inspection completed by LC including AM verification of accountability notebook entries.
- AM completes and provides all LLNL COC and other forms back to the LLNL.

Preparation of Secondary Working Standards (SPA):

- CAO updates status board of planned operations following LC briefing of all staff for CWA planned activity.
- CAO verifies preparation of hazardous waste 5 gal. screw top container with bleach, vial rack, bleach, absorbent towels, wipes, marker, syringe, 2 40 or 60 mL vials $MeCl_2$ rinse solutions, pre-pared labels, hood operation, etc. is available and adequate.
- SPA Hood E is checked for all necessary supplies and equipment, walk-way cleared, signs posted, PPE worn.
- AM unlocks the Warehouse Refrigerator WC-1.
- CAO to place the CWA containment container on the step platform under the railing.
- AM opens the SPA door.
- CAO transports the contained CWA primary standards to Hood E. All activities in the hood will be conducted behind the 8-inch demarcation line.
- CAO removes the CWA standards and verifies proper contents and labeling.
- CAO uses a KimWipe or equivalent to break the top of the CWA primary standards vial.
- CAO prepares each working standard using gas-tight syringes. SEE SOP L-A-502 or L-A-602.

- CAO wipes the vial with a bleach wipe, places vial in the vial rack, places pre-label on the vial, verbally noting each step to AM.
- Place all opened primary standard vials and broken vial tops in the decon container and cover with bleach.
- AM records all preparation of the CWA secondary standards in the accountability notebook.
- CAO wipes down the vials and rack. The vial rack is placed in a lock-n-lock which is placed in another lock-n-lock. CAO disposes outer black gloves in decon container filled with bleach solution. Lock-n-lock containers are then placed on "clean side" inside the fume hood.
- CAO places lock-n-lock container into the 5-gal screw top container for AM to transport to secure storage.
- CAO places new outer black gloves on and wipes down the hood with bleach wipe and disposes of all waste material in the hazardous waste container. Designate hood as a satellite hazardous waste storage area to prevent daily transfer to the less confined main hazardous waste storage area.
- AM verifies Accountability Notebook entries with CAO initial entries.
- The CAO and AM return the CWA primary standards to the secure refrigerator in the warehouse and secure them.
- The AM places the CWA secondary standards in the BUS-1 refrigerator until they are needed for GC/MS analysis.
- All gloves, disposable lab coats, duct tape, used outside of the hood, and other materials that were not suspected of contamination are placed in the non-hazardous waste container.
- All individuals wash their hands, forearms prior to leaving.
- AM locks the lab unit door.
- LC performs End-of Day inspection and updates the HAZCOM status board.

Analysis of Chemical Warfare Agent Secondary Standards (Bus):

- CAO updates status board outside the Bus of planned operation following LC briefing of planned daily CWA activity. Includes all necessary posting of the lab units.
- Pre-check of Bus hood for required supplies.
- PPE is worn by all participants.
- AM unlocks BUS-1 refrigerator, CAO removes the double contained secondary standards.
- CAO places the secondary standards in the Bus hood and removes the secondary package from the container.

- If analysis is to be conducted within 1 hour, the secondary standards are moved behind the 8-inch line from the hood face and the vial rack removed from the Lock-n-Lock container.
- Analysis performed in conjunction with SOP L-A-602.
- Upon completion of the analysis, all vials or other containers containing spent liquids/residue of standards, extracts, or samples containing CWA materials are required to be uncapped and place in an open bleach container for 24 hours to reduce any heat/pressure from methylene chloride and bleach reaction.

Example Labeling of UD Standards for Accountability and Tracking (modify as necessary to correspond to site procedure):

- Primary standard: LIMS generated unique identification numbers C18I062 (C-Castle Rock, 18-year, I- {A- L} for the month, and 062 sixty second standard logged in) which is cross referenced to the LLNL/CBC ID's.
- Secondary standards: For calibrations and calibration verifications: LIMS generated unique identification number.

5.14 CWA Samples

Sample Receipt and Transport Container Screen:

- LC notified in advance of samples and background information (expected concentration range for contaminants, special hazards, potential for packaging surface contamination, field screening results, special instructions).
- LC conducts a pre-operational safety meeting with staff regarding special instructions for sample handling and analysis. HAZCOM status board updated.
- Delivery of samples will be in the SPA, Door I.
- Request the field technician delivering the sample(s) to remain until the interview and initial screening is completed.
- Perform outer transport container initial screen in SPA Hood E, beyond the 8-inch demarcation line (if an outdoor initial screening area has not been established).
- Use the Hazardous and CWA Sample Screening Form (ATTACHMENT I) as the primary screening instruction with documenting observations.
- Perform an initial inspection of outer package for damages, broken seals, etc. Any visible damage, leakage, or coloration requires the AM to conduct an air monitoring AP4C screen and the CAO to perform a M8 paper screen test along with the AM. The LC and CHO will be notified of the findings. Continue if initial inspection is acceptable.
- The CAO will open the package and perform a screen of the inner package head space using AP4C. Proceed to Secondary Containment and Primary Sample Container Screen.
- CAO wipes the outer sample container with a bleach wipe.

- CAO announces the sample information and the AM documents the information on the sample log form with later recording in the LIMS.

Secondary Containment and Primary Sample Container Screen:

- Perform screen in designated SPA laboratory hood E.
- Open outer packaging to the secondary container and perform visual inspection.
- Screen for gross surface contamination using AP4C.
- Screen headspace of transport container holding the sample for vapors using the CWA air monitor equipment (AP4C).
- Wipe the outer container including any labels with bleach wipes.
- Remove the secondary sample container from the transport container and check for surface contamination using M8 paper.
- Wipe the sample container with a bleach wipe.
- Place the sample in a clean secondary containment and place in a carrying container (tertiary containment).
- Complete and verify the sample receipt and screening form and the COC.
- Notify the LC and AM of the screening completion and ready for transport to the designated sample storage refrigerator (SPA -1 or 2) in the SPA unit for processing.

5.15 Acute Toxicity Data and Exposure Limits for CWAs and Nerve Agents

The overall risk of PHILIS CWA sample receiving and processing is determined to be low based on the manner of use and established control measures for expected ultra-dilute standards or samples as noted in Acute Toxicity Data and Exposure Limits for CWAs and Nerve Agents.

Acute Toxicity Data and Exposure Limits for CWAs and Nerve Agents

Agent/Chemical	Acute Toxicity (Animal Toxicity; rat)			Occupational Exposure Limits			General Population-AEGLs		
	LD50 Oral mg/kg	LD50 Skin mg/kg	LC50 mg/min/m^3 (~10 min)	IDLH mg/m^3	STEL-15 min mg/m^3	TWA-8-hr mg/m^3	AEGL-1 1 hr mg/m^3	AEGL-2 1 hr mg/m^3	AEGL-3 1 hr mg/m^3
CWAs									
Sarin (GB)	0.55	24 (1700 mg)	100	0.1	1E-4	3E-5	0.0028	0.035	0.013
Soman (GD)	0.12	4.2 (300 mg)	70	0.05	5E-5	3E-5	0.0014	0.18	0.13
Tabun (GA)	0.3-0.7	57 (4000 mg)	200	0.1	1E-4	3E-5	0.0028	0.035	0.26?
Mustard Gas-Sulfur (HD)	0.7	100 (7000 mg)	1500	0.7	3E-3	4E-4	0.067	0.10	2.1
VX	0.015	0.1 (10 mg)	50	0.003	1E-5	1E-6	0.00017	0.0029	0.010
Lewisite	50	24 (1700 mg)	1200-1500				NR	0.12	0.74
FGAs									
A-230	0.015	0.1 (10 mg)	50	0.003	1E-5	1E-6	0.00017	0.0029	0.010
A-232	0.015	0.1 (10 mg)	50	0.003	1E-5	1E-6	0.00017	0.0029	0.010
A-234	0.015	0.1 (10 mg)	50	0.003	1E-5	1E-6	0.00017	0.0029	0.010
Pest/Insecticides/Others									
Malathion (O-P)	800	2000	Not Listed	250	Not Listed	15 Skin (ACGIH)	15	120	390
Parathion (O-P)	3	6-50	840	10	Not Listed	0.05 Skin (ACGIH)	NR	1.5	2.0
Carbaryl ("Sevin") Carbamate	307	Not Listed			Not Listed	Not Listed	NR	NR	NR
Aldicarb ("Temik") Carbamate	0.8	Not Listed			Not Listed	Not Listed	NR	0.087	0.26
Tetramine Rodenticide	0.1 Human	550			Not Listed	Not Listed	NR	NR	NR

Fourth Generation Agents (FGAs) - Novichok A-series nerve agents (A-230, A-232, A-234) studies are still in their early phases. Novichok is comparable (expected to behave somewhat similarly) to VX, although more persistent. Novichok A-series SDSs reference VX Permissible Exposure Limits (PELs). Novichok A-series is unlikely to present a vapor hazard due to their low volatility but are more persistent (pose a significant cross-contamination hazard and may require more rigorous medical treatment) than other nerve agents. VX exposure data is currently being used for FGAs in this table. This information will be updated as FGA exposure data becomes available.

Acute Exposure Guideline Levels (AEGLs) represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. AEGL-2 and AEGL-3, and AEGL-1 values were developed for each of five exposure periods (10 and 30 minutes, 1 hour, 4 hours, and 8 hours) and will be distinguished by varying degrees of severity of toxic effects. It is believed that the recommended exposure levels are applicable to the general population including infants and children, and other individuals who may be susceptible. The three AEGLs are defined as follows:

- AEGL-1 is the airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic no sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
- AEGL-2 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

- AEGL-3 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Exposure Corresponding Initial Symptoms:

The following table summarizes route of exposure, exposure type, and CWA concentration levels where effect is observed:

Route	Form	Effect	Exposure Type	Tabun (GA) mg-min/m^3	Sarin (GB) mg-min/m^3	Soman (GD) mg-min/m^3	VX mg-min/m^3
Ocular	Vapor	Miosis	ECt50	NA	< 2	<2	< 0.09
Inhalation	Vapor	Runny Nose	ECt50	NA	<2	<2	< 0.09
Inhalation	Vapor	Incapacitation	ICt50	NA	35	35	25

- ECt50 is the Effective Concentration 50%. This differs from LD50, which is the lethal dose normally administered orally, but the "C" relates to airborne concentrations used for exposure of the tested species.
- ICt50 is the incapacitating airborne concentration affecting 50% of the tested species.
- Safety Factor Range; Initial symptoms to incapacitation: < 2- 35 mg-min/m^3. When designing for safe operations include an additional factor of 20 times the limit.

It is highly unlikely that there would be exposure from PHILIS laboratory operations that would produce symptoms as based on the risk and the above table of symptoms.

Hazard Risk Analysis for Worst Case Scenario:

Primary standards of ultra-dilute chemical agents are of a 10 ppm maximum concentration and are packaged in 1 ml vials. Several vials of different chemical agents may be in used in the hood for preparing secondary standards consisting of a mixture of chemical agents. However, the primary standard vials are capped immediately following transfer to the secondary standards, therefore only 1 primary standard vial is uncapped at any time. A worst-case scenario would be the spillage of a maximum of 1 ml of a 10 ppm chemical agent primary standard. In the hazard calculations, no credit was provided for the spill contents absorbed in the absorbent covering the hood working surface and it was assumed that the material is totally vaporized, which is extremely unlikely due to low vapor pressure.

- 10 ppm/1 ml = 10 mg/1000 ml X 1 ml = 0.010 mg spillage
- Spillage in Hood: SPA E (CWA Designated Hood): Volumetric Flow rate, cfm = 334 ft^3/min. (3.34 ft^2 X 100 ft/min)
- 0.010 mg/334 ft^3/min X ft^3/0.0283 m^3 = 0.001 mg/m^3/min After 15 min: 5010 ft^3 exhausted; therefore, air concentration in hood = 0.010/5010ft^3 x ft^3/0.0283 m^3 = 7E^{-5} mg/m^3 (slightly less than the STEL of 1E^{-4}) which is totally enclosed in the hood

- Spillage in SPA Lab Unit: SPA unit volume is 2800 ft^3 with an air exchange rate every 2 min. (30/hr)

  0.010 mg/2800 ft3 x ft3/0.0283 m3 = 1.2 E-4 mg/m3, the air concentration would be reduced by ½ every 2 min. Therefore in 15 minutes the approximate air concentration would be 1 E-5 mg/m3 which is 1/10 the STEL.

The Worst-Case Scenarios described above are less than the exposure limits for unprotected laboratory personnel.

Sensitivity of Field Monitoring Equipment:

Example:

- AP4C: Lowest Detection, mg/m^3: 0.002 G Agents, 0.1 HD

The example above for PHILIS field monitoring cannot be used for unprotected individuals in routine laboratory occupational or general population monitoring. This type of monitoring is only effective for verification of proper selection of respiratory protection using Type A or B respiratory protection with respirator protection factors of 1,000-10,000. For example, the air concentration/exposure for a Type A suit with a corresponding respirator safety factor of 10,000 could be as high 10,000 X Exposure Limit in terms of OSHA compliance. Therefore, the Sarin air concentration for a STEL exposure could be as high as 10,000 X $1E^{-4}$ mg/m^3 equating to 1 mg/m^3. The AP4C with sensitivities of 0.002 mg/m^3, respectively can verify proper PPE selection. The AP4C can detect air concentration at the IDLH of 0.1 mg/m^3 for unprotected individuals. It is also noted that instrument sensitivity/detection limit should be 1/10 of the exposure limit.

The most sensitive field monitoring/near term monitoring is a CAM/thermal desorption system as employed by the ARMY at their arsenals and portable GC/MS. The most effective monitoring for unprotected individuals to verify likely exposure using industrial hygiene exposure modeling is thermal desorption with GC/MS.

Determination of least amount of analyte required to meet the lower detection limit:

Examples (Depends on sample volume, exposure limit), using Sarin:

- STEL (15 min.): Assume a sampling for 15 min. period at a sample rate of 500 ml/min. Sarin STEL is 1E-4 mg/m^3.

  0.0001 mg/ m^3 X m^3/1000L X 1L/1000 ml X 500 ml/min X 15 min = $7.5E^{-7}$ mg 7.5 E^{-7} mg X $1E^{+6}$ pg/mg = 0.75 pg Desired calculation curve: 0.1-10 pg

6.0 CRITERIA FOR IMPLEMENTATION OF CONTROL MEASURES

6.1 Air Sampling and Exposure Assessment

The CHO will develop a workplace air monitoring plan. Air monitoring will be conducted based on the potential for exposure to chemical substances in a manner consistent with the chemical's use, physical and chemical properties, and instituted control measures, or as specified by specific codes or regulations. Typically, air monitoring will be conducted if a job hazard analysis determines that exposure could be greater than 1/4 of the OSHA PEL or the ACGIH TLVs.

The results of air monitoring and exposure assessments will be made available to affected employees with the recordkeeping maintained by the CHO.

Prior to handling CWAs and other Particularly Hazardous Substances, a job hazard analysis must be performed by the CHO. This may include gathering background information of environmental samples and pre-screening for suspected hazards. Work will not commence without the approval of the CHO.

CWA screening and monitoring will be conducted using the Proengin AP4C or other methods for screening airborne CWAs. Screening for surface contamination of liquids will use M8 paper, the AP4C to screen for high contamination levels, and surface wipe sampling and GC/MS conducted for low contamination and following decontamination procedures. Analytical sensitivity of screening methods is adequate for detection levels at approximately the Immediately Dangerous to Life and Health (IDLH) but fall short for standard occupational or general population exposure levels. The following is a summary of the sensitivities for the CWA screening monitoring using the AP4C.

Monitoring	Sensitivity	Reference	Comment
AP4C, Level 1 (lowest MDL)	In mg/m^3: G and V (0.002), H (0.1) and L (0.5) In ppb: G and V (0.15 ppb), H (70 ppb), and L (150 mg/m^3)	Proengin manufacturer	Positive comments regarding G agent sensitivity with less positive review for H agent sensitivity Real time monitoring
M-8 Paper	100-µm drop (~20µl) pure liquid of G, V, and H	Chemical and Biological Terrorism, National Research Council, 1999	Comes in a book of 25 sheets normally used to check liquids Useful in detecting liquid FGAs
M-9 Paper	100-µm drop (~20µl) pure liquid of G, V, and H	Chemical and Biological Terrorism, National Research Council, 1999	A roll of adhesive tape normally used as a patch on protective clothing

Occupational permissible exposure levels are not established by OSHA or the ACGIH. The most updated consensus standards for CWA occupational and general population exposure limits, in addition to Acute Exposure Guideline Levels (AEGL), are as follows:

Agent	General Population Limit (GPL) 24 hr/day, lifetime, mg/m3	Worker Limit (WL) 8hr/day, 5 days/wk, mg/m3	WL Acute Exposure Short-Term Exposure Limit (STEL), 15 min., mg/m3	WL Acute Exposure Immediate Dangerous Life & Health (IDLH), 1-time exposure, mg/m3	AEGLs General Population mg/m3 http://www.epa.gov/oppt/aegl/index.htm			
					AEGL-1 1-hr	AEGL-1 8-hr	AEGL-2 1-hr	AEGL-2 8-hr
GA, GB	1×10^{-6}	3×10^{-5}	1×10^{-4}	0.1	2.8×10^{-3}	1×10^{-3}	3.5×10^{-2}	1.3×10^{-2}
GD, GF	1×10^{-6}	3×10^{-5}	5×10^{-5}	0.05	Not Available	Not Available	Not Available	Not Available
VX	6×10^{-7}	1×10^{-6}	1×10^{-5}	0.003	1×10^{-7}	7.1×10^{-5}	2.9×10^{-3}	1×10^{-3}
HD	2×10^{-5}	4×10^{-4}	0.003	0.7	0.067	0.0083	0.10	0.013
Lewisite	N/A	0.003	0.003	0.003	Not Rated	Not Rated	0.12	0.018
A-230	6×10^{-7}	1×10^{-6}	1×10^{-5}	0.003	1×10^{-7}	7.1×10^{-5}	2.9×10^{-3}	1×10^{-3}
A-232	6×10^{-7}	1×10^{-6}	1×10^{-5}	0.003	1×10^{-7}	7.1×10^{-5}	2.9×10^{-3}	1×10^{-3}
A-234	6×10^{-7}	1×10^{-6}	1×10^{-5}	0.003	1×10^{-7}	7.1×10^{-5}	2.9×10^{-3}	1×10^{-3}

Notes:

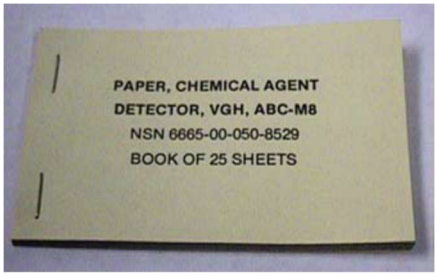
1. G nerve agent exposure at STEL should not exceed 4 times per day with at least 60 minutes between successive exposures in this range
2. VX nerve agent exposure at STEL should not exceed once per day
3. Use VX PELs for FGA Novichok A-series until more comprehensive data is available. SDSs refer to VX exposure limits.

6.2 Workplace monitoring equipment

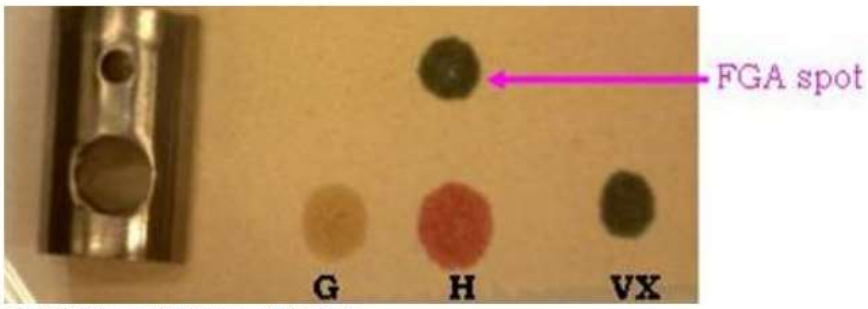
- AP4C is a handheld, portable chemical contamination detector used to detect compounds of phosphorus (G series and V agents: GA, GB, GD, GE, GF, VE, and VX), FGA non-traditional agents (e.g., Novichok), compounds of sulfur (H, HD, HL agents), arsenic compounds (contained in L, SA, DM), and other gases (e.g., Ammonia, Cyanogen chloride, Cyahydric acid). The AP4C is a highly sensitive flame spectrometer that can quickly detect chemical agents in the form of vapor, aerosols, and dust. Training will be provided for each user of the AP4C. Annual calibration check required.

- M8 Chemical Agent Detector Paper is issued in a book of 25 tan sheets of chemically treated, dye-impregnated paper, which is perforated for easy removal. A color comparison bar chart is printed on the inside of the front cover of the book. The book is heat sealed in a polyethylene envelope. Detach a sheet of detector paper from the book and attach it to clothing or place it on a surface so it can be exposed to drops of liquid or splash of chemical agents. If colored spots appear, chemical agent is present. False positive detection may occur (e.g., Methylene chloride; oil-based products; liquid insecticide, antifreeze, and petroleum products; influenced by freezing or hot temperatures). Positive results should always be confirmed by other means. Compare colored spots with colors on inside cover to determine type of agent. The paper may also be used to detect liquid contamination by placing the paper in contact with the suspected surface.

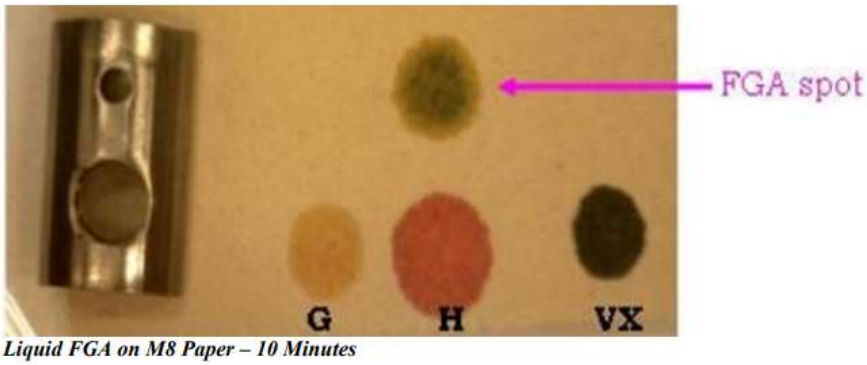
- M8 paper is used to detect the presence of liquid VGH chemical agents. When a sheet is brought in contact with liquid nerve agent or blister agents, they react with chemicals in the paper to produce agent specific color changes. There are three sensitive indicator dyes suspended in the paper matrix. The paper is blotted on a suspected liquid agent and observed for a color change. A color chart inside the front cover of the booklet is used for comparison. The chemical reaction between the M8 paper and chemical agent creates a pH dependent color change on the M8 paper; V nerve agents turn the M8 paper dark green, G nerve agents turn it yellow, and H blister agents turn it red.
- M8 paper cannot be used to detect chemical agents in water, aerosol agents in the air, or vapors. M8 paper is best suited for non-porous materials.



- To test liquids for the presence of a chemical agent, a piece of M8 paper is attached to a probe or similar device or held in a gloved hand. The paper is then blotted, not rubbed, into the suspect liquid. Rubbing the M8 paper into the suspect liquid may cause abrasions on the paper and cause false positive red detection streaks. After the M8 paper is exposed to a liquid, the person conducting the test then compares the color changes on the paper to the color chart inside the cover of the M8 paper tablet: yellow indicates the presence of a G nerve agent, green indicates VX nerve agent, and red indicates either H or L blister agents. If the paper does not change color, CWAs that M8 paper is capable of detecting are not present at the minimum detectable concentration level of the detection paper. The following is an M8 paper detection example found in Fourth Generation Agents: Reference Guide (January 2019):



Liquid FGA on M8 Paper – 10 Seconds



Liquid FGA on M8 Paper – 10 Minutes

6.3 Housekeeping

Each laboratory worker is directly responsible for the cleanliness of his or her workspace, and jointly responsible for common areas of the laboratory. Laboratory management will insist on the maintenance of housekeeping standards.

The following procedures apply to the housekeeping standards of the laboratory.

- All small, easy to manage chemical spills on lab benches or floors will be immediately cleaned and properly disposed of using the required lab spill kits. Large chemical (non-CWA) spills (> 4 liters) which are deemed too hazardous or complex for laboratory personnel cleanup require an Emergency Response Team and/or contracted environmental cleanup firm.

- All lab benches will be kept clear of equipment and chemicals except those necessary for the work currently being performed.
- The work area will be cleaned at the end of each operation and each shift.
- All temporary apparatus will be thoroughly cleaned and returned to storage upon completion of usage.
- All floors, aisles, exits, fire extinguishing equipment, eyewashes, showers, electrical disconnects and other emergency equipment will remain unobstructed.
- All labels will face to the front.
- Chemical containers will be clean, properly labeled and returned to storage upon completion of usage.
- All chemical wastes will be disposed of in accordance with the waste disposal plan as addressed in Section 13.

6.4 Safety and Emergency Equipment

The following procedures apply to safety and emergency equipment in the laboratory:

- Telephone numbers of emergency personnel (e.g., Fire, Medical, Police, Environmental Cleanup Contractor), CHO, PM, and other supporting personnel are posted as addressed in Section 15.
- Laboratory areas will comply with NFPA 45, Fire Protection for Laboratories. Fire protection equipment will include ABC fire extinguishers, smoke and carbon monoxide detectors, spill materials and a first aid kit in each lab unit. The Honeywell Notifier Inergen Suppression System, installed for the mobile labs when stored indoors, must be tested semi-annually by an approved vendor.
- All laboratory personnel will be trained in the proper use of fire extinguishers and emergency procedures with an annual refresher. Prior to the procurement of new chemicals, the LC will verify that existing extinguishers and other emergency equipment are appropriate for such chemicals.
- Each laboratory will maintain an OSHA approved emergency eyewash, and an emergency shower, where significant corrosive materials are used, such as in the SPA.
- All employees who might be exposed to chemical splashes will be instructed in the location and proper usage of emergency showers and eyewashes. The eyewash station and emergency shower will be inspected weekly in accordance with ANSI Z358.1, and the results documented on the inspection card. No chemical operations are allowed if the eyewash station is disabled unless a portable eyewash bottle is available as a temporary measure.
- Location signs for safety and emergency equipment must be posted.
- Spill kits are available in each lab unit consisting of spill absorbing and or neutralizing materials with other spill equipment necessary to address minor/manageable lab spills (e.g., < 4 liters).

- CBRN rated escape respirators are available to staff during CWA and FGA operations. All staff are to be trained in the use of escape respirators. Respirators should be checked before CWA work begins and require documented monthly inspections. When working with CWAs and FGAs in the lab, all personnel shall maintain in their possession (within arm's reach) an escape respirator for use in the event of an accidental spill or release. Escape respirator usage is limited for emergency use only. A MSA Ultra-Elite CBRN full-face respirator is required for particularly hazardous chemical spill cleanup. See Section 5.5 for additional information.
- First aid and exposure incident response kits are available in each mobile lab unit where CWAs, FGAs and opioids may be handled. DuoDote Auto-Injectors (atropine and pralidoxime chloride injection) are provided for the treatment of poisoning by organophosphorous nerve agents as well as organophosphorous insecticides. NARCAN nasal spray (naloxone HCL) is available to all staff at risk for opioid exposure. Staff are to be trained in the signs of exposure and proper use of the antidotes. Aid kit custody seals are to be checked monthly and a full inspection of the exposure incident response kits conducted quarterly.
- Supplies are available to assist in personal decon during a suspected CWA or FGA exposure event. Reactive skin decontamination lotion (RSDL) kits are to be used when there is a delay in receiving wet decon. Drench hoses and emergency showers may be used for wet decon, but additional decon supplies have been purchased for setting up a dedicated area for wet decon (e.g., privacy tent, tarp, water collection pools, sprayer, hose with sprayer nozzle, splash protection kits, Doff-It and Don-It personal privacy kits. Soap, sponges, and other incident response supplies are located in the exposure incident response kits.

6.5 CWA Exposure Signs and Symptoms (Organophosphorus Poisoning)

Mild symptoms:

- Blurred vision, miosis (excessive constriction of the pupils)
- Excessive, unexplained teary eyes
- Excessive, unexplained runny nose
- Increased salivation such as sudden drooling
- Chest tightness or difficulty breathing
- Tremors throughout the body or muscular twitching
- Nausea and/or vomiting
- Unexplained wheezing, coughing, or increased airway secretions
- Acute onset of stomach cramps
- Tachycardia or bradycardia (abnormally fast or slow heartbeat)

Severe symptoms:

- Strange or confused behavior
- Severe difficulty breathing or copious secretions from lungs/airway
- Severe muscular twitching and general weakness
- Involuntary urination and defecation
- Convulsions
- Loss of consciousness
- Respiratory arrest (possibly leading to death)

Guidelines for Administering a DuoDote:

- FOR NERVE AGENT ONLY.
- If a person is exhibiting mild symptoms, administer 1 dose into the person's mid-outer thigh, and immediately seek medical care.
- If a person has any severe symptoms, administer 3 doses into the person's mid-outer thigh in rapid succession, and immediately seek medical care.
- You can inject through clothing, but make sure pockets are empty.
- Keep used DuoDotes with the individual for medical personnel to be aware of how many injections were administered.

7.0 ENGINEERING CONTROLS

The engineering controls installed in the laboratory are intended to minimize any employee exposure to chemical and physical hazards to levels that are well below exposure guidelines. These controls must be maintained in proper working order.

No modification or improper functioning of engineering controls is permissible under any circumstances unless other means of employee protection is provided, with the approval of the LC and the CHO.

All employees will follow proper work practices when using the engineering controls.

7.1 Local Exhaust Ventilation

The following procedures will apply to the use of local exhaust ventilation:

- Local exhaust hoods/capturing vents will be placed as close as possible to sources of the air contaminant.
- Ventilation fans will operate when hoods are being used and upon completion of operations in the hood.

- After using hoods, operate the fan for an additional period of time sufficient to clear residual contaminants from the ductwork (at least 30 minutes).
- The ventilation system will be inspected quarterly for face velocity, hood monitoring system (e.g., airflow, alarm), and safe usage by the CHO or the Facility Manager. A record of each inspection will be maintained by the Facility Manager.
- CHO notification is required for any major changes to the ventilation system or laboratory operations requiring lab hood controls.

7.2 Laboratory Fume Hoods

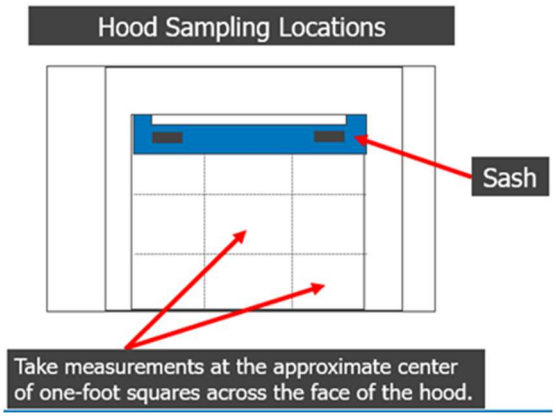
The laboratory fume hoods will be utilized for all chemical procedures which might result in the release of hazardous chemical vapors or dust. Fume hoods will be used for all procedures involving CWA materials and substances which are appreciably volatile or where heating or chemical reactions of the chemical would produce vapors, including but not limited to solvents, acids, and bases.

Ventilation surveys will be conducted using the Fume Hood Ventilation Survey Form (ATTACHMENT O). Ventilation surveys will be performed quarterly and on an as needed basis (e.g., after the laboratory reaches a deployment site, when there has been a significant change in hood configuration, following maintenance of hood ventilation system). Surveys must be performed by a trained health and safety representative or designee. Hot wire anemometer and smoke tube testing are to be conducted during quarterly surveys. A calibrated instrument must be used. Fume hood testing requirements are discussed in depth in the PHILIS Ventilation Program Management Plan.

Instructions for conducting a fume hood ventilation survey are as follows:

- Preparation of hoods before monitoring.
    - Prior to the flow test, ensure that hoods with TSI flow controllers are set at 100 FPM
    - Hoods provided with sash stops shall be tested with the sash fully open to the sash stops (unless there is a known use position which is lower)
    - Air flow readings area taken for each 1 square foot area of the hood face (at the hood face) with the readings subsequently averaged
    - A hood's flow rate will be considered acceptable if the overall average face velocity is 100 FPM, + or - 20 FPM
- Hot Wire Anemometer.
    - Measure at center of each square foot of hood face area
    - Hold instrument measuring point in the plane of the sash
    - Stand clear of hood face so as not to affect the reading
    - Additional readings if equipped with horizontal sliding sash

- Cross draft readings of the hood face shall also be obtained with the hood sash open and the velocity probe positioned perpendicular to the hood face and within 6" of the sash plane. The reading should not be greater than 30% of the averaged face velocity



- Smoke Tubes.
  - Use small-volume generation smoke tubes
  - Smoke test with hood sash at sash stops or full open
  - Place tube six inches inside hood sash plane
  - Test all sides across the face and around any equipment
  - Fail hood if smoke escapes hood or indicates reverse flow and/or dead spots
  - Dry ice is an acceptable substitute - look for smoke/gas excursion at hood face or other areas of hood
- Actions if Fume Hood Passes.
  - Post laboratory hood flow check sticker on fume hood with average reading, date, and signature of monitoring staff
- Actions if Fume Hood Fails.
  - Hood fails test if flow rates are not within limits
  - Attach warning label to fume hood
    - Warning! This Laboratory Hood Is Not Functioning Properly. DO NOT USE. Date Posted and Initials
    - Caution. This fume hood did not meet all safety criteria. The hood can still be used under the following conditions: ___. Date Posted and Initials

The following work practices apply to the use of hoods:

- Confirm adequate hood ventilation performance prior to opening chemical containers inside the hood. This includes checking the airflow by observing the hood airflow monitor (if equipped) or using an airflow meter, smoke testing, or by holding a piece of paper at the face of the hood and observing the movement of the paper. The sash must be operable in proper movement and stop at the sash stops. The required average airflow is 100 +/- 20 feet per minute with no significant turbulence inside the hood. Refer to fume hood user manual for more specific operational requirements.
- Do not use a fume hood operating outside of its acceptable airflow range. Post a do not use warning sign on the hood and notify the LC.
- When working with chemicals in the hood, maintain the sash height at the sash position noted on the hood.
- Storage of chemicals and equipment inside the hood should be kept to a minimum.
- Minimize interference with the laminar flow of air into the hood by preventing blockage of the airflow slots with equipment and materials. Locate larger items as far back as possible without blocking the airflow (e.g., 5-gal screw top decon bucket). Raise large equipment (e.g., centrifuges, shaker tables, and balances) 2 inches to provide airflow to the baffles and reduce any turbulence from air blockage. Perform smoke tests to see the airflow and to help find ways to minimize interference.
- Leave the hood operating when it is not in active use if hazardous chemicals are contained inside the hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when the hood is non-operational.
- Sample processing tasks performed inside the hood must occur behind the 8-inch demarcation line for effective airborne contamination capture. Hoods will have a red line marking the 8-inch distance behind the sash. All chemicals and equipment are to be kept behind this line when working in the hood.
- Outer black nitrile gloves will be worn on top of nitrile gloves when working with CWA and FGA materials in the hood. The black nitrile gloves are to stay in the hood and behind the red line. This is referred to as the Redline Discipline. Before beginning a CWA operation, put clean items into hood onto clean (freshly placed) paper. Ensure there is enough decontaminating solution in the hood to decon reusable items and the material being handled.
- The hoods will not be used as a means of disposal for volatile chemicals, solvent-saturated rags, or other material.

7.3 Hood Exhaust and Filtration System

The exhaust air from each of the lab unit laboratory hoods are designed to be filtered using a charcoal filter and a particulate pre-filter as a minimum for general solvents. Laboratory operations involving unknown or non-characterized highly toxic or hazardous substances such as CWAs will have a 2 or 3-tier system consisting of a high-efficiency particulate air (HEPA) filter, carbon primary filter, and secondary carbon containment filtration unit prior to exiting into the ambient air. ASZM-TEDA impregnated carbon filtration will also be considered. This provides a high degree of air filtration. An example laboratory unit requiring the special filtration system is the Sample Preparation Area (SPA) where screening of the environmental samples is conducted. A laboratory area performing instrumentation analysis with limited chemical agent handling where the hazard was previously screened or environmental samples treated (e.g., diluted) does not require HEPA and carbon special exhaust filtration under normal circumstances.

A bag/in and bag/out design is recommended to avoid airborne contamination in removing the filters.

Make up air hazard controls are established for PHILIS vehicles to eliminate the potential of exposure. The PAL laboratory unit performs only GC-MS instrumentation analysis and has 100% make-up air from the outside with approximately 17 changes/hr. The SLA and SPA have approximately 100% make-up air from outside air with 30 changes/hr. The Bus, performing only GC-MS instrumentation analysis, has 100% outside make-up air. The Edison SPA-01, presently used as a chemical preparation unit, has the same design specifications as the SLA. The Edison mobile laboratory units performing analysis are similar in design as the Castle Rock PAL unit. The following are requirements for the filtration system:

- No laboratory operations requiring hood operability are permitted while the filtration system is disabled or if the system does not meet operating parameters.
- Modification to the filtration system, including a change in filtering characteristics, needs to be approved by the CHO, PM, LC, and the Facilities Manager.
- Periodic checks of the filtration system, including differential pressure gauge readings, will be conducted in accordance with the manufacturer operating guidance and upon a trend of significant reduction of lab hood airflow or other indicators of abnormal exhaust ventilation.
- The filtration system will be checked for breakthrough based on the CHO assessment or manufacturer's recommendations. This may include evaluation of chemical usage in the hoods with air monitoring using detector tubes for solvent and thermal desorption tube sampling at the filtration discharge point.
- Removal of the filters will be accomplished in conjunction with the CHO guidelines for PPE, handling, and disposal. At a minimum, disposable lab coat, cut-resistant gloves, and an MSA Ultra Elite CBRN respirator is required for filters containing potential CWAs or highly toxic material. Check with waste hauler to see if filters may be disposed of as solid, organic waste.

- Maintenance work required for the hood, ductwork, and filtration system will only be conducted following a review by the CHO, PM, LC, and Facilities Manager. In some cases, decontamination of the area for maintenance work will be required with proper selection of PPE and training. Changing ASZM-TEDA filters may require mechanical lifting devices in changing/loading the filters.

8.0 PHYSCIAL HAZARDS

There are numerous potential physical hazards present in all laboratory operations. In many lab operations, physical hazards are overlooked where the greatest attention is focused on chemical exposure hazards. However, physical hazards are responsible for the majority of lab injuries. It is important to be aware of these hazards, preplan, use personal protective equipment, and follow basic safety rules with special attention to the safety warnings provided in the manufacture equipment/instrument manuals. The following are physical hazards associated with PHILIS equipment and tasks conducted at the home base or during mobilization:

8.1 Equipment Related Hazards

Centrifuge

- Mechanical failure.
- Aerosolization of chemical materials resulting in exposure.
- Handle, load, clean, and inspect rotors as recommended by the manufacturer.
- Pay careful attention to instructions on balancing samples. Tolerances for balancing are often very restricted. Check the condition of tubes and bottles. Make sure you have secured the lid to the rotor and the rotor to the centrifuge.
- Whenever centrifuging a high hazard material, it may be necessary to place the centrifuge in a containment hood for the centrifuge as additional precaution or the use of safety cups to protect any breakage of tubes within the centrifuge. Avoid pop-top tubes which can create aerosols upon opening. Use screw capped tubes instead.

Electrical Safety

- Electrical shock.
- Electrical fires caused by shorts and overloaded circuits or wiring.
- Sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials.
- Most incidents are a result of unsafe work practices, improper equipment use, and faulty equipment. Read and follow all equipment manufacturer’s operating instructions for proper use before operating new equipment.
- Access panels and covers may shield high voltages. Do not take apart laboratory instruments or attempt electrical repairs unless you are a qualified technician assigned to perform electrical work by your supervisor. Fixed wiring may only be repaired or modified by properly qualified facilities personnel or an approved repair service vendor.

- Wet hands, salt solutions, and some anti-static devices may enhance electrical contact with the body. Use extra caution and ground fault circuit interrupter (GFCI) devices when these conditions exist.
- Remove rings, watches, and other jewelry, which may become part of an electrical circuit when working around electricity.
- The accidental or unexpected starting of electrical equipment can cause severe injury or death. Common laboratory equipment that may automatically start includes:
    - Vacuum pumps (may start from remote pressure transducer or instrument controller)
    - Air compressors (may start on demand from pressure set point)
    - Auto samplers (may move under computer or instrument control)
    - Ovens (thermostat controlled)
    - Chillers (thermostat controlled)
    - Air conditioners (thermostat controlled)
    - Sump or feed pumps (actuated by fluid level)
- Unplugging something does not necessarily make it safe. Capacitors and battery circuits may remain live or store a lethal charge, such as those found in Uninterruptible Power Supplies. Be extra cautious with these types of devices and apply the applicable energy controls techniques to mitigate the hazards.
- Improper use of extension cords is hazardous. If you need additional power supply, the best solution is to have additional outlets installed by Facilities. Do not use extension cords or power strips ("power taps") as a substitute for permanent wiring. Never daisy chain extension cords or power strips to get power where it is needed.
- Corrosives found in the laboratory environment may deteriorate wiring or insulation. Common causes of cracked insulation are mineral acids and bases, ozone, heat, and ultraviolet light. Inspect all electrical and extension cords for wear and tear. Pay particular attention near the plug and where the cord connects to the equipment. If you discover a frayed electrical cord or corroded contacts, lock out the equipment and make arrangements for repair before use.
- Many electrical devices are also potential ignition sources. Never store flammable liquids such as solvents or fuels near electrical equipment.
- A well-planned layout of temporary wiring will reduce the dangers of fire, shock, and tripping hazards. Electrical equipment must not be installed near eye wash/safety shower stations.
- Access to electric panels must be unobstructed; a minimum 3’ of clearance is required in front of every electrical panel. Each panel must have all the circuit breakers labeled as to what they control. Contact Facilities if breaker panels, outlets, etc. are missing the required labeling.

Gas Chromatography

- Gas chromatography may require the use of compressed gases (nitrogen, hydrogen, argon, helium), and flammable and toxic chemicals.
- Perform periodic visual inspections and pressure leak tests of the sampling system plumbing, fittings, and valves.
- Follow the manufacturer's instructions when installing columns. Glass or fused capillary columns are fragile - handle them with care and wear safety glasses to protect eyes from flying particles while handling, cutting, or installing capillary columns.
- Turn off and allow heated areas such as the oven, inlet, and detector, as well as connected hardware, to cool down before touching them.
- To avoid electrical shock, turn off the instrument and disconnect the power cord at its receptacle whenever the access panel is removed
- Turn off the hydrogen gas supply at its source and allow lines to evacuate before changing columns or servicing the instrument.
- When using hydrogen as fuel (flame ionization FID and nitrogen-phosphorus detectors NPD), ensure that a column or cap is connected to the inlet fitting whenever hydrogen is supplied to the instrument to avoid buildup of explosive hydrogen gas in the oven.
- Measure hydrogen gas and air separately when determining gas flow rates.
- Perform a radioactive leak test (wipe test) on electron capture detectors (ECDs) at least every 6 months as required by PHILIS in accordance with NRC/manufacturers general license for radioactive sealed source.
- Ensure that the exhaust from (ECDs) is vented to the outside.
- When performing split sampling, connect the split vent to an exhaust ventilation system or appropriate chemical trap if toxic materials are analyzed or hydrogen is used as the carrier gas.
- Use only helium or nitrogen gas, never hydrogen, to condition a chemical trap.

Extraction, Distillation, and Evaporation

- Do not attempt to extract a solution until it is cooler than the boiling point of the extractant due to the risk of over pressurization, which could cause the vessel to burst.
- When a volatile solvent is used, the solution should be swirled and vented repeatedly to reduce pressure before separation.
- When opening the stopcock, your hand should keep the plug firmly in place.
- The stopcock, if glass, should be lubricated.
- Vent funnels away from ignition sources and people, preferably into a hood.
- Keep volumes small to reduce the risk of overpressure; if large volumes are needed, break them up into smaller batches.

- Distillations in PHLIS laboratories should be avoided due to the lack of mobile lab utilities in lab hoods. Use of EPA hoods for distillations requires H&S review and approval by both EPA and PHILIS.
- The primary safety concern regarding evaporation is related to reactive chemicals such as ethyl ether and other peroxide forming chemicals upon completion of drying, including the chemical residue drying around the cap of the bottle. PHILIS requires testing of peroxide using a peroxide test strip test every 6 months and disposal of open ethyl ether bottles after 1 year. See PHILIS guidelines for Ethyl Ether.
- Deliberate disposal of chemicals via evaporation is strictly prohibited under RCRA. However, evaporating a bottle for reuse is allowed following rinsing of an empty bottle with water.

Glassware

- Borosilicate glassware (e.g., Pyrex, Kimax) is recommended for use in the laboratory.
- Glass containers of hazardous chemicals should be transported in rubber bottle carriers or buckets to protect them from breakage and contain any spills or leaks. It is recommended to transport plastic containers this way as well since they also can break or leak. Plastic containers can deteriorate with time, typically becoming yellow and brittle. The process is accelerated by exposure to solvents, sunlight, and heat. Be particularly aware of hazardous chemicals stored for a long time in plastic bottles. Replace older plastic pails, as handles may break off, or bottoms crack. Some plastic containers generate static that can ignite flammable vapors. Avoid storing flammables in unapproved plastic containers.
- When handling glassware, check for cracks and chips before using it. Handle glassware with care. Avoid impacts, scratches, and intense heating.
- Use care when inserting glass tubing into stoppers. Use glass tubing that has been fire-polished, lubricate the glass, and protect your hands with heavy gloves. Make sure the diameter of the tube or rod is compatible with the diameter of the hose or stopper when inserting glass tubes or rods into stoppers.
- Broken glassware must be managed to prevent injury. Put other sharps such as pipette tips and razor blades into puncture resistant containers before disposal. Normal sharps can then be placed in the regular trash.

Heat and Heating Devices

- Heating devices that become hot or produce flame should be set up on a sturdy fixture and away from any ignitable materials such as flammable solvents, paper products, and other combustibles. Open flames are NOT ALLOWED in PHILIS labs.
- Heating devices should have a backup power cutoff or temperature limiting controller to prevent overheating. If a backup controller is used, an alarm should notify the user that the main controller has failed.

- Make sure set temperatures do not cause violent reactions and that a means to cool potentially exothermic heat generating reactions is readily available. Note that larger volumes are exponentially more difficult to control should an exothermic process run away.
- Post "Caution: High Temperature" signs to warn people of there is a heat hazard near hot assemblies and to prevent burns.
- Never use space heaters in the laboratory.
- When using ovens generated heat should be adequately removed from the area. Leave ample clearances around all sides of the oven. If toxic, flammable, or otherwise hazardous chemicals are developed from the oven, then only use ovens with a single pass through design where air is ventilated out of the lab and the exhausted air is not allowed to come into contact with electrical components or heating elements. Sufficient room is needed where the oven door can be opened no closer than 8" from the hood face to prevent escape of vapors outside of the hood. Careful placement and elevation is important, because ovens placed in hoods can disrupt airflow.
- Heating flammables should only be done with a heating mantle, steam bath, or special explosion proof oven equipment.
- When using heating baths they should be of sound construction and set up with firm support to prevent tipping. Route cords out of the way to further reduce the risk of tipping. Since combustible liquids are often used in heating baths, the thermostat should be set so the temperature never rises above the flash point of the liquid. Check the chemical SDS to determine the flashpoint. Compare the flashpoint with the expected temperature of the reaction to gauge risk of starting a fire. When filling a water bath, do not turn on the water and leave the area unless your bath has an automatic water shut off device.

Mechanical Hazards

- Many laboratory instruments have moving parts. Some of these devices are automatic samplers, belt-driven pumps, centrifuges, fans, shakers, mixers, and rotary evaporators. Generally, these machines have safeguards or interlocks to prevent machinery related injuries, however caution must always be exercised around moving parts.
- Avoid wearing loose fitting clothing or necklaces that could be drawn into a rotating assembly.
- Do not stop moving parts by hand. Wait for motion to stop on its own.
- Be aware of assemblies that vibrate and could "walk" into other objects or fall off a counter.
- Safety glasses and/or shield must always be worn around any power tool operation.

Vacuum Hazards

- Many laboratories use a vacuum apparatus for analytical equipment, such as mass spectrometers, reactive chemical handling, transfer in Schlenk lines, filtration, and desiccation.
- Inspect glassware that will be used for reduced pressure to make sure there are no defects such as chips or cracks that may compromise its integrity. Use only approved glassware for low pressure work. Never use a flat bottom flask unless it is a heavy walled filter flask, or other thin walled flask that is not appropriate to handle atmospheric pressure.
- Use a shield between the user and any glass under vacuum or wrap the glass with tape to contain any glass in the event of an implosion.
- Glass Dewar flasks, some distillation columns, cathode ray tubes (CRTs), and other apparatus are permanently under vacuum. The same precautions apply to these items. Note that "Thermos" flasks are especially thin and prone to breakage. Wrap them with tape to contain glass shards in the event of an implosion.

Vacuum systems

- Cold traps should be used to prevent pump oil from being contaminated which can create a hazardous waste or contaminate the pump.
- Pump exhaust should be vented into a hood when possible.
- Belts, pulleys, and other moving parts must be properly guarded.
- Follow appropriate lock-out procedures if you cannot directly unplug the device for maintenance. Pumps may start automatically.
- Connect pump inlet and outlet properly. Pump connections can look the same. Reversing the flow direction can pressurize your apparatus leading to an explosion. At minimum you will contaminate it with oil.
- Allow diffusion pumps to cool completely before venting or servicing. These pumps contain oil at very high temperature. Keep combustibles away.
- Used pump fluids must be managed. Oil removed from vacuum pumps for disposal should be labeled "used oil" unless a known contaminant is present.
- Use extra caution with vacuum evaporator applications. Some evaporated films are air reactive, and others may generate particles that can be inhaled. Determine any possible health hazards with process products and protect yourself accordingly.

Noise

- The most likely hazardous noise source is experienced when working too close to one of the operating generators. If closer than 10 feet from the generator; hearing protection is required for PHILIS staff. Other noises may not be hazardous but could be a nuisance.

9.0 HAZARD INFORMATION AND TRAINING

All employees will be trained in the specific hazards of their laboratory functions. Each employee will receive training at the time of initial assignment to the laboratory, prior to assignments involving new exposure situations, and during annual "refresher" training. Upon hire, the New Employee Laboratory Safety Orientation Checklist is reviewed with the new staff member (ATTACHMENT Q). During deployment, the Field Deployment Daily H&S Operations Checklist (ATTACHMENT P) will be used to prepare laboratory staff for the activities to be performed that day. This daily tailgate discussion will include potential job hazards for the day, staff assignments (designating a buddy system), required safety equipment and supplies, and a to-do-list of safety tasks.

Training will include methods of detecting the presence of a hazardous chemical, physical and health hazards of chemicals in the lab, and measures staff can take to protect themselves from these hazards. The training will present the details of the CHP and include:

- The contents of the OSHA Laboratory and Hazard Communication Standard and its appendices.
- The location and availability of the CHP and other H&S documents.
- The permissible exposure limits (PELs) for OSHA regulated substances or recommended exposure values for other hazardous chemicals not regulated by OSHA, which are present in the laboratory (refer to SDSs).
- Signs and symptoms associated with exposure to the chemicals present in the laboratory.
- Location and availability of background reference material on chemical hygiene, laboratory safety, CWAs, and other general safety information.
- PHILIS CHP & Hazard Communication Overview with annual refresher or upon major changes.
- 40-hour Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) with annual 8-hour refresher.
- Federal Emergency Management Agency (FEMA) ICS 100 & 200 and Active Shooter IS-907.
- Respiratory Protection and PPE with annual refresher.
- Hazardous Waste Management Plan with annual refresher.
- Emergency Preparedness and Fire Safety, including fire extinguisher use.
- Spill Cleanup Procedures.
- First Aid/CPR/AED recommended with re-certification every two years.
- CWA specific procedures (e.g., CWA sample receiving and handling).
- CWA and solvent monitoring techniques (e.g., AP4C, surface wipe sampling, and others).
- DuoDote and Narcan antidote administration and usage based on symptoms.

- Others as deemed applicable for employee protection.
- Training will be conducted by or under the support of the CHO.
- All training will be documented and the information to be provided to the PHILIS Program Office.

10.0 OFF-HOURS AND WORKING ALONE RESTRICTIONS AND APPROVAL

All required procedures will be followed for laboratory activities which present hazards to the employees during non-routine and off-hour laboratory functions. Below are safety procedures to be followed for working off-hours, alone, and unattended.

10.1 Off-Hours Work Procedures

Laboratory personnel are not permitted to work off hours in the laboratory, except when permitted specifically by the LC following a detailed review of allowable laboratory tasks and required safe practices.

10.2 Sole Occupancy

All laboratory operations must be performed using the buddy system. If not in direct view, the buddy must have a 2-way radio or telephone. Under unusual conditions, telephone checks, or other measures may be taken when permitted if the work operation is deemed non-hazardous.

All CWA and highly hazardous operations are to be performed during a time when at least two personnel are present in the general area or in close proximity to the person with visual contact at all times.

10.3 Unattended Operations

Unattended laboratory operations should be discouraged unless periodical monitoring is conducted, such as for automated equipment operation and where there is not a significant hazard.

11.0 MEDICAL CONSULTATIONS AND EXAMINATIONS

11.1 Criteria for Medical Examinations and Consultation

Medical attention is available to all employees who work with hazardous chemicals in the laboratory or in the field. The following guidelines present criteria for medical examinations and consultations:

- Medical attention is made available to an employee whenever an employee develops signs or symptoms associated with a hazardous chemical or physical stressor.
- The Medical Surveillance Program, as defined in CSS's Health & Safety Manual (Number 402), is implemented when there is potential for an exposure exceeding OSHA action levels or PELs. All laboratory staff and program personnel that may be assigned to laboratory functions/facilities or perform field work at an environmental remediation site will be included in the medical surveillance program.

- The medical surveillance program will include CSS's requirements for a full physical, consisting of a thorough physical examination, blood tests, urinalysis, pulmonary function test, EKG, hearing, X-ray, cholinesterase, respiratory qualification with Fit-testing and other tests deemed necessary by the examining physician. The routine medical surveillance evaluation frequency is prior to start of work to establish a baseline, annual thereafter or based on physician's recommendations and upon exiting CSS.
- Whenever an incident takes place in the laboratory such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure, the employee will be provided with an opportunity for medical consultation for the purpose of determining the need for medical examination.
- A CSS approved medical facility arranged through WorkCare, will provide the routine medical surveillance.

11.2 Administrative and Recordkeeping

Administrative and recordkeeping information regarding the medical surveillance program is listed below:

- Medical consultations and examinations are provided without cost to the employees, without loss of pay and at a reasonable time and place.
- These medical consultations and examinations are administered by or under the direct supervision of a licensed physician.
- Employees seeking the need for medical consultation regarding occupational illness or injury should contact the LC or the CHO.
- Employees are provided with access to all personal medical records by the medical facility that retains the records. The medical records will be retained for the duration of employment and 30 years thereafter by the medical facility.
- The CHO and the LC will receive the physician's work clearance form which states whether the employee has any medical limitations that would place the employee at risk. The physicians' written opinion will not reveal specific findings or diagnosis unrelated to occupational exposures. Medical records of the examination and counseling will be maintained in a confidential manner at the medical examination location.

12.0 CHEMICAL AND HAZARDOUS SPILLS / INCIDENTAL SPILLS

Follow PHILIS Chemical Accident/Incident Response and Assistance (CAIRA) procedures (SOP H-S-003) for response instructions and to determine if the spill is a CAIRA Reporting Event. A CAIRA reporting event encompasses accidents, incidents or other circumstances involving CWAs or other particularly hazardous chemicals where there is a confirmed or probable release to the environment, staff exposure, any loss, seizure or theft, attempts to steal or divert CWA outside of security controls, accidents in which there was direct evidence of an occupational exposure, injury or death, threat of releasing chemical agent with malicious intent, or any incident that may be of client concern.

A CAIRA response includes all actions taken to save lives, preserve health and safety, protect the environment, secure CWAs, and all related protective measures taken in response to an event. Work with CWAs and decontaminants can be highly hazardous. In the event of an accident, immediately notify appropriate staff, Emergency Coordinator (EC), LC, and local emergency responders. Provide an SDS of any CWAs involved to responders and medical personnel.

PHILIS will notify the EPA and respective client if a CAIRA response has occurred (e.g., STEL is exceeded). The appropriate federal, state, or local law enforcement agencies will also be informed of any theft, loss, release of CWA into the environment, or any other criminal conduct or event associated with PHILIS which requires notification of authorities.

Army Materiel Command (AMC) Chemical Agent Work - CAIRA events will be reported by telephone to the Army Materiel Command (AMC) Operations Center (OC) as soon as possible, within one hour of the event. Army Materiel Command (AMC) Operations Center (OC) operated 24 hours/day at (256) 450-9496 or (256) 450-9497. The AMC OC will notify AMC Surety Division personnel, who will then contact PHILIS. Identify your name, laboratory location, brief summary of the event, and a primary and alternate contact number. An accident report must be submitted to the AMC Provisioning Manager (AMC PM) within 24 hours. PHILIS is also responsible for conducting a full investigation. A copy of the investigation report must be forwarded to the AMC PM within 30 calendar days of the event. The AMC PM will then evaluate the investigation report and may perform additional inquiries. The Army reserves the right to investigate any event involving CWAs at any time.

12.1 Incidental Spills

An incidental spill is a small spill that can be easily and safely cleaned up using the lab's spill kit or similar materials that does not pose a significant risk to employees. For example, spills in the hood of less than 100 milliliters of solvent (non-CWA) would generally be classified as an incidental spill requiring the immediate cleanup of the spill using absorbent material. Refer to CHP Section 5.9 Procedures for Cleanup of Spilled CWA Materials.

If no person was contaminated, evacuate the area and warn others. For contaminated personnel, follow procedures in CHP Section 12.2. Access the chemical SDS and/or the Chemical Hazard Summary sheet for any specific instructions. If the spill can be safely cleaned up, isolate the spill, notify the LC, and perform the following:

- Shut off all electrical devices and heat sources if the material is flammable and make sure the exhaust ventilation and hoods are operating prior to evacuating the area. If feasible, place an absorbent pad on the spill. Obtain additional spill cleanup materials as necessary, PPE (e.g., nitrile gloves, shoe covers), scoop, empty containers, garbage can or chemical resistant disposable bags, and other needed materials.
- Place the absorbent and/or spill pillows around and over the spill. Scoop up the material into the waste container with an attached Hazardous Waste Label. Special care is needed if broken glass is present.
- CWA spills require the use of commercial bleach decontamination solution (5-6% sodium hypochlorite) to be added to the spill. Spills containing ultra-dilute CWA may use a 1:10 diluted solution of bleach.
- Transfer the waste material and any contaminated PPE to the Satellite Accumulation Area (SAA) or Hazardous Waste Storage Area.
- Wash all hands and any other potentially contacted body parts.
- Prepare an Incident Reporting Form to document the accident and investigation to determine methods to prevent re-occurrence.

12.2 Contaminated Personnel

For contaminated personnel, perform the following:

- Call for immediate assistance. Notify Emergency Coordinator (EC). When additional personnel are available, one person will provide buddy aid (a military term for first aid provided to another individual) while a second person will seek additional assistance and notify 911. Notification of 911 for any emergency requires clear and concise statements, especially regarding symptoms and directions to the facility.
- DuoDotes should only be administered to staff experiencing symptoms of nerve agent organophosphorus poisoning in a situation where exposure is known or suspected (NARCAN provided for Opioid exposure). Begin buddy aid, which may include administration of DuoDotes, and continue buddy aid throughout decon activities. A DuoDote should be administered as soon as 2 or more mild symptoms appear or if 1 or more severe symptoms appear. Administer 1 DuoDote for mild symptoms or 3 DuoDotes in rapid succession for severe symptoms. Follow DuoDote Instruction Sheet. Each time a DuoDote is used, place a dosage tag from the response kit on the person's wrist. Keep the used auto-injector(s) with the person for further verification of how many injections were administered.

- Immediately bring the person to a drench hose or shower. Use a dedicated area for wet decon if set up. A Megamover can be used for individuals who cannot move on their own. Remove the outer clothing. Undergarments (e.g., underwear and bra) are not required to be removed if decon is being performed due to an air monitoring alarm. PPE (e.g., nitrile gloves, lab coat, splash suit) may be required to protect the person providing buddy aid if there is a threat of cross-contamination.
- Individuals with possible CWA exposure must complete three washes with soap and copious amounts of water prior to going to the hospital. Decon is considered complete once these three washes are complete. Initiate the three washes decontamination process detailed below:
    - Wash 1: This wash includes the use of Dial soap and water, washing all areas of the body from head-to-toe using a clean sponge. Use a clean sponge for each individual.
    - Wash 2: The second wash should be completed at a separate shower location (if available), repeating the head-to-toe washing technique described for Wash 1.
    - Wash 3: In the final wash the head-to-toe washing technique is repeated and includes a Pert shampoo and rinse of the hair.
- Wrap the person in an emergency blanket or some other garment after decon (e.g., Don-It personal privacy kit). Provide buddy aid until a medical response team arrives. Individuals with possible exposure should be taken to the hospital for observation and evaluation.
- Scan staff member with the AP4C for clean confirmation prior to them leaving with medical responders.
- Keep the person calm while the emergency team arrives (estimated time is approximately 4 minutes). Laboratory staff will flag the emergency vehicle at the street level.
- Emergency assistance is required if any personnel experience symptoms such as dizziness, headaches, and other symptoms related to potential chemical exposure. The chemical SDS and other information will be needed by the medical team. Have CWA and FGA SDSs in the Emergency Action Plan binder ready for emergency responders.

12.3 Large or Uncontrolled Chemical or Hazardous Material Spill (Emergency Spill)

A large or uncontrolled CWA spill is classified as a spill exceeding 10 milliliters in the hood or any amount outside of the hood. Additionally, a spill exceeding 1 liter of a highly volatile substance (methylene chloride, methanol, or acetone) is considered a large spill, but may be manageable. An example of an uncontrolled spill is one requiring outside emergency assistance and not manageable by PHILIS staff. This could include a cylinder leak with significant pressure inside the lab unit or a flammable substance making contact with a heated source that may result in a fire. Upon identifying a CWA large chemical spill or an uncontrolled spill/potential release, notify all personnel in the general spill area to evacuate to a safe area and notify the EC. The EC will assess the extent of the spill in accordance with CHP Section 15, Emergency and Evacuation Planning. The EC and CHO will determine if the spill is a manageable cleanup for PHILIS.

If the spill is determined to be manageable, the same procedure as noted for Incidental Spills will be performed with the following additional requirements:

- No reentry is allowed for at least 30 minutes to enable the exhaust ventilation to reduce the airborne solvent concentration. EC must give approval before reentry. As a minimum approach, after 30 minutes, if the material spilled can be monitored with a detection device (e.g., AP4C), the room can "progressively" be cleared (e.g., readings taken first from the laboratory doorway with progressive readings taken to spill location) with staff wearing MSA CBRN full-face respirators, a disposable Tyvek lab coat, double nitrile gloves with extended cuffs or duct tape, disposable Tyvek sleeves, and shoe covers.
- Once the room has been cleared (or after 1 hour from the time of the spill), staff will be permitted to re-enter the lab using MSA CBRN full-face respirators (due to the use of bleach outside of containment), a disposable Tyvek lab coat, double nitrile gloves with extended cuffs or duct tape, disposable Tyvek sleeves, and shoe covers to clean up the spill using bleach (or other decon deemed appropriate by the EC). Care will be taken to bag any contaminated clothing/PPE for disposal and clean up any glass (do not pick up broken glass by hand).
- Air monitoring results must show that the air contains no chemical contaminant levels above established exposure limits before laboratory staff are allowed to re-enter the laboratory/area for normal operations. If the contaminated area is determined to have residual contamination (e.g., > Worker Population Limit), repeat the Re-Entry procedures.
- All CWA and large or uncontrollable spills will have an incident investigation and reporting conducted in accordance with Section 14.

13.0 HAZARDOUS WASTE MANAGEMENT

Hazardous waste is addressed in the Hazardous Waste Management Plan. A hazardous waste profile listing the laboratory's waste streams needs to be documented to ensure proper segregation of waste. Hazardous Waste Stream Profiles (NFPA 30 & 45):

- Chemical Warfare Agents (CWAs) – Solid and liquid waste generated from CWA analytical processes, spills or disposal of standards are placed in fresh commercial bleach solution (5-6% sodium hypochlorite) for at least 24 hours in a lab hood to neutralize/deactivate chemical agent. Verification of the neutralization process is conducted by testing the waste solution with a Hypochlorite Test Kit or KI starch paper, indicating presence of free chlorine (all organic substances have been destroyed). When providing a description of the bleach waste to a waste transporter, do not label as CWAs. Classify the waste as "Corrosive Hazardous Waste, D002" if waste is at least 20% aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5. Classify the bleach waste as "Industrial Waste" if pH is less than 12.

- Methylene Chloride Ampoules – Are collected in the satellite waste storage area. A waste stream is created for the disposal of standards and native samples that have been extracted and concentrated and placed in glass ampoules. Glass ampoules containing methylene chloride extracts, and not containing PCBs, are separated from glass ampoules containing flammable solvents. An open top plastic bucket is placed in a hood in the SPA, within the control of the instrument operators, and is labeled "methylene chloride in vials" and "hazardous waste satellite accumulation area." The waste container is dated when it has been filled to capacity and the satellite accumulation area designation is removed. The waste container is then moved to the hazardous waste storage area where it is removed by a licensed waste hauler within 6 months of dating the container.
- Methylene Chloride Disposal – A waste stream is created for the disposal of methylene chloride generated from laboratory testing procedures. A waste container is labeled for chlorinated solvent disposal.
- Mixed Acids and Water – A waste stream is created for the disposal of acidic waste generated from laboratory testing procedures. A waste container is labeled for mixed acids and water disposal.
- Other Hazardous Waste – Additional lab packs are prepared for substances known to be hazardous (e.g., strong oxidizers, poisons, toxics, unknowns) that have not been previously included.
- Polychlorinated Biphenyl (PCB) Disposal – A waste stream has been created for disposal of all native samples and glass ampoules of extracted samples that contain PCBs greater than 50 parts per million (ppm). In addition, all ampulated standards used in PCB analyses are segregated and disposed in this waste stream. The waste container is labeled as hazardous and has a PCB label.
- Volatile Organic Compound (VOC) vials containing 5 grams (g) soil/5 milliliters (ml) methanol – This waste stream is collected in the satellite storage area. The waste container is placed adjacent to the volatiles preparation area and within the control of the instrument operators and is labeled "methanol contaminated soil in vials" and "hazardous waste satellite accumulation area." When the waste container has been filled to capacity it is dated immediately, the satellite accumulation designation is removed, and the container is moved to the hazardous waste storage area where it is removed by a licensed waste hauler within 6 months of dating the container.

Excluded as hazardous waste:

- Samples - Samples that are sent to the laboratory for analyses are not considered regulated waste while awaiting testing, while stored after testing for a specific purpose, or while being transported back to the sample collector (40 CFR 261.4(d)). For example, samples are not yet considered waste if analytical results have not been completed and re-testing may be necessary. Once a sample is no longer being held for a specific purpose, then it must be managed as waste, and designated as a hazardous waste if appropriate (e.g., if it is listed or displays hazardous waste characteristics).

- Empty Containers – Empty containers that once held hazardous waste are not regulated as hazardous waste if they meet the definition of "empty" as defined in 40 CFR 261.7. A container is empty if all waste has been removed to the extent possible by common practices (e.g., by pouring, pumping, or aspiration) and only trace residue is remaining. A water rinse is recommended with the rinsate disposed of as aqueous hazardous waste. Highly volatile solvents may be air evaporated preferably in the hood. Original solvent bottles should be re-used if possible. Containers that held acutely hazardous waste are considered empty only after being triple rinsed with a solvent capable of removing the acutely hazardous waste residue. The solvent rinsate must be managed as acutely hazardous waste and the container treated as general waste.

General requirements of hazardous waste management are as follows:

- Hazardous Waste containers in the Hazardous Waste Storage Area are required to have proper labeling such as “Hazardous Waste, Acetone Waste,” date of first use and fill date including labeling as required by the Hazardous Waste contractor. Satellite Waste Accumulation Area (SAA) containers require similar labeling except date of first use is not required. SAA containers must be dated when full and require transfer to the Hazardous Waste Storage Area within 3 days of being full.
- Hazardous waste containers must have a secondary containment such as a tray or separate container.
- The hazardous waste container must have a lid secured to the container; a funnel or drain tubing from an analytical instrument does not constitute a tight lid.
- The Hazardous Waste Storage Area is not allowed to be located near a drain.
- A spill kit with adequate supplies such as adequate absorbing material is required to be in close proximity to the waste area.
- Waste is required to be segregated by hazard classification and flammable waste is stored in a flammable storage cabinet.
- The contents of a waste container should have ample headspace for expansion, typically ¾ full or less.
- Specific storage time limits are applied based on the facility generator classification per the state regulatory agency. PHILIS operates under the requirements of Small Quantity Generator (SQG), although PHILIS waste generation is typically that of a Conditionally Exempt Small Quantity Generator (CESQG).
- Treatment of corrosive waste may be neutralized using safe methods and disposed of down the drain only if in accordance with the local sanitary district.
- All laboratory personnel are required to receive hazardous waste training including proper PPE and spill control.
- A weekly inspection of the Hazardous Waste Storage Area is required using the PHILIS Hazardous Waste Inspection Form (ATTACHMENT K).
- Records of the generator’s waste characterization determination and inspections are to be maintained for three years.

- CWA waste will require additional requirements such as the following:
    - All liquid decontamination waste must be tested prior to disposal. The test will include Hypochlorite Test Kit or KI starch paper to determine presence of decon-chlorine content.
    - All disposable PPE used in CWA handling such as gloves and absorbent material used in CWA or solvent spills must be classified as Hazardous Waste.

14.0 INCIDENT NOTIFICATION, INVESTIGATION AND REPORTING

The requirements for incident notification, investigation, and reporting are as follows:

- All occupational injuries and illnesses will be reported immediately to the LC with follow-up notification to the CHO and PM. CSS Workman's Compensation Coordinator must be notified for all injuries requiring medical billing.
- All occupational injuries and illnesses will be investigated.
- All accidents resulting in property damage greater than $500.00 will be investigated.
- All exposures exceeding one-fourth of the PEL or guidance exposure limit will be investigated.
- All near-misses, spills, and other potentially abnormal laboratory events which could have resulted in a greater impact to health, safety, or the environment will be investigated. CWA spills of greater than 10 µl inside a hood or any amount of a spill outside the hood will be reported immediately to the EC, LC and the CHO.
- Army Materiel Command (AMC) Chemical Agent Work - CAIRA events will be reported by telephone to the Army Materiel Command (AMC) Operations Center (OC) operated 24 hours/day at (256) 450-9496 or (256) 450-9497. Notify as soon as possible, within one hour.
- Non-conformance to federal, state, or local regulations requires an investigation.
- All incidents involving an investigation will have an Incident Reporting Form (ATTACHMENT D) completed, which will be a documented report of root cause, contributing factors of the incident, and corrective actions to prevent reoccurrence. The LC will be the lead in conducting the investigation and report preparation with assistance from the CHO.
- Auto accidents involving a rental car during official travel will be investigated and reported in conjunction with CSS H&S Policies 304 and 305. Employees are required to have the CSS provided Insurance Identification Card with them when driving rental vehicles. The following are reminders in case of a rental car accident:
- Report the accident to your supervisor within 24 hours.
- If requiring medical treatment, CSS Workman's Compensation insurance should be billed.
- Do not "quick drop" a rental car involved in the accident.

- File an accident report in the car rental office. Collect as much information as possible as noted in CSS's H&S Policy 305; "Auto Accident Reporting Form". Be sure to take photographs of any damage.

15.0 EMERGENCY AND EVACUATION PLANNING

PHILIS laboratory emergency procedures are provided in the PHILIS Emergency Action Plan. This section summarizes response actions for various emergencies from the PHILIS Emergency Action Plan.

15.1 Reporting a Fire or Fire Alarm Activation

- Report the fire. Call 911 and alert others. All personnel are required to exit the area and proceed to the designated assembly point where personnel roll call will be conducted.
- All personnel should cease all operations, and if safe, close all chemical and CWA containers and place them in their designated storage area or in the laboratory hood with the hood operating and the sash closed. Close all laboratory doors when exiting.
- Use of a fire extinguisher is allowed if the fire is small and can be extinguished safely and if there is a direct escape route.

15.2 Medical Emergency (Injury Only-No Chemical Exposure)

- Contact 911 and provide details of the emergency and follow any instructions provided by the 911 operator. Alert others of the emergency to assist. A staff member will flag the ambulance at the street area and guide them to the injured employee.
- Comfort the injured employee. Provide first aid and/or CPR as necessary until medical emergency personnel arrive.
- Check where the injured employee had been working to assure that operations have been stopped and that chemicals and CWA materials have been properly placed into their designated storage areas.

15.3 Employee Exposure Incident (Chemical)

Refer to CHP Section 12.2 for CWA exposure incident.

- Chemical splashed in the eye:
- Help the individual to the nearest eyewash station and assist them with keeping their eyelids open while flushing.
- Flush the eyes for at least 15 minutes.
- All eye contact with chemicals requires medical attention.
- Chemical splashed on the body:
- Acquire the Exposure Incident Response Kit.

- Remove the person's contaminated clothing using disposable nitrile gloves and a lab coat. Spread plastic on the floor to collect the contaminated clothing (to prevent further area contamination). Body contamination over a large area requires a drench hose/emergency shower rinse prior to removing the contaminated clothing.
- Complete three washes with copious amounts of water and soap.
- Assist the person in donning a disposable covering (e.g., emergency blanket) if clothing was removed.
- All contaminated clothing requires disposal as Hazardous Waste. Transfer contaminated clothing to the Satellite Accumulation Area or Hazardous Waste Storage Area. Refer to CHP Section 13.0 Hazardous Waste Management.
- Exposure Incident Response Kits are available to employees handling chemicals and CWA materials. If an individual is exhibiting 2 or more mild CWA nerve agent exposure symptoms, administer one DuoDote injection into their outer thigh. For 1 or more severe CWA nerve agent exposure symptoms, administer 3 successive DuoDote doses. Keep used auto-injectors with the person and apply a DuoDote tag (slap bracelet) for each dose given to keep track of how many doses were administered. Additional DuoDote injections will be provided by emergency medical personnel if needed. All potential overexposure and/or symptoms require immediate medical assistance. PHILIS CWA Symptoms and DuoDote Administration posters are located in each laboratory unit where CWAs may be handled.

16.0 RADIATION SAFETY (SEALED SOURCES)

PHILIS laboratories have radioactive sealed sources for chemical analysis using gas chromatography with micro electron capture detector and near-term monitoring equipment used for CWA screening. Each of the sealed sources contains a small radioactive amount (10-20 millicuries[mCi]) of Ni-63 within a steel housing. The radioactive decay process involves emission of Beta particles which are non-penetrating within the sealed housing and therefore not hazardous. Each of the sealed sources is regulated as a Nuclear Regulatory Commission (NRC) general license. A leak test is required at least every six months using the leak test kit and instructions provided by the manufacturer or the CHO. The leak test results will be provided to the CHO and documented in PHILIS SharePoint, H&S folder.

16.1 Micro Electron Capture Detector

A Micro Electron Capture Detector (μECD) with a 15 mCi Ni-63 sealed source is designated for use at the PHILIS Edison laboratory. The μECD is manufactured and installed by Agilent. Agilent is required to install the detector and perform the initial follow-up testing including a radioactive contamination wipe test to verify no leakage of the sealed source. The carrier gas used with the detector can be helium or hydrogen. In the case of hydrogen, additional precautions are needed due to hydrogen's potential as a fire hazard. The following are safety requirements extracted from the manufacture's safety guidance and NRC requirements.

- Agilent installation, operating requirements, and all safety precautions will be followed as outlined in the Agilent Gas Chromatograph Safety Manual and Agilent Electron Capture Detectors Information for General Licensees.

- All radioactive sealed sources and the general area where they are located must be labeled as "Caution Radioactive Materials."
- The μECD will be logged in an inventory record.
- The sealed source may only be opened by an authorized manufacturer representative to handle radioactive materials.
- To prevent possible hazardous contamination of the area with radioactive material, the detector exhaust vent must always be connected to a fume hood or local exhaust system.
- Only thermal bake-out cleaning of the detector is allowed by PHILIS staff in accordance with the manufacturer's procedure. Prior to cleaning, verify that the carrier supply gas and flow system has been leak checked.
- Any possible damage to the sealed source detector requires immediate reporting to the CHO and leak testing. Use of the detector will be discontinued.

16.2 CWA Monitoring Equipment

PHILIS currently uses the AP4C for portable handheld CWA monitoring. The AP4C is a non-radioactive monitoring source.

All CWA radioactive sealed source monitoring equipment will be logged in an inventory record.

- The sealed source is only allowed to be opened by an authorized manufacturer representative who is licensed to handle radioactive materials.
- Prior to use of the CWA monitoring equipment, the manufacturer's operating manual must be read and understood.
- A leak test is required at least every six months using the leak test kit and instructions provided by the manufacturer or by an approved testing laboratory (National Leak Test Center or RSO, Inc.). Results will be documented.
- Any possible damage to the sealed source requires immediate reporting to the CHO and leak testing. Use of the detector will be discontinued.

17.0 LABORATORY MOBILIZATION

In the event of laboratory mobilization, the H&S requirements referenced in the PHILIS Readiness Plan will be implemented. These include pre-mobilization activities, taking into account deployment site hazards, site requirements, and emergency planning. Additionally, the Readiness Plan addresses transportation and set-up/tear-down safety-related issues. Readiness checklists must be completed prior to leaving. The development of an H&S site plan is also required and should include:

- Site location and maps.
- Specific site hazards including chemical contaminants.
- Site control including site access, security (security fencing, surveillance as needed), lab location (support zone), and site communications (key personnel).

- Emergency response including emergency planning maps/driving directions, emergency contacts, on-site emergency response, etc.
- Waste management in accordance with local and state regulations to include selection of a hazardous waste contractor as needed for disposal.

18.0 SEVERE WEATHER AND LABORATORY SHUTDOWN GUIDELINES

Severe weather and laboratory shutdown guidelines are referenced in the PHILIS Emergency Action Plan. H&S procedures will be implemented whenever severe weather threatens laboratory operations, or when the state or local agencies designate an emergency condition. The highest priority is placed on staff safety. Below are guidelines to follow regarding severe weather and other emergency conditions:

- Monitor weather reports and local emergency sources.
- The LC will keep staff members informed of emergency conditions and instruct staff not to report to duty during severe weather based on state and local official advisement.
- Ensure that the laboratory facilities have available emergency supplies in place at the home base warehouse and during mobilized activities. Emergency supplies to include:
- Winter weather: gloves, boots, hats, blanket, snow shovel, ice melt, ice scraper/snowbrush, tire chains.
- Communication devices: personal/work cell phones, radios, weather radio.
- Emergency kit: flashlights, extra batteries, water, snacks, jumper cables, road flares.
- Emergency phone numbers: State/Local/FEMA, Utilities (water, gas, electric), and environmental disposal.
- Laboratory shutdown procedures to include:
- Plug computers and other identified critical equipment into an uninterruptible power supply and if needed connect to an emergency power back-up system.
- Remove all chemicals and glassware from bench tops and secure safely in cabinets.
- Close the sash on all chemical fume hoods in the event that ventilation is lost.
- Ensure that all chemical and hazardous waste containers are properly covered and sealed.
- Ensure that all gas valves are closed.
- Turn off all appliances, computers, hot plates, ovens, and other equipment.
- Review storage of perishable items. Consolidate valuable items within storage units that have backup systems or store items in duplicate locations as appropriate. Review safety precautions for the use of alternate cooling methods (e.g., dry ice, etc.) if used. PPE is required for handling dry ice (e.g., cryogenic gloves, face shield).
- Ensure that water reactive chemicals are in sealed containers and stored in areas that are unlikely to become wet.

- Check that all gas cylinders are secured. Remove regulators and install transport caps where possible.
- Remove steps to a secure location.
- If high winds, outdoor canopy needs to be closed and secured.
- Exterior antennas, windsock, and other external equipment affected by high winds require removal.
- Vehicles may need to be tied down such as with a hurricane.
- Close all doors, including cabinets, storage areas, offices, and utility chase-ways. Lock all exterior lab doors before leaving.
- Secure lab notebooks and backup critical data on computers.
- If staff may be in danger, relocate to a safe location (home base, designated shelter, hotel, or fire house if mobilized). Vehicles should not be moved during high winds.

19.0 LABORATORY MAINTENANCE SAFETY

The purpose of this section is to ensure laboratory maintenance safety is addressed for facility personnel and contractors prior to performing maintenance related work. These guidelines apply to all laboratory staff, supervisors, and facility managers, who oversee building and maintenance contracts and all contractors who will be involved in the laboratory activities. Non-laboratory maintenance such as main building renovation or vehicle repair/inspection is not included. Maintenance activities of highest concern include the following:

- Work or inspections conducted on the exhaust ventilation ducting system including the filtration system where there is a potential for contact with hazardous chemicals. This includes routine changing and disposal of contaminated filters.
- Work inside a fume hood such as changing lights, electrical system work, airflow monitor installation, sash and pulley system repair.
- Activities in direct contact with compressed gas lines and the handling of compressed gas cylinders.
- Work in the vicinity of chemical or hazardous waste storage.
- Repairs on vacuum pumps containing oil contaminated with hazardous chemicals.
- Work performed in the vicinity of critical or expensive instrumentation/equipment.
- Repairs or inspections of high voltage power sources.

The LC or Facility Manager is responsible for the effective planning, coordination, and implementation for safe maintenance activities for the protection of all personnel and laboratory equipment. The Facility Manager will plan, coordinate, and schedule all maintenance to assure that:

- All laboratory staff are aware of maintenance activities affecting operations.
- All hazard communication awareness is provided for contractors.
- Verification of all safety steps as outlined are successfully completed.

The following guidelines are provided to ensure that the affected laboratory area is safely secured prior to maintenance work and that contractors are provided disclosure of potential laboratory hazards:

- Planning and scheduling of maintenance activities will be coordinated with routine laboratory activities and all laboratory staff will be made aware of maintenance activities.
- An exchange of information between the LC/Facility Manager and the contractor should occur prior to work commencing. Maintenance personnel will be briefed of all potential hazards in the laboratory area scheduled for work, including specific laboratory requirements, chemical hazards with provision of SDSs, compressed gases, emergency actions including alarms, and equipment lockout/tagout procedures. Special training is required for CWA or Particularly Hazardous Substances if there is any potential for contact with these substances.
- Similarly, the contractor must inform the LC/Facility Manager of any hazardous materials to be used and the extent of the maintenance work to be conducted in the laboratory. This helps to identify any incompatibilities between laboratory work and the proposed maintenance work and appropriate actions to be taken.
- Fume hoods should be emptied of all chemicals as applicable.
- All chemicals and other hazardous material, waste, and equipment should be removed from the immediate maintenance work area and stored in a safe place until the work is completed.
- Sinks and laboratory equipment should be clean and decontaminated. In areas where CWAs were used, the designated bleach solution (5-6%) will be used as the decontamination solution for any CWA residue with follow-up surface wipe sampling/ analysis conducted to verify surfaces are free of chemical agents.
- Gas cylinders should be securely stored, and regulators removed where necessary.
- The LC/Facility Manager must complete and sign the Laboratory Maintenance Safety Checklist/Permit Form (ATTACHMENT L), which serves as a "work permit" indicating that the area is free of uncontrolled risks, the necessary hazard communication information and training has been provided, and the equipment and area have been cleaned and decontaminated.
- The contractor will display the completed Laboratory Maintenance Safety Checklist/Permit Form in the area where the work is being conducted.

- When the work has been completed, the contractor signs the Laboratory Maintenance Safety Checklist/Permit Form and returns it to the LC/Facility Manager who verifies the safe completion of the work. This verification step will include performance testing following any maintenance work that could influence critical equipment (e.g., fume hoods). Verification of inspections by a contractor will also be conducted, normally in the form of a visual verification rather than performance testing such as with the fire suppression system.
- The laboratory staff will be kept informed of the maintenance status and will be provided the opportunity to assist in the work completion verification step.

20.0 RECORDKEEPING

Guidelines for recordkeeping:

- Incident investigations will be conducted by the LC with assistance from laboratory staff and the CHO. Records will be maintained on the PHILIS SharePoint site.
- Incident reports, including OSHA injury/illness reporting (OSHA 300 log) records, will be retained by the CHO. The OSHA 300 log will be posted in the PHILIS facility in accordance with OSHA requirements.
- Exposure records for hazardous chemicals and harmful physical agents will be maintained for 30 years per 29 CFR 1910.20 by the CHO.
- Medical records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years by the contracted occupational medical provider. The CHO and LC will maintain any medical opinions for fitness of duty in a confidential manner as addressed in Section 11.
- The monthly laboratory inspections will be maintained for one year by the appropriate PHILIS facility.
- Waste Manifests and Hazardous Waste Storage Area inspection records will be kept for a minimum of three years.
- Records of employee training will be maintained by the LC, CHO, Human Resources, and maintained on the PHILIS SharePoint site.
- CWA standards and environmental samples have dual accountability records. These are the LIMS-Element and the CWA logbook which tracks CWAs of 1 ug/l or greater as required in CWA Sample Receiving, Handling, and Disposal Protocol.

21.0 REFERENCES AND RECOMMENDED READING

Code of Federal Regulations, 29 CFR part 1910 subpart Z section 1910.1450, Occupational exposure to hazardous chemicals in laboratories.

CSS Policies & Procedures, Health & Safety.

EPA Dilute Solution Hygiene Plan (DSHP).

Title 40 Code of Federal Regulations Part 260-266 “Hazardous Waste Management Regulations.”

U.S. Department of Health & Human Services, Fourth Generation Agents: Reference Guide.

22.0 DOCUMENT REVISIONS

This document may be revised by the CHO as changes become necessary.

ATTACHMENT A -

CHEMICAL/BIOLOGICAL HAZARD ASSESSMENT AND COMMUNICATION FORM

PHILIS Program

CHEMICAL/BIOLOGICAL HAZARD ASSESSMENT AND COMMUNICATION FORM

Chemical / Biohazard Name: _____ **CAS #:** _____

Background / Pre-Screening Results for Samples: _____

Required SOPs: _____

Summary Hazard/Risk Assessment: _____

Hazard Label:	**HMIS:**	**NFPA:**	**NFPA Hazard Storage Class:**	**Hazardous Waste Code:**
Pictograms:				
Description of Use:				
Frequency of Use (#times/shift):			Duration for Each Use (minutes/task):	
Local Exhaust & Engineering Controls Required:				
PPE Required:			PPE Optional:	
Spill Cleanup Method:				
Exposure Limits:				
Monitoring Required:		Emergency/Spill Response Monitoring:		
Monitoring Results:				

PHILIS2 Form ID#: HS-012 / Release Date: 09/18/2023

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ATTACHMENT B -

HAZARD RISK ASSESSMENT FORM

PHILIS Program

CSS

HAZARD RISK ASSESSMENT FORM

This HRA Form should include, if applicable, (1) a description of any required skills, training, special equipment or experience for staff members performing the specified operation (2) any required PPE.

Purpose	Method Used	Prepared by

Operation Hazard Analysis

Operation Step	Potential Hazard(s)	Potential Consequence(s)	Recommended Procedure(s) for Risk Mitigation	Hazard Category - Following Risk Mitigation
1.				
2.				
3.				

PHILIS: Form ID#: HS-019 / Release Date: 09/18/2023

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ATTACHMENT C -

LABORATORY MONTHLY SELF ASSESSMENT / INSPECTION FORM

PHILIS Program

CSS

LABORATORY MONTHLY INSPECTION FORM

Location	Date	Inspector's Name

Contact the CHO with any questions on how to complete this form or for a more detailed description as to what to look for when checking each item.

S=Satisfactory *U=Unsatisfactory (Discuss in Comments)* *NA=Not Applicable*

General & Housekeeping	S	U	NA	Comments
Lab door is kept closed (Fire safety)				
View through door's window is unobstructed				
Aisles and exits are unobstructed				
No food, drinking, or applying cosmetics allowed in the laboratory				
Lab staff are assigned lab and bay cleaning duties. Lab staff need to clean where general cleaning companies are not assigned/permitted (e.g., dust cabinets, shelves, IT areas, corners)				
Work areas are uncluttered				
Good work habits – nitrile gloves, syringes, pipettes, ampoules, and other used lab items are not being left unattended around lab. Staff treating everything as "hot" with assumption of contamination				
Sharps container in each lab				
Broken glass container available				
Chemical Storage	**S**	**U**	**NA**	**Comments**
Chemicals segregated by NFPA hazard class				
Chemical containers in good condition				
Chemical containers properly labeled				
Larger chemical containers on lower shelving (but not on floor)				
Chemical approved refrigerator used for highly volatile chemicals				
Flammable cabinet used for > 10 gallons flammable chemicals				
Peroxide formers are labeled date of receipt, upon opening and discarded as hazardous waste after 1 year (includes isopropanol)				
Acids stored in acid cabinet or secondary containment				
All chemical storage shelves have a secondary containment (e.g., tray)				

PHILIS2 Form ID#: HS-005 / Release Date: 09/18/2023

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ATTACHMENT D -

INCIDENT REPORTING FORM

PHILIS Program

CSS

INCIDENT REPORTING FORM

Location	Date	Inspector's Name

I. Incident Information:

A. Type of Incident (Check All that Apply):

- ☐ Injury/Illness
- ☐ Potential Exposure Exceeding Exposure Limits
- ☐ Property Damage
- ☐ Hazardous Material Spill
- ☐ Near-Miss
- ☐ Employee / Community Concern
- ☐ Regulatory Agency Investigation or Non-Compliance
- ☐ Biological Exposure

B. Date & Time of Incident: _____

C. Specific Location of Incident: _____

D. Work Performed Resulting in Incident: _____

E. Equipment Involved: _____

II. Injury/Illness Section:

A. Name of Person: _____

B. Employee Classification: ☐ Full Time ☐ Part Time ☐ Contract ☐ Temporary

C. Specific Job Function Performed: _____

D. Nature of Injury (Specify) Injured Body Part (e.g. right hand, left forearm):

Discomfort:	Strain/Sprain:	Abrasion:	Irritation:	Dizziness:
Foreign Body:	Fracture:	Burn:	Cut/Laceration:	Other:

E. Treatment Facility Name and Address, Treating Physician and Date: _____

F. First Aid Provided (Describe): _____

PHILIS2 Form ID#: HS-004 / Release Date: 09/18/2023

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ATTACHMENT E -

PARTICULARLY HAZARDOUS SUBSTANCE USE APPROVAL FORM

PHILIS Program

PARTICULARLY HAZARDOUS SUBSTANCE USE APPROVAL FORM

Before using any Particularly Hazardous (Chemical/Biohazard) Substance, please complete this form and have it approved by the H&S Manager/Chemical Hygiene Officer (CHO).

Location: _____ **Lab Unit:** _____

Supervisor or Designee: _____

1. Chemical or Biohazard Information

A. Chemical Name: _____ CAS number: _____

B. Type: ☐ Carcinogen ☐ Reproductive Toxin ☐ High Acute Toxicity

C. Estimated Rate of Use (e.g., liters, grams/week, month): _____

D. Max. concentration of the hazardous chemical/material: _____

E. SDS reviewed and readily available: *(Provide SDS or source to obtain SDS)* Yes ☐ No ☐

2. Hazards

Physical Hazards

A. Flammable: Yes ☐ No ☐ B. Corrosive: Yes ☐ No ☐

C. Reactive: Yes ☐ No ☐ D. Temperature sensitive: Yes ☐ No ☐

E. Stability (*e.g., decomposes, forms peroxides, polymerizes, shelf-life concerns*): Stable ☐ Unstable ☐

F. Known incompatibilities in laboratory operation (list): _____

Health Hazards

G. Significant Route(s) of Exposure: _____

Inhalation Hazard: Yes ☐ No ☐ Skin Absorption: Yes ☐ No ☐

H. Sensitizer: Yes ☐ No ☐ Biological Agent: _____

Is the chemical/material a nerve gas or related CWA (explain if YES): _____

3. Procedure

A. Briefly describe how the material will be used:

B. Vacuum system used: Yes ☐ No ☐ C. If yes, describe method for trapping effluents: _____

PHILIS2 Form ID#: HS-006 / Release Date: 09/18/2023

Please submit this form to the PHILIS Chemical Hygiene Officer
Do not use the substance until approval is granted.

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ATTACHMENT F -

CHEMICAL INVENTORY FORM

PHILIS Program

CSS

CHEMICAL INVENTORY FORM

Location	Date	Person Completing Inventory

Lab Unit	Chemical Name	CAS #	How Used	Est. Amt. Mthly Use	Quantity In Inventory	Type Storage	SDS on File	Comments

PHILIS2 Form ID#: HS-001 / Release Date: 09/18/2023

ATTACHMENT G -

CHAIN OF CUSTODY FORM

PHILIS Program

CSS

CHAIN OF CUSTODY RECORD

Project Name:		**Project Manager:**		**Analysis Turnaround Time**	**Date:**
Project Number:		**Address:**			**COC No:**
Sample Team Leader:		**Phone No:**			**Lab ID:**
Phone No:		**Carrier/Waybill No.:**			**SDG ID:**

Sample ID	Sample Description	Collected		CWA / Toxic Sample Field Screening Result (mg/m3)	Analysis Requested	Grab/ Comp.	No. of Cont.	Quantity	Preservative
		Date	Time						

Description of Packaging, Containers, Custody Seal and Observations:

Possible Hazard Identification:
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *TIC*
☐ *CWA* ☐ *Other:* _____

Special Instructions / QC Requirements & Comments:

Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Received at Lab By:	Date/Time:		

PHILIS2 Form ID#: QA-005 / Release Date: 09/18/2023

ATTACHMENT H -

EMPLOYEE SAFETY SUGGESTION FORM

PHILIS Program

CSS

EMPLOYEE SAFETY SUGGESTION FORM

PHILIS Location: _____

This form is for use by employees who wish to provide a safety suggestion or report an unsafe workplace condition or practice.

To Be Completed by Employee

Description of unsafe condition or practice: _____

_____

_____

Causes or other contributing practices: _____

_____

_____

Employee's suggestion for improving safety: _____

_____

_____

Has this matter been reported to a supervisor? ☐ Yes ☐ No

Employee Name: _____ Date Submitted: _____

(Recommended for obtaining additional details as necessary and to be informed of the resolution)

To Be Completed by Investigator (Supervisor, Health & Safety, Project Manager, Facility Manager)

Investigator's Name: _____ Date investigation initiated: _____

Specific actions to be completed, including any temporary actions: _____

_____

_____

_____

_____

Actions assigned to: _____ Estimated date for completion: _____

Completion verified by: _____ Completion Date: _____

Investigator to send final copy of the Employee Safety Suggestion Form to PHILIS H&S Manager.

PHILIS2 Form ID#: HS-010 / Release Date: 09/18/2023

ATTACHMENT I -

HAZARDOUS AND CWA SAMPLE SCREENING FORM

PHILIS Program

CSS

HAZARDOUS & CWA SAMPLE SCREENING - SHORT FORM

PHILIS Unit / Location: _____ **Name of Sample Receiver:** _____

Delivery Date: _____ (mm/dd/yyyy) Time: _____ A.M. / P.M.

Sampling Location(s): _____ Agency/Dept Submitting Sample: _____ Person Submitting Sample: _____

Analyte of Interest: _____ Sample Matrix: _____ Sample Date: _____

1. Field Pre-Screening & Background Information: (outside of lab): Provide information to CHO			**Comments**
A. Environmental and/or human health impacts/special hazards of handling samples?	YES	NO	*Explain*
B. Radiological levels; airborne/surface contamination below 2X background?	YES	NO	*If No, Do Not Accept*
C. Has the sample been surveyed for Chemical or Other Agent contamination?	YES	NO	*Agent & Estimated Concentration Level:*
D. Are there strange odors or apparent damage of the sample container or samples?	YES	NO	
E. Oily stains, discoloration, or crystallization?	YES	NO	
F. AP4C screen-outer packaging/container seams-, no airborne positive response	YES	NO	*Any positive response, don respirator, seal up container, contact CHO*
G. Outer package/container surface contamination check with M8 paper or using gauze wipe for follow-up GC/MS screening analysis	YES	NO	
H. Outer package wipe with bleach wipe prior to transfer to lab unit hood for opening	YES	NO	

PHILIS2 Form ID#: HS-009 / Release Date: 09/18/2023

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ATTACHMENT J -

PRIMARY STANDARD ACCOUNTABILITY FORM

PHILIS Program

PRIMARY STANDARD ACCOUNTABILITY FORM

Location: ☐ Castle Rock ☐ Edison **PHILIS Unit:** _____

Use one sheet for each primary standard vial or container.** Page: _____ of _____

Type of Standard: ☐ Agent ☐ Opiate ☐ Other: _____

Primary Standard ID (LIMS): _____ Compound Name: _____

Received Date: _____ Concentration Received: _____

Vendor Lot ID: _____ Lot Expiration Date: _____

Manufacture Date: _____ Solvent: _____

Refrigerator/Freezer ID: _____ * Disposal Date: _____

Original Amt as received (measured via syringe): _____ Original Amt as received (estimate - if vial not opened): _____

Activity	Date	Amount Used to prepare secondary standard (units must be same as Original amt received)	Secondary standard ID (LIMS)	Initials/Date	
				CAO	Agent Manager
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Primary Standard Label (LIMS):	*AFFIX LABEL HERE*

* when vial and its contents disposed of in decontamination solution. ** Primary standard is the undiluted standard as received from vendor.

PHILIS2 Form ID#: OP-006 / Release Date: 09/18/2023

ATTACHMENT K -

HAZARDOUS WASTE INSPECTION FORM

PHILIS Program

CSS

HAZARDOUS WASTE INSPECTION FORM

Location	Date	Inspector's Name

_____ 1) Are "Satellite Accumulation Area" signs posted at designated collection points?

_____ 2) Are all hazardous waste containers properly and clearly labeled "Hazardous Waste" and include specific description & initial date? (SAAs – date container when full and move waste to Hazardous Waste Storage Area.)

_____ 3) Are containers in good condition: i.e. no leaks?

_____ 4) Are containers clean: i.e. no major spill marks? Are wastes in compatible containers?

_____ 5) Are incompatible wastes segregated?

_____ 6) Are containers closed (finger tight) when not in use?

_____ 7) Is waste collected at or near the point of generation and "under the control of the operator": i.e. in the same area?

_____ 8) Are waste containers inside a secondary spill containment container, or at a minimum on top of/surrounded with an absorbent material?

_____ 9) Is housekeeping performed around the accumulation point: i.e. no excess clutter?

_____ 10) Is no more than 55 gallons of non-acute hazardous waste and/or no more than one quart of acutely hazardous waste stored in one designated point?

_____ 11) Hazardous waste containers are coordinated with the Hazardous Waste Contractor when 75% full? (Hazardous Waste cannot be stored on site for more than 180 days.)

_____ 12) Are spill control kits and PPE available?

_____ 13) Are all personnel who generate hazardous waste trained appropriately?

_____ 14) Are training records, inspection forms, waste manifests, and other documentation maintained for at least 3 years?

_____ 15) The Hazardous Waste Storage Area and Satellite Accumulation Areas are not located near drains?

_____ 16) Comments (List):

_____

_____

_____

Note: The Hazardous Waste Storage Area must be inspected at least weekly. Inspections must be documented.

PHILIS2 Form ID#: HS-003 / Release Date: 09/18/2023

ATTACHMENT L -

LABORATORY MAINTENANCE SAFETY CHECKLIST/PERMIT FORM

PHILIS Program

CSS

LABORATORY MAINTENANCE SAFETY CHECKLIST/PERMIT FORM

The form must be completed by the Lead Chemist or the Facility Manager with complete knowledge of planned maintenance work in the laboratory area.

Laboratory Location: ☐ **Castle Rock, CO** 1230 Park Street Castle Rock, CO 80109 ☐ **Edison, NJ** 2890 Woodbridge Ave., Bldg. 238 Edison, NJ 08837

Section 1 - Location and Work Details:

Lab Unit:	Specific Location in Lab Unit:
Describe the maintenance activity to be performed and identify any planned hazardous materials	
Name of Contractor or PHILIS Employee to Perform Work	

Areas to which access is required

Item	Yes	No	Other areas of importance (*if yes, specify*):
Sinks and/or drains	☐	☐	
Lab Benches	☐	☐	
Floors	☐	☐	
Ceilings/Vehicle Roof	☐	☐	
Fume hoods	☐	☐	
Chemical storage/ waste areas	☐	☐	
Ventilation/Ductwork	☐	☐	
Filtration/Exhaust Filters	☐	☐	
Fire suppression system	☐	☐	
Compressed gas cylinders	☐	☐	
Adjacent/Near GC/MS or other critical equipment		☐	
High voltage power		☐	
Physical security affected		☐	
Does anything need to be moved or areas cleared to allow access?	☐	☐	

Section 2 - Control:

Type of hazards in affected work area: ☐ Chemical ☐ Electrical ☐ Pressure ☐ Contamination ☐ Equipment

Describe: _____

_____

PHILIS2 Form ID#: HS-020 / Release Date: 09/18/2023

Page 1 of 2

ATTACHMENT M -

CWA SAMPLE ACCEPTANCE AND PROCESSING CHECKLIST FORM

PHILIS Program

CWA SAMPLE ACCEPTANCE AND PROCESSING CHECKLIST FORM	
DATE:	**Client:**
Prepared By:	**Work Order:**

Sample Information & Pre-screening

Action	Yes	No	N/A	Comments	Initials
Prior notification of samples or standards delivery					
Sample background information provided & accepted to indicate level of safety; est. concentration, hazards, source, etc.					
Custody of samples at loading dock with accepted shipping papers, chain of custody forms					
Sample packaging visually checked - no apparent damage or leakage					
COC forms, certificates, initial assessment & other information recorded in LIMS and manual entry in the CWA notebook					
Lead Chemist notifies staff & coordinates planning for the analysis					
Pre-laboratory safety check satisfactorily completed:					
PPE available					
Hood air flow and alarm checked					
Decontamination solution, spill control (pads, wipes, spill trays), eyewash/shower available/operable					
Adequate room in CWA refrigerator and at proper temperature, secured lock					
Signs posted					
CWA Operational Status Board in-place					
Samples transported to CWA receiving chemical hood using triple/containment for spill control, proper PPE worn and buddy system used					
Performed test of the AP4C before use; AP4C is located inside the hood and it is on					
No surface contamination of containers indicated using M8 indicator paper or other approved method					
No airborne CWA detected using detector tubes and/or AP4C					
Prescreening of the samples/standards conducted					

PHILIS2 Form ID#: HS-002 / Release Date: 09/18/2023

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ATTACHMENT N -

HAZARDOUS CHEMICAL LABORATORY SAFETY FORM

PHILIS Program

CSS

HAZARDOUS CHEMICAL LABORATORY SAFETY FORM

Project/Deployment: _____

General Laboratory Safety Information:

- Plan for work to identify and minimize risks in the laboratory.
- Read Safety Data Sheets (SDSs) before chemical work begins.
- Use the buddy system – always work with a partner in the laboratory when working with hazardous chemicals.
- Know the location and use of escape respirators, exposure incident response kits, spill kits, eyewashes, drench hoses/emergency showers, fire extinguishers, and Safety Data Sheets (SDSs).
- Identify personal protective equipment that is needed for work in the lab (e.g., safety glasses with side shields, lab coat, and nitrile gloves).
- Do not bring personal items into the laboratory.
- Work properly in a fume hood. Verify hood face velocity is within 80-120 fpm. Operations in the hood should be at least 8 inches from the hood face.
- Clean up lab work areas and equipment after use.
- Do not leave laboratory supplies (e.g., syringes, pipettes, glassware) laying around the lab. They will have to be treated as "hot."
- Dispose of needles, sharps, broken glass, and pipette tips in appropriate containers.
- Properly label and store chemical containers.
- Dispose of chemical waste in right manner.
- Wash your hands before leaving the laboratory.
- Take precautions to prevent accidents -chemical spills/exposure, fires, slips, trips, and falls, ergonomic injuries, and security breaches.

Emergency Response Procedures: In case of an emergency as evidenced by audible alarms, verbal announcements, or observation, evacuate the laboratory to a safe location and contact your supervisor.

Chemical Hazards: There are numerous hazards associated with the work being performed in the mobile laboratories. The facility utilizes specialized engineering controls and extensive written procedures to reduce these hazards.

PHILIS handles two general categories of chemical warfare agents: vesicants and nerve agents. Be aware of chemical odors to identify potential exposure hazards.

Common Laboratory Odors:

Chemical Agent	Odor
Mustard	Garlic like
Lewisite	Geranium Flowers

Common Laboratory Solvents	Odor
Acetone	Sweet
Methylene Chloride	Sweet
Toluene	Sweet, pungent and Benzene like
Methanol	Alcohol like
Bleach	Chlorine, pungent

PHILIS2 Form ID#: HS-016 / Release Date: 09/18/2023

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ATTACHMENT O -

FUME HOOD VENTILATION SURVEY FORM

PHILIS Program

CSS

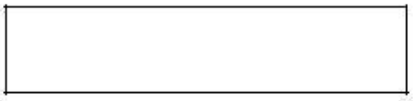
FUME HOOD VENTILATION SURVEY FORM

Lab:		**Fume Hood ID:**		**Survey Date:**	
Manufacturer:		**Model:**		**Serial No:**	
Hood permissible procedures:					
CWA Workspace: ☐ Yes ☐ No					
Anemometer Serial No.:			**Survey:** ☐ Non-Routine ☐ Quarterly		
Anemometer Model.:			**Calibration Expiration Date:**		
Face Velocity Measurements (readings at each approx. ft2 of hood face)					**Remarks**
Hood Sketch Points	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
Avg. Velocity (lfpm)					
±20% Avg. Vel.					
Height/width of Sash					
Cross Flow					
Test Methods					
Inspector					

HOOD CONFIGURATION

Type: ☐ Constant ☐ Variable ☐ Bench-top ☐ Arm ports
Sash: ☐ Vertical ☐ Horizontal ☐ Combination ☐ Hinged sash

Hood Sketch Points



TEST METHOD KEY

A. Hot Wire Anemometer
B. Vane Anemometer
C. Smoke Tube
D. Dry Ice

This hood is approved for use in its current configuration based upon average face velocity and smoke testing results.

Signature: _____ Date: _____

PHILIS2 Form ID#: HS-031 / Release Date: 07/18/2023

ATTACHMENT P -

FIELD DEPLOYMENT DAILY H&S OPERATIONS CHECKLIST

PHILIS Program

CSS

FIELD DEPLOYMENT DAILY H&S OPERATIONS CHECKLIST

Site Location: _____

Deployed Vehicles: _____

Staff at Location: _____

Tailgate Discussion Topics

Activities to be performed during the day: _____

_____

_____

Potential job hazards for the day: _____

_____

_____

Staff assignments (designate a buddy system): _____

_____

_____

Required safety equipment and supplies:

- ☐ CWA PPE
- ☐ AP4C
- ☐ 5-6% bleach, Screw top disposal vessels.
- ☐ Other: _____
- ☐ Escape Respirator
- ☐ CBRN MSA Full-Face Respirator
- ☐ Exposure Incident Response Kits containing DuoDotes. **LOCATION:** _____

Task	COMPLETE	Comments
1. Place escape respirators within arm's reach for each laboratory staff member.	☐	
2. Check that laboratory engineering controls are working properly (e.g., fume hood air flow 80-120 fpm, sash positioned at sash stops for proper fume hood working height, ventilation system working and minimize turbulence).	☐	
3. Make sure the chemical SDSs are available.	☐	
4. Check for adequate water supply for work task and decon if needed.	☐	
5. Have CBRN MSA respirators available (e.g., project work, re-entry, spill clean-up). Store away from chemical work.	☐	
6. Ensure staff are using appropriate PPE for work activities and that the PPE is the proper fit and donned correctly.	☐	
7. Set up the AP4C for air monitoring (if applicable).	☐	
8. Make sure necessary absorbents and reagents are available for small scale spill cleanup, agent deactivation, and disposal.	☐	

Completed By: _____
Signature Date

PHILIS2 Form ID#: HS-022 / Release Date: 09/18/2023

ATTACHMENT Q -

NEW EMPLOYEE LABORATORY SAFETY ORIENTATION CHECKLIST

PHILIS Program

CSS

NEW EMPLOYEE LABORATORY SAFETY ORIENTATION CHECKLIST

Review the following safety program aspects

Task	COMPLETE
1. Explain the Medical Monitoring Program (required initial and annual medical exams)	☐
2. Review required H&S training	☐
• FEMA ICS 100 (take online through FEMA)	☐
• FEMA ICS 200 (take online through FEMA)	☐
• FEMA Active Shooter (take online through FEMA)	☐
• HAZWOPER 40hr (HAZWOPER 8-hr annual refresher thereafter)	☐
• HazCom (describe to new employee chemical safety in the workplace - chemicals used, their hazards, labeling, SDS format, where to find SDSs, and what PPE is available and its use)	☐
• Safety and Chemical Hygiene Plan (S&CHP) (provide an overview to new employee, new employee must read this plan)	☐
• Emergency Response (review Readiness Plan and Emergency Action Plan, show new employee emergency evacuation routes and designated assembly point)	☐
• CWA (explain to new employee procedures when handling CWAs, including air monitoring, donning and doffing PPE, how and when to use a DuoDote, and Exposure Incident Response Kits). Review H&S SOPs	☐
• Respiratory Protection Program. Will the new employee be assigned a respirator? If yes, the new employee will need to be fit-tested	☐
• CPR/First Aid/AED (if not already certified, new employee needs to take online course and then skills session through the Red Cross)	☐
• Radiation Sealed Sources (μECD, refer to section in S&CHP)	☐
• RCRA Hazardous Waste Management (employees of Small Quantity Generators (SQGs)	☐
• DOT CDL Medical Exam and Drug and Alcohol Testing (if applicable to new hire)	☐
• HAZMAT Shipping DOT & IATA (if applicable to new hire)	☐
• Lockout/Tagout (if applicable to new hire)	☐
3. Demonstrate availability of all H&S documents on PHILIS-2 SharePoint	☐
4. Show location of AED, First Aid Kits, Exposure Incident Response Kits, Escape Respirators, Eyewash/Drench Hose/Showers, Fire Extinguishers, and Spill Kits	☐
5. Discuss waste management and spill procedures	☐
6. Give an overview on driver requirements for driving or hauling a PHILIS mobile laboratory unit and/or towing auxiliary equipment (e.g., generators). Reference PHILIS Vehicle Driving Safety Plan	☐
7. Explain incident reporting requirements and investigation protocol	☐

New Employee Name: _____
Name Signature Date

Orientation Provided By: _____
Name Signature Date

Orientation Date(s): _____

PHILIS2 Form ID#: HS-023 / Release Date: 09/18/2023

ATTACHMENT R -

LABORATORY SAFETY EQUIPMENT & SUPPLIES CHECKLIST

PHILIS Program

CSS

LABORATORY SAFETY EQUIPMENT & SUPPLIES CHECKLIST

Location	Date	Name

Required laboratory safety equipment and supplies for CWA, FGA, and opioid work. Sample handling techniques require increased precautions with stringent engineering and PPE control measures including strict hygiene practices. Concentrations of analytes in environmental samples are potentially unknown. Complete pre-operational section of checklist prior to receiving environmental samples and reference standards and end of workday section when work is done for the day.

Action	Yes	No	NA	Comments	Initials
Pre-operational:					
Inform VWR/Fisher sales rep(s) that we will be working in the field. Provide a field address where chemicals can be shipped. Ensure that chemicals can be shipped to the designated field address.					
Received prior notification of sample or standard delivery. Sample background information provided and accepted to indicate level of safety, est. concentration, hazards, source, etc.					
Digital camera available to document delivery.					
SDSs are available in the laboratory.					
Verified staff are current with H&S training, medical monitoring, and respirator fit testing.					
Completed Readiness Plan checklists prior to deploying.					
Reviewed CWA sample receiving, handling, & disposal operating procedures (CHP Section 5), applicable SOPs, and SDSs. Forms ready.					
Conducted briefing with lab staff of planned procedures, hazards, and required resources. Assigned roles – ex. "clean hands" "dirty hands."					
Prepared PPE - disposable Tyvek lab coats with sleeves, safety glasses with side shields, black nitrile gloves with extended cuffs or duct tape, blue nitrile gloves, disposable Tyvek sleeves (optional), shoe covers (as needed).					
Readied emergency equipment and supplies - personal decon equipment and supplies (exposure incident response kits, RSDL kits, privacy tent, pools, tarp, sprayer/hose, splash protection kits, Doff-It and Don-It personal privacy kits). Eyewash drench hose/shower and hand washing available. First aid kits and fire extinguishers available.					

PHILIS2 Form ID#: HS-025 / Release Date: 09/18/2023

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