

# EXERCISE PLAN

## FORT MEADE CWA EXERCISE

August 20, 2014



# **EXERCISE SCHEDULE / TIMELINE**

**FORT MEADE CWA EXERCISE**

**AUGUST 20, 2014**

# FORT MEADE CWA EXERCISE

## Field and Laboratory Timeline

**August 20, 2014**

**AGENDA      ESC CWA EXERCISE**  
**August 06 and 20, 2014**

Location: Environmental Science Center, Fort Meade, MD

### LABORATORY EXERCISE

#### Day One

Wednesday, August 20

Time:	Activity:	Location:
10:00	Tailgate Safety Briefing	Main Conference Room
10:30 – 12:00	Set up A	<u>Cold zone</u> EMSI (spill response, waste removal contractor) Security (notify 911; deliver evac bags; block hallways; meet emergency response team) Skip Weisberg (Regional SHEM, spill cleanup) Susan Shinn (Facility SHEM, observer)
	Set up B	<u>Warm zone</u> Cindy Caporale (Agent Manager; observer) Jeff Dodd (Facility Manager; observer)
	Set up C	<u>Hot zone</u> John Curry (Chemist A) Eric Graybill (Chemist B) Kevin Poff (Clean hands; escort) Robin Costas (Acting Manager; observer)
	Set up D	FGGM FD and paramedic team
12:00 – 1300	Lunch	Main Conference Room (Quizno's)
1300 – 1400	Hotwash	Main Conference Room

# **EXERCISE SCOPE**

**FORT MEADE CWA EXERCISE**

**AUGUST 20, 2014**

## **CWA 2014 EXERCISE SENARIO**

**Date:** 20 August 2014

**Purpose:**

To provide practice of internal Chemical Warfare Agents (CWA) spill/emergency procedures with in the CWA laboratory while in operation mode.

**Milestones:**

- May 29, 2014 – CWA 2014 Exercise Briefing Complete
- June 18, 2014 – SHEM Equipment Day Complete
- July 17, 2014 – CAO Training Complete
- July 22, 2014 – CWA Quarterly Meeting Complete
- August 06, 2014 – Dry Run/Walkthrough Complete
  - Pre-Exercise Briefing
- August 20, 2014 – CWA 2014 Exercise
  - Post-Exercise Debriefing

**Objectives are to practice and test the following:**

- Communication
- Spill response
- Spill cleanup
- Decontamination of personnel
- Notification to hospitals (notional)
- Notification of ESC security personnel
- Notification of paramedics/FGGM FD
- Dispensing of duo dote kits and notification processes to FGGM Paramedics.

**Players:**

John Curry (Chemist A,)  
Eric Graybill (Chemist B)  
Kevin Poff (Clean hands, escort)  
Cindy Caporale (Agent Manager)  
Security (notify 911; deliver evac bags; block hallways; meet emergency response)  
EMSI (spill response; waste removal contractor)  
Jeff Dodd (Facility Manager)  
Skip Weisberg (Regional SHEM, spill cleanup)  
Susan Shinn (Facility SHEM, observer)  
Robin Costas (Acting Lab Branch Manager, observer)  
FGGM FD (Chief Bruce Smith, Chief Wray Kinsley and paramedic team)  
OPP (observers)

**Scenario:**

The spill occurs while the CWA laboratory is conducting a through put study in G205. At approximately 10:00 am, Chemist A is receiving samples for water extraction from Chemist B. The samples were transported by Chemist B and his escort from the primary CWA lab G102, upstairs via the CWA cart and the elevator.

As the samples are being removed from the secondary containment in G205 Chemist B hits the rack on the lip of the hood causing the samples to hit the floor, breaking an undetermined number of samples and splashing him on the leg and foot. Chemist A determined that the spill was outside of his control and radios for help.

Security, will notify 911 (notional), SHEM, Facility and OASQA Managers of the incident. SHEM Manager(s) will NOTIONAL the building evacuation and notify EMSI of incident. Security will follow through normal steps of evacuation procedures without giving out the bags and radios.

After Chemist A notifies security via radio, he then determines the need for a duo dote injection(s) based on signs and symptoms displayed by Chemist B (notional injections will be made). Decontamination procedures will be started on Chemist B (NOTIONAL safety showering and decontaminating personal). Once Chemist B has been properly decontaminated, he will be transferred via FGGM paramedics to the ambulance (notional, transportation to the local hospital). Chemist A will also be transported alongside Chemist B.

FGGM FD/EMSI will perform decontamination of G205 and proper disposal of broken samples containers and potential hazardous materials.

All verbal communications should be preceded with "Exercise, exercise, exercise" and ended with the same phrase.

**Chemist A radio communication:**

"Exercise, exercise, exercise. Incident involving CWA in G205. Two exposures. CWA spill outside of controls. Exercise, exercise, exercise."

**Security 911 communication:**

"Exercise, exercise, exercise. CWA incident at EPA Building 701 G-wing. Two exposures. CWA spill outside of controls. Exercise, exercise, exercise."

**SAFETY INFORMATION**

**FORT MEADE CWA EXERCISE**

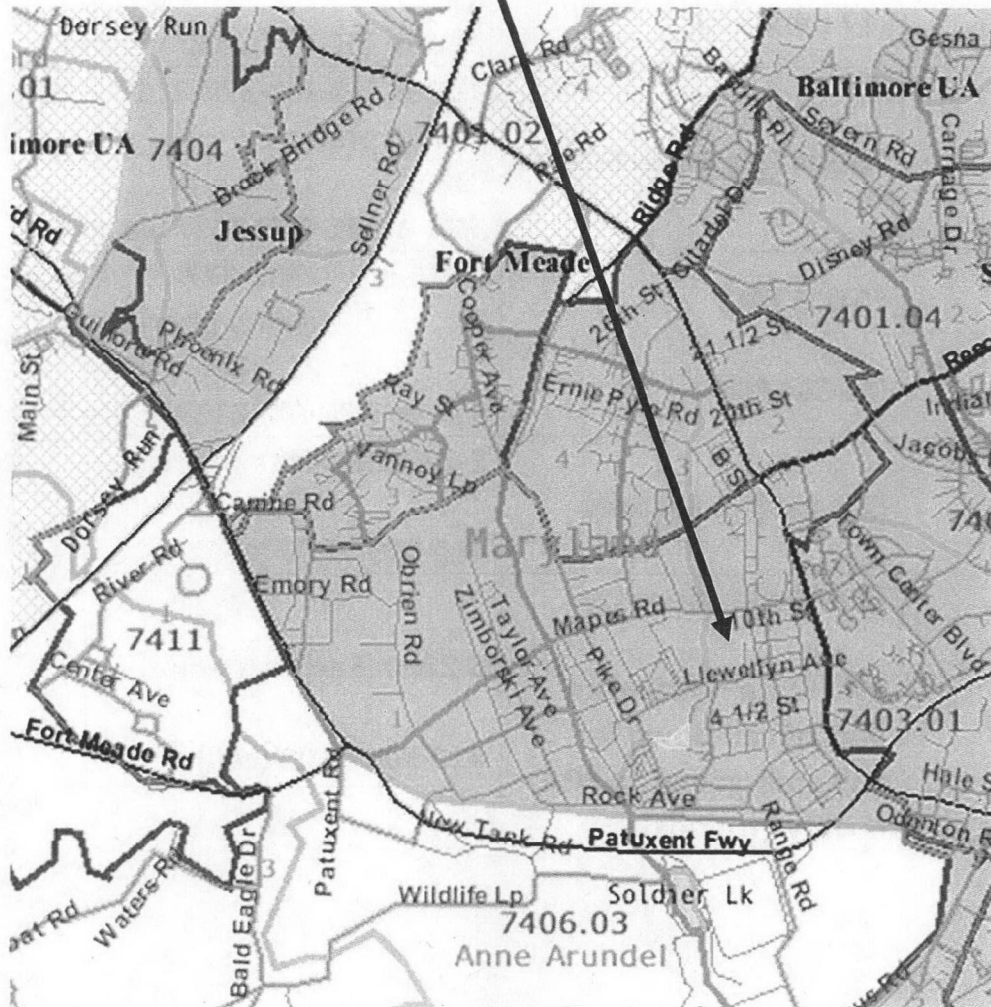
**August 20, 2014**



EPA ESC

(Exercise Location)

701 Mapes Road  
Fort Meade, MD 20755-5350



Map of Fort Meade, MD



## **EMERGENCY CONTACTS AND PHONE NUMBERS**

**Exercise Location:**  
**U.S. EPA ENVIRONMENTAL SCIENCE CENTER**  
**701 MAPES ROAD**  
**FORT MEADE, MD 20755-5350**

<b>Agency</b>	<b>Contact</b>	<b>Phone Number</b>
<b>Local Medical Emergency Facility (LMF)</b>	<b>Baltimore Washington Medical Center (17 minutes)</b>	<b>911 or 9-1-301-677-2117 if using facility phone OR 911 or 301-677-2117 via cell</b>
<b>Fire Department</b>	<b>FGGM Fire Department</b>	<b>911 or 9-1-301-677-2117 if using facility phone OR 911 or 301-677-2117 via cell</b>
<b>EMS</b>	<b>FGGM EMS  (FGGM FD)</b>	<b>911 or 9-1-301-677-2117 if using facility phone OR 911 or 301-677-2117 via cell</b>
<b>Police Department</b>	<b>EPA Facility Security</b>	<b>5-2800 (Facility Phone)  410-305-2800 (cell)</b>
<b>EPA Facility Security</b>	<b>EPA Facility Security  (MUST be notified as part of call-down for any emergency on EPA facility grounds)</b>	<b>5-2800 (Facility Phone)  410-305-2800 (cell)</b>

## **DRIVING DIRECTIONS / ROUTE TO HOSPITAL (written detail):**

**Baltimore Washington Medical Center**

**301 Hospital Drive**

**Glen Burnie, MD 21061**

**410-787-4000**

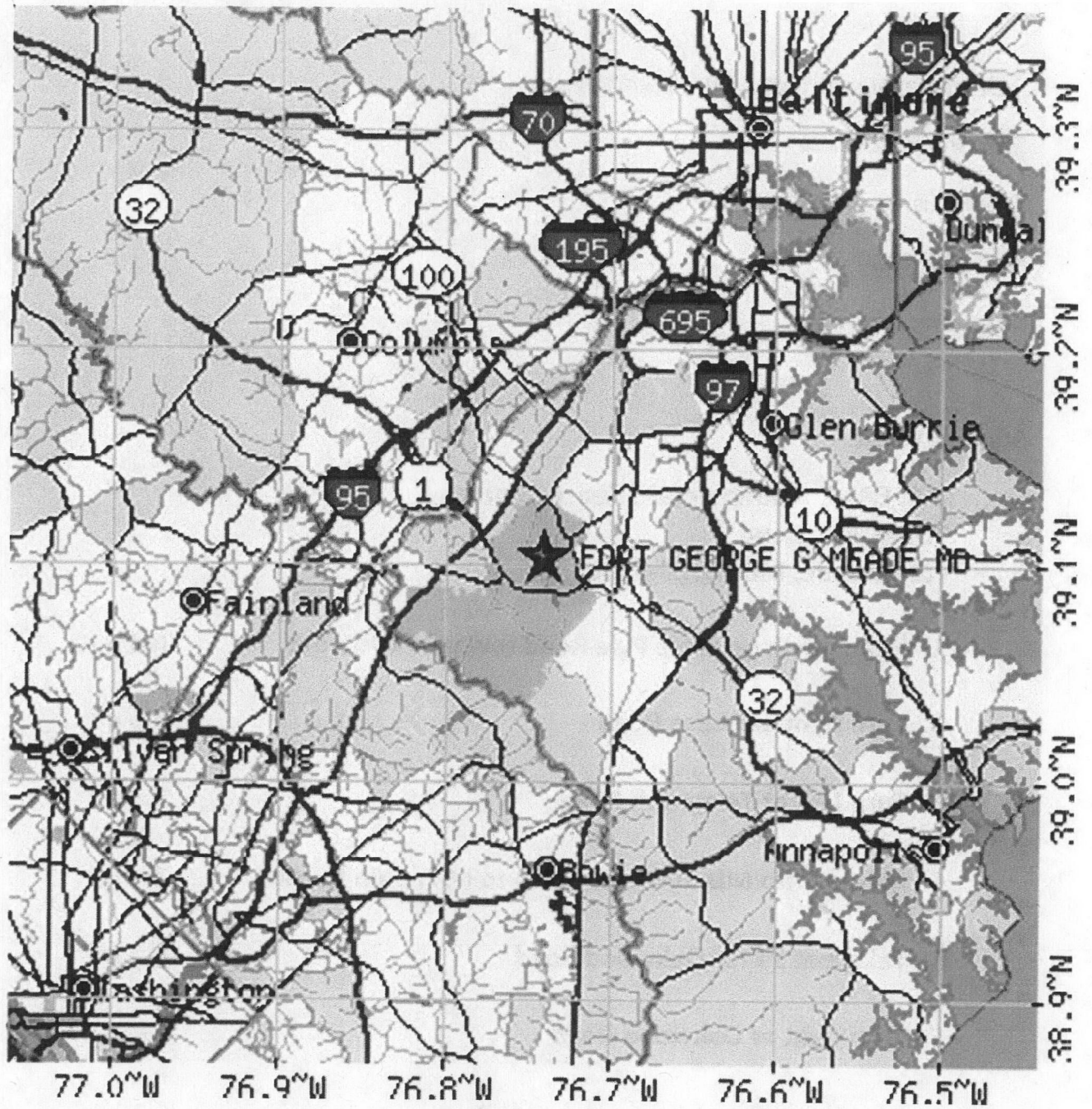
**[mybwmc.org](http://mybwmc.org)**

### **Starting Point:**

**U.S. EPA Environmental Science Center  
701 Mapes Road  
Fort Meade, MD 20755-5350**

- |   |               |
|---|---------------|
| <b>1. Head north on Ernie Pyle Road toward 14<sup>th</sup> Street</b> | <b>0.4 mi</b> |
| <b>2. Turn right at Reece Road</b>                                    | <b>3.3 mi</b> |
| <b>3. Turn Left at Telegraph Road</b>                                 | <b>0.7 mi</b> |
| <b>4. Merge onto MD-100 E via ramp to I-97/Glen Burnie</b>            | <b>4.3 mi</b> |
| <b>5. Take exit 15 for Oakwood Road</b>                               | <b>0.2 mi</b> |
| <b>6. Turn right at Oakwood Road</b>                                  | <b>325 ft</b> |
| <b>7. Take the first right onto Hospital Drive</b>                    | <b>0.2 mi</b> |

Need map from mapquest.com



## LABORATORY ACTIVITIES SHEET

### US EPA – Region 3

☒ **ESC**    ☐ **WHO**    ☐ **Mobile Lab**

#### Purpose

To ensure adequate review of proposed occupational safety and health precautions, procedures and techniques for use involving hazardous agents, equipment or operations in laboratory activities. This review applies to all "laboratory activities" meaning EPA program activities that are conducted by EPA employees within an EPA laboratory facility and/or mobile laboratory vehicle/trailer. (Assistance in completing this form is available from the SHEM office).

<b>Labwork Project / Description:</b>		
CWA Laboratory Through-Put Study		
<b>Start Date: August 20, 2014</b>	<b>End Date: August 20, 2014</b>	
<b>Branch: OASQA</b>	<b>Lab: CWA UDA</b>	<b>Room #: G102, G205</b>
<b>Point of Contact / Phone #: John Curry / 5-2608</b>		
<b>Person Conducting Assessment / Phone #: Susan Shinn / 5-2618</b>		
<b>Employee's Performing Laboratory Activity:</b> <input type="checkbox"/> <b>Additional Sheets</b>		
John Curry (Chemist)	(ESAT analyst)	
Eric Graybill (Chemist)		
Kevin Poff (clean hands)		
<b>Closest Medical Facility / Phone # (Mobile Lab work only): Anne Arundel County</b>		

<b>Physical Hazards (check all that apply)</b>			<input type="checkbox"/> <b>None</b>
<input type="checkbox"/> Noise > 85 dBA	<input type="checkbox"/> Oxygen deficiency	<input checked="" type="checkbox"/> <b>Sharps</b>	<input type="checkbox"/> Electrical (shock, short circuit)
<input type="checkbox"/> Extreme temperatures	<input type="checkbox"/> Pressurized vessels	<input type="checkbox"/> Autoclaves / Ovens / hotplates	<input type="checkbox"/> Electrical (static, ESD)
<input type="checkbox"/> Extreme weather conditions	<input checked="" type="checkbox"/> <b>Compressed gases</b>	<input type="checkbox"/> Strenuous tasks	<input type="checkbox"/> Electrical (loss of power)
<input checked="" type="checkbox"/> <b>Slip-Trip-Fall</b>	<input checked="" type="checkbox"/> <b>Lifting heavy objects</b>	<input checked="" type="checkbox"/> <b>Security (locked doors, refrigerators, confined areas)</b>	<input type="checkbox"/> Flammable liquids storage
<input type="checkbox"/> Electrical hazards	<input type="checkbox"/> Non-portable power tools	<input type="checkbox"/> Cryogenics	<input type="checkbox"/> Flammable solids
<input type="checkbox"/> Power tools	<input type="checkbox"/> Open flames / Bunsen burner	<input type="checkbox"/> Hand tools	<input type="checkbox"/> Flammable gas storage
<input type="checkbox"/> Vacuum chambers or systems	<input type="checkbox"/> Other spark producing activity	<input type="checkbox"/> Flame (Bunsen burner)	<input checked="" type="checkbox"/> <b>Water (specify) – STF from shower (notional)</b>
<input type="checkbox"/> Welding, brazing, soldering	<input type="checkbox"/> Explosive potential		
<input checked="" type="checkbox"/> <b>Ergonomic (design flaw)</b>	<input type="checkbox"/> <b>Ergonomic (overexertion risk factors)</b>		
	<input type="checkbox"/> <b>Ergonomic (excessive vibrations)</b>		
<input checked="" type="checkbox"/> <b>Other (specify): Human factor (stress)</b>			

<b>Biological Hazards (check all that apply)</b>			<input type="checkbox"/> <b>None</b>
<input type="checkbox"/> Bacteria, mold, viruses, etc	<input type="checkbox"/> Insects	<input type="checkbox"/> Animal	<input type="checkbox"/> Vegetation
<input type="checkbox"/> Mold	<input type="checkbox"/> Organic dust	<input type="checkbox"/> Vectors	<input checked="" type="checkbox"/> <b>Medical sharps – duo dotes</b>
<input type="checkbox"/> Viruses	<input type="checkbox"/> Allergies	<input type="checkbox"/> Blood components	
<input type="checkbox"/> Poison plants	<input type="checkbox"/> Recombinant DNA	<input type="checkbox"/> Tissue	
<input type="checkbox"/> Contaminated water (microorganisms)		<input type="checkbox"/> Body Fluids	
<input type="checkbox"/> <b>Other (specify)</b>			

(\*\*Supervisor signature certifies that employee is up to date on all necessary monitoring and training. If controls for identified hazards are deemed insufficient, supervisor should contact the SHEM office for consultation and further review.)

Chemical Hazards (check all that apply)			<input type="checkbox"/> None
<input type="checkbox"/> Carcinogens	<input type="checkbox"/> Nanomaterials	<input checked="" type="checkbox"/> Acids / Bases	<input type="checkbox"/> Perchlorates
<input type="checkbox"/> Flammable liquids	<input type="checkbox"/> Highly acute toxins	<input checked="" type="checkbox"/> Corrosives	<input type="checkbox"/> Mutagens
<input type="checkbox"/> Flammable gases	<input type="checkbox"/> Pesticides / herbicides	<input type="checkbox"/> Oils	<input type="checkbox"/> Teratogens
<input type="checkbox"/> Flammable solids / dust	<input checked="" type="checkbox"/> Semi-Volatile Organics	<input type="checkbox"/> PCBs	<input checked="" type="checkbox"/> CWA materials
<input type="checkbox"/> Explosives	<input type="checkbox"/> Reproductive toxins	<input type="checkbox"/> Dioxins / furans	<input checked="" type="checkbox"/> Spill potential
<input type="checkbox"/> Asbestos	<input type="checkbox"/> Pyrophoric materials	<input type="checkbox"/> Strong oxidizers	<input checked="" type="checkbox"/> Bleach
<input checked="" type="checkbox"/> Solvents / volatiles	<input checked="" type="checkbox"/> Controlled substances	<input type="checkbox"/> Formaldehyde (any use)	<input checked="" type="checkbox"/> Transportation of chemicals
<input type="checkbox"/> OSHA regulated chemicals (any use)	<input type="checkbox"/> Highly reactive materials	<input type="checkbox"/> Lead (any use)	
<input type="checkbox"/> Toxic metals (e.g., As, Ba, Be, Cd)	<input checked="" type="checkbox"/> Methylene chloride (any use)	<input type="checkbox"/> Mercury / Hg compounds (any use)	
<input type="checkbox"/> Other (specify)			

Ionizing and Non-Ionizing Radiation Hazards (check all that apply)			<input checked="" type="checkbox"/> None
<input type="checkbox"/> Radioactive sources	<input type="checkbox"/> Lasers	<input type="checkbox"/> Radio frequency (RF) / Microwave energy	
<input type="checkbox"/> Dispersible radioactive materials	<input type="checkbox"/> Non-fissionable radioactive materials	<input type="checkbox"/> Extreme, low frequency (ELF)	
<input type="checkbox"/> Magnetic / electric fields	<input type="checkbox"/> Fissionable radionuclides	<input type="checkbox"/> X-ray devices	
<input type="checkbox"/> Infrared / ultraviolet sources	<input type="checkbox"/> Transportation of radiological materials	<input type="checkbox"/> Any atmospheric discharge of radiological material	
<input type="checkbox"/> Other (specify):			

Significant Laboratory Potential Hazards (check all that apply)	<input type="checkbox"/> None
<input checked="" type="checkbox"/> Any hazardous / radiological waste generation – CWA UDA waste, bleach, spill response materials, broken glass	
<input checked="" type="checkbox"/> Any liquid discharges that require engineering controls – shower or eyewash use, hoods,	
<input checked="" type="checkbox"/> Storage or use of any chemicals or radioactive materials that required engineering controls – refrigerators, hoods, solvent cabinets	
<input checked="" type="checkbox"/> Medical Waste – duo doses	
<input checked="" type="checkbox"/> Other laboratory hazards related to your work (specify): communications (radios), PPE failure, safety equipment failure,	

Other Issues (Security, Notifications, etc.)	<input type="checkbox"/> None
Specify: Notification to ESC Security, DO, OEC, FGGM FD, FGGM paramedics	

Risks & Hazard Controls		<input type="checkbox"/> None
Hazard / Task:	Controls (include ventilation and PPE requirements)	Approved (supv initials)
Absorption, ingestion, inhalation	Gloves, safety glasses, lab coat, respirator, hood, proper training, CHP/OEP	
Engineering and/or power failures	Practice drills conducted to include shut down of operations associated with engineering failures such as hood failure and power outages.	
Engineering and/or power failures	Fume hood inspections.	
Engineering and/or power failures	Hand-held detector equipment calibrations and working properly.	
Training	Ensure that the operator and buddy are prepared for each operation and review the SOP prior to beginning work.	

(\*\*Supervisor signature certifies that employee is up to date on all necessary monitoring and training. If controls for identified hazards are deemed insufficient, supervisor should contact the SHEM office for consultation and further review.)

Preventive Measure	When in doubt, consult the CAHO	
Preventive Measure	Use the buddy system.	
Preventive Measures	Use secondary containers and spill trays.	
Preventive Measure	Be aware and attentive (no distractions)	
Preventive Measure	Emergency PPE and decon equipment/reagents readily available.	
Chemical Use	Proper training, CHP/OEP, user knowledge, proper PPE for the task	

**Preparer's Signature:** \_\_\_\_\_ **Mail Code:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Supervisor's Approval\*\*:** \_\_\_\_\_ **Mail Code:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Supervisor's Contact Number (Mobile Lab Only):** \_\_\_\_\_

**Analyst Signature** \_\_\_\_\_ **Date** \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**(\*\*Supervisor signature certifies that employee is up to date on all necessary monitoring and training. If controls for identified hazards are deemed insufficient, supervisor should contact the SHEM office for consultation and further review.)**

---

---

**(\*\*Supervisor signature certifies that employee is up to date on all necessary monitoring and training. If controls for identified hazards are deemed insufficient, supervisor should contact the SHEM office for consultation and further review.)**



## **JOB HAZARD ANALYSIS / WORK CONTROL PLANS**

Modify site-specific Job Hazard Analysis (JHA) / Work Control Plans (WCP) and the accompanying data sheets when:

- The scope of work is changed by adding, eliminating, or modifying tasks
- New methods of performing tasks are selected
- Observation of the performance of tasks results in a revised characterization of the hazards
- New chemical, biological, radiological or physical hazards are identified
- Exposure data indicate changes in the concentration and/or likelihood of exposure
- New/different control measures are selected

When JHA/WCP are modified, related provisions in other chapters of the HASP must also be modified as needed. The modified JHA/WCP and HASP requirements must be communicated to all affected personnel.

**JHA/WCP-1    Modified Level D PPE (Sample Prep, Lab)**

<u><b>Operational Phase</b></u>	<u><b>Task / Operation</b></u>	<u><b>Location</b></u>
Active Assessment	Laboratory	G205

**Date(s) this JHA/WCP Conducted:**      August 20, 2014

**Employee(s) Certifying this JHA/WCP:**

Susan Shinn    SHEM  
Skip Weisberg . SHEM  
Cindy Caporale Associate Director for OASQA  
Robin Costas    Acting Lab Branch Chief

**Chemical Hazards:**

<u><b>Chemical Name / Source</b></u>	<u><b>Concentration</b></u>	<u><b>Regulatory Exposure Limits</b></u>
GB    Sarin	None, simulated scenario	
GD    Soman	None, simulated scenario	
GF    Cyclosarin	None, simulated scenario	
HD    Sulfur mustard	None, simulated scenario	
VX    VX	None, simulated scenario	

**Physical Hazards:**

<u><b>Name of PH / Source</b></u>	<u><b>Potential Hazard / Outcome</b></u>
Ambient Heat Stress	Heat rash//cramps/exhaustion/heat stroke
Improper Lifting	Back strain/abdomen/arm/leg muscle/joint injury
Poor Housekeeping	Slips/Trips/falls/punctures/cuts/fires
Hostile Persons	Bodily injury
Vehicle Hazards	Struck by vehicle/collision
Vehicles/Driving	Accidents/fatigue/cell phone use
Communications	Disruption of communications

**Biological Hazards:**

<u><b>Name of BH</b></u>	<u><b>Source</b></u>	<u><b>Exposure Potential</b></u>
NA		

**Control Measures Used:**

**Level of PPE: Modified Level D (See Section 6 – PPE)**

Appropriate clothing  
Closed-toed shoes  
Safety eye protection  
Gloves  
Lab Coats  
Two-way radio

Respirator: NA

Cartridge / Canister: NA

Service Life:

Air Monitoring: PID, Altair 4X, Drager tubes, M8 and M9 papers, M256A 1 chemical agent detector kit, AP4C, HazMat CAD

Equipment: fire extinguisher, first aid kit, heat stress monitoring equipment, bleach or other hypochlorite decontamination chemicals, tap water sprayers, scrub brushes, decontamination tubs and basins, 5-gallon buckets, 55-gallon drums (for decon fluids), paper towels, plastic trash bags.

**Other Control Measures Used:**

Buddy system required

Duodotes (notional)

Dilute Chemical Warfare Agent  
**Response To Life-Threatening Or Serious Illness / Injury**

- Use DuoDote (if appropriate – possibly for victim **and** buddy/rescuer)
- Call 9-911
- Engage alarm to alert CAHO/SHEM Manager and Supervisors

**Identify the nature of the injury / illness: (Circle one)**

**Medical Problem:**

Dizzy  
Chest pain  
Disoriented  
Asthma attack  
Unconscious  
Other: \_\_\_\_\_

**Injury:**

Puncture  
Cut  
Fall  
Stain / Sprain  
Other: \_\_\_\_\_

**CWA Exposure:**

Compromised PPE  
Spill / Splash  
Explosion  
Protective Engineering Failure  
Other: \_\_\_\_\_

**RESCUERS (Medical / Injury only):**

- Remove to clean anteroom
- Lay patient on a clean blanket
- Remove PPE (cut away?)
- Not breathing? Establish airway
- No pulse? Administer AED
- Support until EMT Team arrives

**RESCUERS (possible UDA Exposure):**

- Remove to clean anteroom
- Lay patient on a clean blanket over a plastic barrier sheet on gurney
- Begin decon procedure (see separate instructions)
- Remove and bag clothes & blanket
- Replace with Tyvek garment
- Support until EMT Team arrives

**Once EMT arrives be prepared to:**

\_\_\_\_ Supply patient name  
\_\_\_\_ Name of CWA patient was working with  
\_\_\_\_ (M)SDS for UDA / MOU / "Grab and Go" Packet  
\_\_\_\_ Time and frequency of DuoDote injection(s), if given  
          #1 Time \_\_\_\_\_ #2 Time \_\_\_\_\_ #3 Time \_\_\_\_\_

**Contacts:** (Check as they are completed)

\_\_\_\_ UDA H&S Manager has been notified  
\_\_\_\_ Patient's direct supervisor notified

Form is subject to OSHA medical records regulation 1910.1020.  
Form does not replace EPA Accident / Illness / Injury Report Forms.

**Dilute Chemical Warfare Agent**  
**Response To Life-Threatening Or Serious Illness / Injury**

**Patient Name:** \_\_\_\_\_

**Rescue Buddy:** \_\_\_\_\_

**UDA being analyzed:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_ **Room Number:** \_\_\_\_\_

**Other Responders:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Describe:**

**Events leading to incident (Patient should describe or concur if she/he is able):**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Hazards remaining in the room where the incident occurred:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**FORM INSTRUCTIONS**

- This form should be filled out every time there is a first aid response for a lab worker who is working the day of the incident in a UDA laboratory space.
- To be filled out by "Buddy" first responder immediately after incident.
- Buddy makes two (2) copies of this report:
  - i. Original goes to the CAHO/CAHO on the day of the incident.
  - ii. One copy goes to the worker's direct Supervisor.
  - iii. Originator (Buddy) keeps a copy for 30 days, then passes that copy to the CAHO/CAHO for disposition.

Form is subject to OSHA medical records regulation 1910.1020.

Form does not replace EPA Accident / Illness / Injury Report Forms.

## HEALTH AND SAFETY PLAN (HASP)

**Prepared By:** Susan Shinn

**Date:** August 20, 2014

**Site Name:** Environmental Science Center CWA Exercise

**EPA Contact:** John Curry

**Site Address:** Fort Meade, MD

**Scope of Work:** (1) respond to CWA incident, set up work and decontamination zones, conduct ambient air monitoring, document site conditions. (2) conduct site entry; perform air monitoring and decontaminate all personnel and equipment as needed. (3) Additional tasks TBD as needed.

**Background Information:** this Health and Safety Plan (HASP) addresses responding to a CWA incident located in G205 laboratory.

Responses to a CWA incident pose additional concerns and potential stresses not typically present at a hazardous material incident. There will probably be considerable public interest and an unusual amount of news media attention; the operations will be subject to public scrutiny. Also, there may have been deaths and/or injuries stemming from the incident. The situation may present serious physical and psychological threats that cause stress in the workers. Team members should be aware of the unusual aspects of the response and potential effects on team members.

### Additional Site-Specific Information:

The ESC CWA Exercise is being conducted in order to provide practice of internal Chemical Warfare Agents (CWA) spill/emergency procedures within the CWA laboratory while in operation mode.

### Hazard Assessment and Equipment Selection

In accordance with ESC's Personal Protective Equipment Program and 29 CFR 1910.132, at the site prior to personnel beginning work, the Safety Officer and/or the Site Leader will evaluate conditions and verify that the personal protective equipment selection outlined within this HASP is appropriate for the hazards known or expected to exist (Refer to ESC CHP Dilute Solution Hygiene Plan).

<b>Potential Hazards / Risks: Chemical</b>
Simulated response, no contaminants present. <i>Typical text for an actual incident: may involve nerve, blister, or blood agents, or intentional release of toxic industrial chemicals; appropriate work zone delineation, awareness of potential chemicals and their properties, appropriate use of PPE and air monitoring, attention to surroundings, and use of the "Buddy System" will reduce the risk of exposure. Primary threat is through inhalation or contact with materials; contact with any material should be minimized during all activities.</i>
<b>Potential Hazards / Risks: Physical (medium)</b>
Physical hazards may include slip/trip/fall hazards. Heat stress may also be a hazard. Awareness of potential hazards, use of the "Buddy System," and careful observation of surroundings will minimize risks. Hostile, frightened, or panicked persons may be encountered. Awareness of potential hazards, use of the buddy system, and careful observation of surroundings will minimize risks.

<b>Potential Hazards / Risks: Biological (none)</b>
<b>Levels of Protection / Justification</b>
Level B PPE with air monitoring for waste removal response, attention to surroundings, use of the buddy system, and thorough decontamination should provide sufficient protection.

All work will be performed in accordance with the provisions of this HASP, OSHA guidelines, OASQA SOPs, and ESC CHP.

<b>PERSONNEL PROTECTION PLAN</b>			
<b>Engineering Controls</b>			
Fume Hoods, real time air monitoring			
<b>Administrative Controls</b>			
8-Hour OSHA H&S refresher training, medical monitoring clearance, current respirator fit test, Level A/B/D training, CPR/AED/1 <sup>st</sup> Aid			
<b>Personal Protection Equipment</b>			
Level A/B/C/D			
<b>Description of Levels of Protection</b>			
<b>Level D / Level D Mod</b>	<b>Level C</b>	<b>Level B</b>	<b>Level A</b>
<input type="checkbox"/> Head – Hard Hat <input checked="" type="checkbox"/> Eye (Safety Glasses) <input type="checkbox"/> Hearing – Ear plugs <input checked="" type="checkbox"/> Appropriate uniform <input type="checkbox"/> Coverall (Tyvek) <input checked="" type="checkbox"/> Hand – Gloves (inner surgical) <input type="checkbox"/> Hand – Gloves (middle) <input checked="" type="checkbox"/> Hand – Gloves (outer – surgical) <input type="checkbox"/> Foot – Safety Boots <input type="checkbox"/> Foot – Over boots <input type="checkbox"/> Other - specify	<input type="checkbox"/> Head – Hard Hat <input type="checkbox"/> Face (splash shield) <input type="checkbox"/> Hearing – Ear plugs <input checked="" type="checkbox"/> Appropriate Uniform <input checked="" type="checkbox"/> Coverall (Tyvek) <input checked="" type="checkbox"/> Hand – Gloves (inner surgical) <input type="checkbox"/> Hand – Gloves (middle) <input checked="" type="checkbox"/> Hand – Gloves (outer – surgical) <input checked="" type="checkbox"/> Foot – Safety Boots <input checked="" type="checkbox"/> Foot – Over boots <input checked="" type="checkbox"/> Respirator (Full Face APR) <input checked="" type="checkbox"/> Cartridge (OV/HEPA) <input type="checkbox"/> Other (specify)	<input type="checkbox"/> Head – Hard Hat <input type="checkbox"/> Face (splash shield) <input type="checkbox"/> Hearing – Ear plugs <input checked="" type="checkbox"/> Appropriate Uniform <input type="checkbox"/> Coverall (Tyvek) <input checked="" type="checkbox"/> Hand – Gloves (inner surgical) <input type="checkbox"/> Hand – Gloves (middle) <input checked="" type="checkbox"/> Hand – Gloves (outer – surgical) <input type="checkbox"/> Foot – Safety Boots <input type="checkbox"/> Foot – Over boots <input type="checkbox"/> SCBA <input type="checkbox"/> Other (specify)	<input type="checkbox"/> Head – Hard Hat <input type="checkbox"/> Face (splash shield) <input type="checkbox"/> Hearing – Ear plugs <input checked="" type="checkbox"/> Appropriate Uniform <input checked="" type="checkbox"/> Coverall (Kappler responder CSM fully encapsulating chemically-resistant suit) <input checked="" type="checkbox"/> Hand – Gloves (inner surgical) <input type="checkbox"/> Hand – Gloves (middle) <input checked="" type="checkbox"/> Hand – Gloves (outer – Butyl – integral to suit) <input checked="" type="checkbox"/> Foot – integral to suit <input checked="" type="checkbox"/> Foot – Over boots <input checked="" type="checkbox"/> SCBA – 60 minute <input type="checkbox"/> Other (specify)

Note: respiratory protection must be NIOSH CBRN certified.

<b>SITE AIR MONITORING PROGRAM</b>			
<b>Action Levels</b>			
These Action Levels, if not defined by regulation, are some percent (usually 50%) of the applicable PEL/REL/TLV. These numbers must also be adjusted to account for instrument response factors.			
	<b>Tasks</b>	<b>Action Level<sup>1</sup> Ambient Concentration</b>	<b>Action</b>
<input type="checkbox"/>	<b>Explosive atmosphere</b>	<10% LEL  10 to 25% LEL  >25% LEL	Work may continue. Consider toxicity potential.  Work may continue. Increase monitoring frequency.

<sup>1</sup> Action levels listed above do not include confined space entry work; adjustments will be required.



			Work must stop. Ventilate area before returning.
<input type="checkbox"/> Oxygen		<p>&lt;19.5% O<sub>2</sub></p> <p>19.5% to 25% O<sub>2</sub></p> <p>&gt;25% O<sub>2</sub></p>	<p>Leave area. Re-enter only with SCBA</p> <p>Work may continue. Investigate changes from 21%</p> <p>Work must stop. Ventilate area before returning</p>
<input type="checkbox"/> Radiation		<p>&lt;3X background</p> <p>3X background to &lt;1 mR/hr</p> <p>&gt;1mR/hr</p>	<p>Continue work</p> <p>Possible rad source(s) present (normal background is 0.01-0.02 mR/hr). Continue investigation with caution. Perform thorough monitoring. Consult with a Health Physicist.</p> <p>Potential radiation hazard. Continue investigation only upon the advice of Health Physicist.</p>
<input type="checkbox"/> Unknown Organic Gases/Vapors		<p>&lt;1 unit above background</p> <p>1 to 5 units above background</p> <p>&gt;5 to 500 units above background</p> <p>&gt;500 units above background</p>	<p>Level D, continue air monitoring.</p> <p>Level C, continue air monitoring.</p> <p>Level B, continue air monitoring.</p> <p>Level A or evacuate affected area.</p>
<input type="checkbox"/> Specific Organics/Inorganics			
<input checked="" type="checkbox"/> CWA		<p>Airborne Exposure Limit Worker Population Limit specific to CWA. See attached USACHPPM document entitled Table 1. Summary of Chemical Agent Air Exposure Values: Existing Information as of 8/03/04- POC: V. Hauschild, USACHPPM<sup>2</sup></p> <p>&gt;AEL GPL</p> <p>&gt;AEL WPL</p> <p>&gt;AEL STEL</p> <p>&gt;AEL IDLH</p>	<p>Level A – OR – Level D with continuous air monitoring</p> <p>Level A – OR – Level C with continuous air monitoring</p> <p>Level A – OR – Level B with continuous air monitoring</p> <p>Level A – OR – evacuate affected area</p>

<sup>2</sup> USACHPPM AELs for CWA are based upon CDC values or USACHPPM derived values. OSHA, NIOSH, or ACGIH exposure values are not applicable.

AIR MONITORING / SAMPLING SUMMARY LOG								
Work Location Instrument Readings								
Location	% LEL	% O <sub>2</sub>	PID (units)	FID (units)	Aerosol Monitor (mg/m <sup>3</sup> )	Rad Meter (uR/hr)	Detector Tubes (ppm)	Other

CONTINGENCY PLAN			
Response Plans			
<b>Medical – General</b> – provide 1 <sup>st</sup> Aid as trained, assess and determine need for further medical assistance. Transport or arrange for transport after decontamination.			
<input type="checkbox"/> <b>1<sup>st</sup> Aid Kit required</b>	Type – standard field including bloodborne pathogen kit	Location – laboratory hallways	Special 1 <sup>st</sup> Aid procedure: Cyanides on site <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, contact LMF. Do they have antidote kit? <input type="checkbox"/> Yes <input type="checkbox"/> No
<input type="checkbox"/> <b>Eyewash required</b>	Type – standard gravity fed	Location – laboratory hallways	Hydrogen Fluoride on site <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, need neutralizing ointment for 1 <sup>st</sup> Aid kit. Contact LMF.
<b>Spills</b> – in the event of a spill or release, ensure safety, assess situation and perform containment and control measure as appropriate.	a. Small spill – clean up per SDS; Notify emergency coordinator b. Large spill – sound alarm; notify emergency coordinator c. Evacuate to pre-determined safe place d. Account for all personnel e. Determine if Team can respond safely	Spill Response Equipment	Location: G205
<b>Fire/Explosion</b> - in the event of a fire/explosion, ensure safety, assess situation and perform containment and control measure as appropriate.	a. Sound alarm and call assistance; notify emergency coordinator b. Evacuate to predetermined safe place c. Account for personnel d. Use fire extinguisher, only if safe and trained e. Standby to inform emergency responders of materials and conditions	Location – laboratory and laboratory hallway	
<b>Security problems</b> – law enforcement agency involvement is likely. Personnel should assess safety of field team, notify local police or other agencies if necessary, and assist incident commander with preventing unauthorized persons from entering exclusion zone and contaminated persons from leaving exclusion zone.			

## DECONTAMINATION PLAN

### Levels of Protection Required for Decontamination Personnel

The levels of protection required for personnel assisting with decontamination will be:

☐ Level A    ☐ Level B    ☐ Level C    ☐ Level D    ☐ Level D Mod

Modifications include:

### PPE and Monitoring Equipment Decontamination

Decontamination should be achieved through a combination of tap water rinses/showers and thorough scrubbing using a 5% sodium hypochlorite (straight household bleach) solution. Decontamination of human skin with bleach will not occur. A 5-minute contact time is necessary for chemical agents. Decontamination areas must be set up upwind of the hot zone, and must be moved if the wind direction changes. In the event of mass casualty situations, a decontamination line for casualties should be set up separately from that for the responders. All decontamination fluids should be bermed/containerized for disposal, and care should be taken that decontamination equipment is itself subsequently decontaminated. The levels of protection required for personnel assisting with decontamination will be levels A, B, C and D PPE, dependent on site conditions. Decontamination should be conducted as follows:

- 1) Gross physical removal: any gross contamination should be removed (if possible) while still in the hot zone.
- 2) Boot rinse: a bleach rinse should be used to prevent spreading agents during decontamination. Level A/B required for personnel assisting with decontamination.
- 3) Glove rinse: a bleach rinse should be used to prevent spreading agents during decontamination. Level A/B PPE required for personnel assisting with decontamination.
- 4) Full PPE decontamination: a thorough scrubbing using 5% sodium hypochlorite with sufficient contact time is necessary. Level A/B PPE required for personnel assisting with decontamination.
- 5) Full PPE rinse: a tap water rinse using hoses or water sprayers should be used to remove bleach and neutralized agent residues. Level C PPE required for personnel assisting with decontamination.
- 6) Outer Boot removal: remove decontaminated boots. Level C/mod D PPE required for personnel assisting with decontamination.
- 7) Level A suit removal: personnel should remain on SCBA through this step. Level C/mod D PPE required for personnel assisting with decontamination
- 8) SCBA removal.
- 9) Inner glove removal.
- 10) Field wash: personnel should wash hands and face using soap and water

A diagram of the decontamination process is shown on the following page.

### Disposition of Investigation-Derived Wastes

All PPE, decontamination fluids, and other potentially contaminated materials will be containerized and stored on site pending disposition as directed by EPA or other Federal Officials.

CHEMICAL AGENT HAZARDS							
Agent	Symbol	Hazard	Signs/Symptoms	Onset	Duration of Persistence	Physical Properties	Odor
<b>Nerve</b>							
Sarin	GB	Inhalation Absorption	Runny nose, localized sweating, dimness of vision, pinpoint pupils, tightness in chest, difficulty breathing, drooling, cramping, tearing, frontal headaches, involuntary jerkin and twitching, drowsiness, coma, convulsions, nausea, cessation of breathing, death.	Very rapid Vapor-secs Liq – mins to hours depending on amount	<20 hr	Colorless liq	None when pure; fruity
Soman	GD	Inhalation Absorption			<10-15 hrs	Colorless liq/vap	
Cyclosarin	GF	Inhalation Absorption Ingestion		Very rapid		Colorless liq	Sweet, musty, peaches, shellac
V Agent	VX	Inhalation Absorption		Very rapid Death – 15 min	1 week if heavy concntr. As volatile as motor oil. High	Amber, oily thick liq	none
<b>Vesicant</b>							
Sulfur Mustard	H	Inhalation Absorption Ingestion		Delayed 4-6 hrs to 24 hrs	Days to weeks – very high	Oily, colorless to amber liq	Garlic, onion

CWA – DETECTION INFORMATION			
Agent	Symbol	Initial Treatment	Field Detection
Sarin	GB	Mark-1 = 2 mg Atropine and 600 mg 2-PAM Cl (Pralidoxime chloride) Diazepam follows 3 Mark-1s. IV effects within 1 min IM 8 min Ventilation and suction airway	M-8 or M-9, APD2000/AP2C, CAM, HazMatCAD, MiniCAMS, DAAMS, colorimetric tubes detection kits: M-256A1, M18A2, pesticide tickets
Soman	GD		
Cyclosarin	GF		
V agent	VX		
Mustard	H	Remove agent from skin. Remove contaminated clothes. Eyes must not be bandaged. Flush contaminated areas but watch runoff. BAL (British Anti-Lewisite cream) antidote = dimercaprol for intramuscular. Tx-symptomatically.	M-8 or M-9, APD2000/AP2C, CAM, HazMatCAD, MiniCAMS, DAAMS, colorimetric tubes

Additional resources upon request: laboratory SOPs, field SOPs, SDSs, incident report form, Environmental H&S Inspection Checklist, Environmental Protection and Sustainability Checklist, and Summary of Chemical Agent Air Exposure Values: Existing Information as of 8/03/04 POC: V. Hauschild, USACHPPM.

# **Supporting Documents**

**FORT MEADE CWA EXERCISE**

**AUGUST 20, 2014**

Ultra-Dilute Chemical Warfare Agent (UDA) Standard Reference Material (Shipment Coordination, Receipt, Initial Accountability, Storage and Disposal Procedures)

Effective Date: 06-16-14

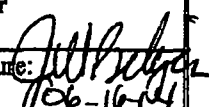
Page 1 of 35

Ultra-Dilute Chemical Warfare Agent (UDA) Standard Reference Material  
(Shipment Coordination, Receipt, Initial Accountability, Storage and Disposal Procedures)

Effective Date: 06-16-14

***All Chemical Agent Operators must have studied and understood all UDA SOPs (R3-QA5000 series) and the ESC Chemical Hygiene Plan before proceeding with this SOP***

EPA Region III

<b>SOP Approvals:</b>			
<b>Preparer/Submitter</b>	<b>Primary Technical Reviewer</b>	<b>Safety/Health Review</b>	<b>Quality System Review</b>
Name: Eric Graybill  CAO	Name: Cynthia Caporale  Laboratory Branch Chief (LBC) / Agent Manager (AM)	Name: Susan Shinn  ESC SHEM Manager	Name: Jill Bilyeu  Quality Assurance Officer
Signature: /s/ Date: 04-11-14	Signature: /s/ Date: 04-14-14	Signature: /s/ Date: 04-14-14	Signature:  Date: 06-16-14
<b>Hazard Analysis (See Attachment to SOP):</b>			
	LBC/AM	ESC SHEM Manager:	
	/s/	/s/	
<b>Verification Run: (See Appendix A)</b>			

Office of Analytical Services and Quality Assurance  
701 Mapes Road  
Fort Meade, Maryland 20755

The official version of this document is the paper copy located in A-205.  
/s/ indicates the SOP was signed. See R3QA5001 SOP records file for details.

**Peer reviewer's initials indicate that changes meet the TNI and regulatory requirements described in Section 9.4 in SOP R3-QA060**

[illegible]



## 1 Scope and Application

This standard operating procedure (SOP) describes shipment coordination and receipt procedures for UDA standard reference material at the Office of Analytical Services and Quality Assurance (OASQA) laboratory in Fort Meade, Maryland.

## 2 Summary of Method

Log-in is the procedure by which submitted UDA materials are introduced into the laboratory. The documentation recorded during log-in of reference materials includes: agent name and ID number, origin and quantity (concentration and volume per vial and number of vials). Upon receipt, the accompanying documentation (chain of custody sheets and certificates), preservation and shipping conditions are documented by manual entry into a notebook. Procedures for use of the UDA reference solutions in preparation of calibration standards and quality control checks and other more dilute solutions are described in SOP R3-QA5003, Procedures for Opening Ultra-Dilute Chemical Warfare Agent (UDA) Vials and Preparation of Standards for Calibration of GC/MS.

The following cardinal principle will be followed for all procedures for dealing with chemical agents: **limit the potential exposure to a minimum by using the minimum amount of hazardous material, utilizing the minimum number of personnel for a minimum period of time.** OASQA's primary concern is for safety and environmental stewardship.

## 3 Definitions

- 3.1 Ultra Dilute Chemical Warfare Agent (UDA) - Reference Material of Sarin (GB), Soman (GD), Cyclohexyl Sarin (GF), Sulfur Mustard (HD) and VX, dissolved in solvent, at a concentration not to exceed 10 mg/L in 1.2 mL sealed glass vials. The maximum total mass of each agent at the Environmental Science Center (ESC) is not to exceed 100 µg at any time (per interagency agreement between EPA and DoD (Section 16).

3.1.1 The 10 mg/L solutions as received are termed "**primary**" solutions. Upon further dilution, the solutions are referred to as "**secondary**" solutions. All procedures are the same for both concentration levels except storage location, accountability and glove change frequency.

3.1.1.1 Primary solutions are tracked under the initial "accountability" procedures described in this SOP and when working with this material the outer gloves are changed approximately every 5 minutes. **Transfer and log in of unopened UDA vials from the loading dock to the UDA laboratory refrigerators per this SOP does not constitute working with agent and outer glove change does not apply.**

3.1.1.2 Secondary agent solutions are tracked per procedures and documented as detailed in SOP R3QA5002. These procedures are also consistent with OASQA's

traceability procedures as for other organic calibration standards (SOP R3QA063).  
For secondary solutions outer glove changes are required as needed (when contaminated or torn).

3.1.1.3 Primary and secondary solutions are stored separately in different refrigerators with different access requirements.

3.1.2 The materials at the 10 mg/L concentration level are not lethal but can cause health effects (blisters and adverse nervous system reactions).

3.2 Chemical Agent Operators (CAOs) - A chemical agent operator is anyone that works directly with UDA solutions or unknown samples potentially containing chemical agents. Users of UDA solutions must receive agent orientation and safety training and comply with the accountability procedures described in this SOP and SOP R3-QA5002, Accountability Procedures for UDA Reference Solutions. They are responsible for documenting their use and disposal of Primary UDA standards.

3.2.1 CAOs are responsible to observe receipt of reference material at the loading dock, transport of the material to the UDA laboratory (UDAL) and participate in completion of the initial entries in the UDA Delivery & Accountability Assessment Notebook.

3.2.2 All CAOs are responsible for maintaining the security and integrity of stored and in-use UDA solutions at all times. Entry into UDA primary standard refrigerator #1 is ultimately controlled by the physical refrigerator hasp/chain lock key. Attachment #1, Refrigerator Access, details the "two personnel to enter" approach to control access to agent material in the secure refrigerators. The security procedures for UDA are included in ESC's Site Security Plan and SOP R3-QA5002.

3.2.3 CAOs are responsible to complete the UDA Accountability Standards/Reagent Preparation Log as per R3-QA5002.

3.3 Chain of Custody (COC) - An unbroken trail of accountability that documents the physical security of UDA reference material from origin to ESC (Attachment 6).

3.4 Laboratory Branch Chief (LBC) - As a laboratory supervisor, is responsible for the health and safety of the CAOs during all UDA procedures.

3.4.1 LBC is responsible to request and coordinate delivery of UDA reference material from the supplier of the chemical agent. This is documented in the UDA Delivery and Accountability Assessment Notebook.

3.4.2 Serves as backup for the Agent Manager for receipt of standard reference materials and all other AM duties except those involving refrigerator access.

- 3.5 Agent Manager (AM) - Individual responsible to assure accurate accountability of UDA agent reference materials (primary material as received) from receipt, through usage to disposal.

3.5.1 The AM signs courier form/s for receipt of material and completes any chain of custody forms and accompanies UDA material until secure in the UDAL.

Note: Though on the COC form, the Social Security Number of AM is not entered.

3.5.2 Routinely records the receipt and use portions of the Accountable notebook (entry of the delivery code # and vial identification numbers).

3.5.3 Performs checks of house keeping in the UDAL and of accountability records on days when primary UDA is used.

3.5.4 With CAOs performs physical inventories prior to each delivery and before each new request for agent material or at least quarterly. The results of the physical inventory and the status of use of all agent materials is documented in accountability Summary reports. Details of the daily checks (when primary solutions are in use) and accountability audits are included in SOP R3-QA5002, Accountability Procedures for Ultra-Dilute Chemical Warfare Agent (UDA).

3.5.5 The AM is responsible for maintaining the security and integrity of stored and in-use primary UDA solutions at all times.

3.5.6 Serves as backup for coordination of UDA primary solution delivery in case the LBC is not available.

3.5.7 Holds the keys (lock-and key entry) to the primary UDA refrigerator (UDA Refrigerator-1). The LBC holds a backup key in case of the AM's absence.

3.5.8 The AM is responsible to complete the UDA Primary Reference Standards Record in the UDA Accountability notebook to document use of primary UDA solution use in the preparation of stock reference solutions as per SOP R3-QA5002.

- 3.6 In case of LBC and AM absence, delivery of UDA reference material is not to be accepted. Also, unannounced, unplanned or unscheduled shipments of UDA reference material will not be accepted.

- 3.7 Accountability Summary Report – Summarizes the results of physical inventory and use of primary UDA reference material (See R3-QA5002).

- 3.8 UDA Delivery & Accountability Assessment Notebook – A record of primary UDA reference material receipt, as well as, usage and disposal. This notebook is retained secure in the UDAL.
- 3.9 Lawrence Livermore National Laboratory, 7000 East Avenue L-091 Livermore, CA 94550 - Current source of UDA reference material.
- 3.10 Chemical Agent Hygiene Officer (CAHO) or ESC Safety, Health and Environmental Manager (SHEM)- Individuals responsible to ensure the UDA workplace is free of hazards and conducts regular chemical hygiene and housekeeping inspections of work areas and emergency equipment. Ensures that the safety training, equipment and procedures in use in the UDA work areas are adequate. Assures UDA area hoods are tested and found satisfactory every month. These results are recorded in the ESC facility safety records.
- 3.11 Visitors- Include instrument repair personnel and janitorial entry are only allowed into UDAL after they have had required safety training specified by the CAHO or the SHEM Manager for “visitors” and must be accompanied at all times while in the UDAL. Visitor entry into the UDAL is only authorized after “End of Day” procedures have been performed and no UDA activities are occurring in the workspace. Visitors are not permitted to enter the UDAL whenever UDA materials are being used.
- 3.12 Environmental Services Assistance Team (ESAT) - Contractors whose duties include the CAO duties listed above. The contractor reports to a separate management chain and is overseen by an EPA Project Officer. The contractor follows the procedures as per OASQA’s Laboratory Quality Manual and SOPs.
- 3.14 Environmental Services Assistance Team Project Officer (ESAT PO) - Responsible for assuring ESAT operates within the scope of their contract.
- 3.15 Work Day- Refers to each day UDA material is being manipulated. The exception is for refrigerator temperature monitoring that is required each day the operators are at work.

#### **4 Interferences**

Not applicable

#### **5 Safety**

- 5.1 Before beginning any procedures, refer to the Environmental Science Center (ESC) Chemical Hygiene Plan (CHP), including Appendix A (Dilution Solution Hygiene Plan) and ESC Occupant Emergency Plan (OEP) for general safety precautions and

required guidelines. **In addition, the following special safety procedures apply to UDA materials:**

- 5.1.1 Reference material moved outside of the agent laboratory must be in triple containment at all times.
- 5.1.2 Each agent is stored separately in secondary containment in locked refrigerators (plastic containers with lids within trays on each shelf). The refrigerators used for storage of UDA have lock and key, as well as, electronic locks.
- 5.1.3 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, this is to be noted in the UDA Accountability Notebook and the AM notified.
- 5.1.4 **UDA Safety Checklist, Beginning and End of Day (Attachment 5). Beginning of day checks:** The following items are to be checked and found satisfactory prior to any laboratory operations in UDAL: hood operations, lab at negative pressure relative to the hall way, decontamination solution and available containers, 2-way radio, PPE including respirator and gloves. At the end of the day when the final section of the checklist is completed it is placed in the UDA Safety Checklist & Hood Reports Log in UDAL.
- 5.1.5 The following signs are associated with OASQA's UDA analyses:
  - 5.1.5.1 Hallway wall directly outside of UDA storage and analyses areas:
    - 5.1.5.1.1 "Authorized Personnel Only", "Personnel/Emergency Contacts".
    - 5.1.5.1.2 White board: "Date & Time of Entry", "Activity (Check: UDA in Use or Non-UDA Work)", "Air Flow Check", "Stop Sign" (posted); "Safety Start CKL" (completed), "Safety End CKL (completed)", "Stop Sign Out", "Notes".  
The white board information is updated with each entry and change in activity in the UDAL. If items do not apply they are entered as "NA".
    - 5.1.5.1.3 Egress route.
    - 5.1.5.1.4 Magnetic board with magnets to indicate personnel are in or out of UDAL.
    - 5.1.5.1.5 "Stop" sign – to be posted when UDA material is being utilized.
  - 5.1.5.2 Inside UDAL.
    - 5.1.5.2.1 **"Hood failures / power outages: Evacuate UDAL Immediately and SHEM Manager"**.
    - 5.1.5.2.2 Signs and Symptoms of nerve agent & blister exposure.
    - 5.1.5.2.3 Personnel decontamination procedures: Tap water the liquid soap/ Repeat 3 times (minimum total of 15 minutes).
    - 5.1.5.2.4 Results of hood tests by the ESC Contractor.
    - 5.1.5.2.5 UDA spill cleanup procedures.

- 5.1.5.2.6 Refrigerator for storage of primary UDA solutions: “#1”, “Restricted, Authorized Personnel Only”.
- 5.1.5.2.7 Refrigerator for storage of secondary UDA solutions and other standards: “#2”, “Restricted, Authorized Personnel Only”, “Emergency Contacts”.
- 5.1.5.2.8 On inside of the UDAL door: “STOP, Remove PPE & Wash Hands”.
- 5.1.5.2.9 UDA Activities Calendar.
- 5.1.5.2.10 Tabular listing of instructions for UDA stock and standards preparation.
- 5.1.6 Physical air flow indicator- UDAL must have negative pressure relative to the hallway (the indicator ball must not be visible from the hallway).
- 5.1.7 Material Safety Data Sheets (MSDS) for all the UDA reference materials and other reagents used in this SOP, are available in the ESC Library, on file with the SHEM Manager and copies retained in the UDA Delivery & Accountability Assessments Notebook.
- 5.1.8 All applicable safety and compliance guidelines set forth by the EPA and by federal, state and local regulations must be followed during the performance of this SOP. In addition, all procedures outlined in the ESC CHP and OEP must be adhered to. **In the event of a known or potential compromise to the health and safety of any person, immediately stop all work and leave the UDAL, pull the fire alarm and evacuate the building.** Notify the CAHO or the SHEM Manager and other appropriate personnel as outlined in the CHP.
- 5.1.9 **All UDA reference materials shipping containers are to be handled with caution.** The UDA materials are hazardous (can cause non-lethal chemical burns and nervous system disorders). Protective clothing is to include: disposable laboratory coats; safety glasses with side shields; trousers; disposable nitrile/silver-shield gloves and closed toed shoes. A CBRN respirator is to be available at all times in the UDAL (For details see safety equipment listed below).
- 5.1.10 Upon arrival, all shipping containers must be inspected at the loading dock prior to entry into ESC. During the inspection of each shipping container, if any of the containers has been damaged or are leaking **under no circumstances are such containers to enter the building.** The CAHO or the SHEM Manager and LBC are to be notified immediately. Take care to protect yourself, your coworkers, equipment and the loading dock receiving area from contamination.
- 5.1.11 Sample receipt procedures are to use the **“buddy system”**, with a second person fully trained in these procedures. **All operations in using UDA materials (primary and secondary), must use the buddy system.** In addition, as a backup to the ESC phone system, 2-way radios are to be available at all times during UDA procedures. Cell phones are to be turned off during activities utilizing UDA.

**5.1.12 Safe Storage Procedures:**

5.1.12.1 Primary UDA glass vials are to be stored in the refrigerator #1 in UDAL in closed secondary containers within trays on each shelf.

5.1.12.2 UDA glass vials shall only be opened in UDA laboratory fume hoods.

5.1.12.3 When opened, UDA vials shall be supported by a vial rack or other physical support to prevent tipping. Procedures for opening and use of primary UDA material are described in SOP R3-QA5003.

5.1.12.4 Secondary UDA materials are to be stored in glass Teflon lined screw cap vials or sealed auto injector vials in UDA Refrigerator #2 in a vial rack or other physical support to prevent tipping within trays on each shelf. Volumetric flasks and other glassware containing UDA material are not to be stored in the UDA refrigerators or in the UDA hood.

5.1.12.5 Environmental samples received must be stored in the sample receipt area of the Environmental Science Center (ESC) Building until required for extraction and analyses in the UDAL. The exterior of the sample containers are screened for agent contamination.

5.1.12.6 Working batches of environmental samples must be contained in coolers and placed on a cart or a fume hood in the UDAL.

5.1.12.7 Extracted samples must be stored in a refrigerator not containing primary, secondary, or QA/QC standards.

**5.1.13 Spill Cleanup Procedures:**

5.1.13.1 In the event of an in-hood "spill" of 1 mL or less, decontamination solution (5-6% bleach) is applied to the "spill" immediately. Operators shall use silver-shield gloves and carefully blot the decontamination solution/spill material with absorbent lab paper towels/pads. Contaminated paper is placed in the hood decontamination waste container (solid waste). The hood is not to be closed but remain at the marked level to assure no fume backwash due to the high flow velocity in the UDA hoods.

5.1.13.2 The spill area is then rinsed with water and wiped dry with laboratory tissue/absorbent pads. This material is to be placed in the decontamination containers in the hood.

5.1.13.3 Following spill clean-up, operators shall dispose of all contaminated PPE in hazardous waste decontamination containers for solids in the hood.



5.1.13.4 CAOs shall report the spill and circumstances leading to the event to the Assistant SHEM or the SHEM Manager. Any losses of UDA material are to be recorded in the UDA Accountability Notebook and the AM and LBC notified.

5.1.13.5 In case of larger spills or any spills outside of the fume hoods, the areas is evacuated and then the CAHO or the SHEM Manager are called.

5.1.14 **With loss of engineering controls** (ventilation, hood alarms or intercom), all personnel are to immediately remove PPE and evacuate the UDAL and call the CAHO or the SHEM Manager.

5.1.15 **Work area**- The handling and use of UDA material is to be restricted to UDAL.

5.1.16 **Personnel Decontamination**. If suspected or actual direct contact or exposure to UDA, wash with liquid soap and rinse with tap water. This wash and rinse cycle is to be repeated three times using the sink or safety shower. Also, eye washes are available in UDAL. The minimum rinse time for personnel decontamination is 15 minutes. The incident is to be immediately reported to the SHEM Manager.

5.1.17 With any **minor injury or illness** resulting from working in the UDAL, personnel are to immediately decontaminate and leave the UDAL area and report to the CAHO or the SHEM Manager. A general first aid kit is available in the hall way.

5.1.18 With any **major injury or illness**, ESC security are to be notified immediately. Security personnel will notify off-site emergency personnel as appropriate and the CAHO or the SHEM Manager. **In the event of a known or potential compromise to the health and safety of any person, immediately stop all work, remove any contaminated PPE and leave the UDAL, pull the fire alarm and evacuate the building.**

5.1.19 **Fume Hoods**- Satisfactory fume hood operations are to be verified before each use by the CAOs (**anemometer** flow meter must indicate at least 100 LFM). The operations are tested and verified by SHEM personnel monthly and immediately after any malfunction or with significant change in equipment in the hood which could impact air flow. The CAOs are to report to CAHO or the SHEM Manager any hood malfunction or change in equipment in the hood that could impact air flow.

5.1.19.1 Fume hoods in UDAL are independent from other ESC ventilation hoods and **are marked at 20 cm beyond the sash as the "safe zone"** from which agent materials are not to leave the hood without decontamination. The drains in the hood have been sealed off.

5.1.19.2 **At no time during hood usage is the face or head of the CAO to break the plane of the hood sash.**

5.1.19.3 The fume hoods are equipped with spill trays lined with paper absorbent towels to assist in recognition and containment of spillage. Fume hoods have audible and visual alarms to warn of low flow.

5.1.19.4 Fume hoods shall be equipped with containers of prepared decontamination solution.

5.1.19.5 The fume hoods are marked one sash opening level that is protective of the operators (based on their "breathing height") and to assure the flow is sufficient to maintain the UDAL at negative pressure relative to the hallway.

5.1.20 Gloves are to be worn while working with any UDA materials. Two layers of gloves are required when working with UDA reference materials. An inner layer of nitrile gloves (duct taped to the CAO's laboratory coat sleeve) and an outer layer of nitrile gloves (configuration allows 5 minutes of work time) or an outer layer of silver-shield gloves (allows 4 hours of work time) when working with primary solutions. For more dilute (secondary solutions), the 2 layers of nitrile are sufficient and need only be changed if compromised by a solution spill or tear. The inner layer of gloves are taped to the sleeve of the lab coat (not to the coat directly) with a tab fold over at the end to allow for easy removal.

5.1.21 UDA Safety Checklist, End of Day (Attachment 5). End of day checks: All UDA reference materials (10 mg/L) are to be locked in the refrigerators. All working solutions and decontamination solutions and solvent materials are to be securely capped, labeled as per SOP R3QA063 and in secondary containment. All uncontaminated solid waste is double bagged and all decontamination solutions are covered. All hood surfaces are to be wiped with water using laboratory tissue/pads. All locks are to be secured and all checklists and other records completed. Hood operations are verified. If hazardous waste containers are full, the ESC waste contractor is notified. This information is entered at the end of the day by the CAOs in the Safety Checklist retained in the Safety Checklist & Hood Reports Log in UDAL. The AM is to verify UDA records and housekeeping in the UDAL at the end of each working day.

5.1.22 "Observers" of the receipt procedures, not working directly with UDA such as the AM, SHEM Manager and LBC are to wear the same PPE as the CAOs except that only one pair of gloves are worn. In case of an emergency, e.g., such as a spill, these personnel are to immediately leave the UDAL.

5.1.23 Before leaving the UDAL PPE is to be removed, including safety glasses, gloves and laboratory coats and hands are washed with soap and water.

- 5.1.24 CWA specific safety training is required prior to personnel using this SOP. In addition, to the safety training specified in the CHP, at a minimum the following training and OASQA management approval is required:
- a. CWA Awareness Training.
  - b. CWA Visitor Training (currently under development and this requirement is waived until the training is available, since the content is covered in other training).
  - c. CWA CAO Workers Training.

## **6 Equipment and Supplies**

6.1 Refer to the following listing of necessary equipment and supplies:

### **6.1.1 Loading Dock Receipt**

#### **6.1.1.1 Safety Equipment and Supplies**

- Safety glasses with side shields or safety goggles.
- Disposable Tyvex laboratory coats.
- Closed toed shoes.
- Long pants.
- Gloves (double nitrile allow 5 minutes of direct work with primary UDA reference material and nitrile silver-shield, e.g., North Silver-Shield, allows 4 hours of direct work with primary UDA reference material).
- Respirator (NIOSH CBRN).
- 2-way radios (**channel 1** is routinely used and Channel 4 is for private conversations and Channel 3 is open and can be used by all UDA personnel to practice radio use).

#### **6.1.1.2 Other Equipment & Supplies, etc.**

- Lab cart with containment well.
- Spill decontamination material (5-6% commercial bleach or prepared from granular chlorine, waste container absorbent lab paper/absorbent mats).
- One 2 ½ gallon bucket with screw caps.
- One 2 ½ gallon bucket with screw caps.

Note: Liquid soap and water available near loading dock in J-102.

- Photo Ionization Detector (PID), MSA Sirius, Multigas Detector with 10.6 MEV PID (S#A3-4222).
- Listing of the supplier of the chemical agent and EPA's Office of Emergency Management contacts.

### **6.1.2 UDA Laboratory (UDAL)**

#### **6.1.2.1 Safety Equipment and Supplies**

- Safety glasses with side shields or safety goggles.
- Disposable Tyvex laboratory coats.

- Closed toed shoes.
- Long pants.
- Gloves (double nitrile allow 5 minutes of direct work and nitrile silver-shield, e.g., North Silver Shield, allows 4 hours of direct work with primary UDA solutions.
- Duck tape.
- Respirator (NIOSH CBRN).
- 2-way radios.
- First aid kit (general) is on the wall across the hall.
- Fume hoods independent from other non- UDA ESC hoods (100 LFM) will sill cover with Teflon to protect against corrosive decontamination solution. . Fume hoods have auditable and visual alarms to warn of low flow.
- Spill decontamination material (5-6% commercial bleach or prepared from granular chlorine, waste container absorbent lab towels/pads).
- Eye wash station.
- Fire extinguisher.
- Safety shower.
- Wash sink.
- Liquid soap and water available near loading dock in J-102.
- 8100-8 Anemometer, Alnor Instrument Company, Niles, ILL.

#### 6.1.2.2 Other Equipment and Supplies

- Plastic containers with lids for storage in refrigerator.
- Secondary containment trays for refrigerator.
- Secondary containment tray for hoods in UDAL.
- Utility knife or scissors.
- Permanent markers and pens.
- Laboratory cart with sealed wells.
- Four 2 ½ gallon buckets with screw caps (2 for each hood, one for decon. of liquids and one decon. of solids).
- One 2 ½ gallon bucket with screw caps for non-hazardous solid waste.
- Wipes/absorbent laboratory pads.
- Two 500 mL plastic bottles and caps for 0.5% decon. solution.
- Two locked refrigerators (Norlake Scientific) with calibrated thermistors, recording temperature charts and card access readers secured to the wall in UDAL with locked braided cable.
- Pasteur pipets and suction bulbs.
- Vial racks.
- Decontamination solutions.
- Waste disposal containers.
- Personnel decontamination solution (liquid soap and tap water).
- KI-Starch indicator paper.
- Large trash bags and plastic trash can for non-hazardous material, e.g., uncontaminated packing material.
- Laboratory pure water polishing unit (Ultrapure De-I polishing unit).

- 500 mL plastic graduated cylinder.
- 40 ml septa vials (testing of decontamination solutions prior to disposal).

## 7 Reagents and Standards

7.1 Decontamination solution for spills (5-6%) - commercially available 5% sodium hypochlorite (bleach). Unopened containers have a shelf-life of one year. Opened, in use "Decon" solution should be replaced after 90 days or whenever the material fails a KI/starch test (acceptable solution give a positive blue color for chlorine presence).

7.2 Decontamination solution for UDA contaminated liquids and solids material (0.5-0.6%) - commercially available sodium hypochlorite (bleach) diluted 1:10 with water. One liter of this solution is prepared at the beginning of each working day and disposed of as part of the end of day procedures. This material is used for the routine decontamination of liquid and solids in the decontamination containers in the UDAL hoods.

7.3 Ultra Dilute Chemical Warfare Agent reference material (UDA) - will be provided in sealed glass vials. Each vial contains 1 mL of one agent in solvent at 10 mg/L. Ten vials are provided for each agent (maximum quantity of 100 µg for each agent).

7.4 Hexane (pesticide grade) or Methylene Chloride - used for final screening of liquid waste decontamination solutions prior to final disposal. This procedure is described in SOP R3-QA5003.

## 8 UDA Reference Material Preservation and Storage

8.1 UDA Refrigerators - After UDA reference materials are received, they are stored at  $4\pm 2^{\circ}\text{C}$ , secured by electronic and lock & key access control and dedicated to UDA materials only. Security includes key pads in the 2<sup>nd</sup> floor G-wing hallway for UDAL and a lock and key and electronic entry refrigerator system. Access to the UDA Reference Material laboratory is limited to authorized staff only (signs posted).

8.1.1 The refrigerator electronic system retains a record of entry in both refrigerators. The AM output this record every two weeks for entry in the Refrigerator Entry & Temperature Log. The CAOs and AM also indicate on a handwritten sheet the reason for entry (Attachment 7). The temperature charts are changed by the CAOs each week (charts are initialed and dated when installed and when removed). The charts and reason for entry sheets are retained in the Refrigerator Entry & Temperature logs.

8.1.2 Log book entries are checked each week by the AM per the procedures in R3-QA5002.

8.1.3 Refrigerator #1 contains the UDA **primary solutions** (10 mg/L) of reference material as received from the supplier of the chemical agent. The AM controls the physical lock and key access to the UDA refrigerator #1. Both the AM and COs must

be present to access this material and this material is tracked to the 1 uL amounts in the UDA Accountability Notebook. Refer to Attachment 1 for a listing of personnel having access to the UDA refrigerators.

8.1.4 Refrigerator #2 contains more dilute **secondary solutions**. The more dilute solutions in Refrigerator #2 are tracked by the AM using procedures in R3-QA5002. In addition, the CAOs document preparation of secondary solutions using traceability procedures as for other non-UDA calibration materials used in the OASQA laboratory (R3QA063, Laboratory Notebooks). The later documentation is retained in the UDA Accountability Standards/Reagent Preparation Logs (ESAT and EPA).

8.2 UDA reference materials are stored in a refrigerator dedicated to reference material separate from any sample or reagent storage.

## 9 Quality Control

9.1 The temperature of the refrigerators used for storage of the UDA reference materials must be maintained at  $4 \pm 2^{\circ}\text{C}$ . The refrigerators have a built in temperature recording charts. The charts are checked by the CAOs each work day and if the temperature is or has been out of range, the refrigerator/s are not opened and the LBC and ESC SHEM Manager are notified.

9.2 Delivery coordination, COC records, certificates of analyses and other records accompanying UDA reference material are also stored in the UDA Delivery & Accountability Assessments Notebook (Section 17). Use of all UDA primary agent solutions is also recorded in this notebook.

9.3 Accountability inventories, summary reports and AM Checklist serve as an ongoing check on the process and documentation and the reports from these assessments are retained in the UDA Delivery & Accountability Assessment Notebook. Details on accountability procedures are included in SOP R3-QA5002, Accountability Procedures for Ultra Dilute Chemical Warfare Agent (UDA).

9.4 Procedures for use of the UDA reference solutions in preparation of secondary solutions such as calibration standards and quality control checks are described in SOP R3-QA5003.

## 10 Calibration and Standardization

10.1 Initially, and annually, the CAOs calibrate the refrigerator temperature devices against a reference thermometer as per SOP R3QA065, current revision.

10.2 Since UDA reference material is not shipped with a temperature blank, a working thermometer to check receipt temperature is not necessary.

## **11 Procedure**

### **11.1 Coordination of shipment and receipt of UDA reference material**

11.1.1 The LBC is the point of contact for the initiation of all shipments of standard agent material to the ESC. Deliveries of UDA reference material are carefully planned and scheduled. A courier service is employed for the delivery of UDA reference material from the supplier of the chemical agent to assure delivery is completed and the UDA material is secure. Unannounced, unplanned or unscheduled shipments are not accepted and are to be returned to the supplier of the chemical agent. In case of LBC and AM absence, delivery of UDA reference material is not to be accepted. Communications with the supplier of the chemical agent are retained in the UDA Delivery and Accountability Assessment Notebook.

11.1.2 The LBC coordinates receipt and log-in via E-mail messages to the facility management, ESAT project Officer (if applicable), CAOs, AM and CAHO or the SHEM Manager.

11.1.3 The LBC or designee notifies facility management to instruct ESC security staff to bar entry of the carrier to the ESC compound until notification of the LBC, AM, CAHO or the SHEM Manager or personnel trained for receipt of this material. ESC employees attempting to use the J-wing elevator or the transport route corridor should be asked to wait until the UDA material is moved through the area.

11.1.4 The Agent Manager assumes LBC's agent delivery coordination related duties in cases of the LBC's absence.

### **11.2 Shipment receipt and transport to UDAL hood**

11.2.1 The CAOs complete the beginning of day portion of the Safety Checklist (Attachment 5). This includes collecting of the necessary materials for receipt of the UDA reference material at ESC's loading dock. If problems are detected the LBC is notified immediately so that corrective actions can be completed prior to agent arrival.

11.2.2 All UDA reference material shipments are to be delivered to the OASQA loading dock within a secure compound area (security fence, electronic lock entry control and surveillance cameras).

11.2.3 Shipments are by courier delivery services which tracks the location during transport.

11.2.4 Each shipping container must be visually inspected to ensure that they are sealed and show no evidence of tampering, damage or leaks. Shipping seals must be unbroken. The package should be scanned using the portable PID to detection of solvents.

11.2.5 The CAHO or the SHEM Manager is to be called immediately if there is any evidence of these conditions. If these conditions exist, no material is to enter the ESC and decontamination will be performed under the supervision of the CAHO or the SHEM Manager or designee.

11.2.6 If the reference material containers are acceptable to inspection, the material is signed for by the AM.

11.2.7 The acceptable containers are placed in a welled laboratory cart dedicated for this purpose (stored in UDAL) and moved from the loading dock directly to the J-wing elevator (J-114 will not be entered) and down the 2<sup>nd</sup> floor E-wing corridor and placed in the ventilation hood in UDAL and opened.

### 11.3 Opening shipping container and log-in of material

11.3.1 Once in the ventilation hood in UDAL, remove and set aside all documentation associated with the reference material, including certificates from the supplier of the chemical agent, COCs, etc. This material will be retained in the UDA Delivery & Accountability Assessment Notebook. The package should be scanned using the portable PID to detect any spilled solvents that could indicate broken UDA vials.

11.3.2 Uncontaminated packaging material including vermiculite, Styrofoam spacers and ice pack from each shipping container is to be left in the shipping container and double bagged in polyethylene bags, labeled as "Non-hazardous Waste" and this will be disposed of routine non-toxic material for incineration.

11.3.3 If the UDA reference packaging material has been contaminated the CAHO or the SHEM Manager are to be notified regarding disposal.

11.3.4 Each vial of material arrives with a unique identification number and this information is recorded in the UDA Accountability Notebook by the AM. The information entered is verified and initialed/dated by the AM and CAOs.

11.3.5 The vials are placed in plastic containers with press seal lids and in turn placed in secondary containment plastic trays in side the reference material refrigerator. Paper towels are used to cushion the glass vials. A separate plastic container is used for each agent (labeled with agent name). Nerve agent is always stored separately from blister agent material.



11.3.6 The AM notifies the supplier of the chemical agent of any discrepancies in number or amount of reference material (completes Shipment Condition Report form and sends that and a signed COC form to the supplier of the chemical agent).

11.3.7 The chemical agent supplier's COC and condition form are critical documents that must be complete and accurate (See Attachment #3, #4 and #6). These forms and other documents that arrive with each UDA shipment are retained in the UDA Delivery & Accountability Notebook in UDAL.

11.3.8 The CAOs complete the end of day portion of Safety Checklist.

#### **11.4 Decontamination of contaminated liquids and solids**

11.4.1 All materials exposed directly to UDA material are to be decontaminated (placed in decontamination solution in marked 2 ½ gallon screw capped containers in the UDAL hoods). In case of breakage during shipping or during unpacking, that contaminates a large amount of packing material, evacuate the area and notify the CAHO or the SHEM Manager and the AM.

11.4.2 Separate decontamination containers are available in the hood in UDAL for solid material and liquid material. Containers are filled 1/8 full with 0.5-0.6% bleach solutions prior to use. Organic material such as solvents, should not be added at more than 1/3 the capacity of the container at one time (to avoid excess heat). "Decon" containers are not to be filled more than 4/5 full. Full containers are closed, marked full and labeled for waste disposal.

11.4.3 Materials for emergency decontamination will be routinely brought to the loading dock when UDA reference materials are received.

11.5 The CAO's complete the end-of-day portion of the Safety Checklist (Attachment 5).

11.6 The AM verifies of accountability documentation, security and good house keeping in the UDA Delivery and Accountability Assessments Notebook as per R3-QA5002. The LBC serves as backup for all AM duties except those involving refrigerator access.

#### **12 Data Analysis and Calculations**

12.1 The Agent Manager signs the carrier form and COC forms.

12.2 The AM initiates completion of the Chemical Warfare Agent 1<sup>0</sup> Standard Receipt form and the Chemical Agent Shipment Condition Report Form. Subsequent tracking of usage of UDA material is described in SOP R3-QA5002.

12.3 The AM sends copies of the completed condition form, COC, carrier form, receipt form, certificate of analysis and MSDS sheets are sent to the provider, the EPA Office of Emergency

Management, OASQA's Director, the ESC SHEM Manager, the LBC and the provider of the Agent. Hardcopy documentation is retained in the UDA notebooks as listed in Section 17.1 of this SOP.

### 13 Method Performance

13.1 Before approval of these procedures a **hazard analysis** is performed by the CAOs, Agent Manager, LBC, CAHO or the SHEM Manager (results summarized in Attachment #2), who sign off on this assessment.

13.2 Initially before approval of this SOP, an acceptable **verification run** of the procedures is performed by the CAOs with sign off by the CAOs, Agent Manager, LBC and SHEM Manager (approval signatures are included per Appendix A).

13.3 To help assure safe operations and the accuracy of the hazard analysis and verification run, all changes to this SOP will be reviewed and approved in writing by the signers of this SOP.

13.4 To help control distribution and accuracy of this SOP each copy will be assigned a unique identifier.

### 14 Pollution Prevention

14.1 As this SOP is performed, the CAOs should consider steps to reduce the use and generation of hazardous chemicals and record this information for future revisions of the SOP.

14.2 Resource Management: Water conservation. Laboratory personnel should be mindful of water consumption, and whenever possible, employ practices that minimize water use.

### 15 Waste Management

15.1 Expired or other unneeded UDA reference material is removed to the hood and placed in the decontamination solution.

15.2 Decontamination solution containers that are full are labeled for disposal as hazardous waste. This is documented in the UDA Accountability Notebook.

15.2.1 *Waste Type Code:* **D002**, pH  $\geq 12.5$  solution,  
**MD02**, decontamination of CWA material.

*Estimate Amount of Waste per shipment:* 6 L

*Describe any Treatment:* No treatment of the waste is performed in the laboratory.

15.2.2 The decontamination solutions will be of three types. One is from decontamination of spills. Another is from the decontamination of liquids and the third is from decontamination of solids (includes solid materials such as gloves and paper

pads/absorbent material). Solid and liquid wastes are to be kept separate and in addition to the MD02 and DOO2 codes, are to be labeled "Liquid Decon" and "Solid Decon".

- 15.3 Uncontaminated solid waste such as packing material will be marked as "Non-hazardous Waste" and will be disposed of as routine non-toxic material for incineration (large trash bags).
- 15.4 Waste concentration must be determined before disposal. This may be accomplished by testing or generator knowledge:
- 15.4.1 Option A) Waste concentration is tested prior to disposal. The tests include KI-paper (blue indicating presence of active chlorine) and GC/MS screen. For the latter 1/2 mL of solution to be tested is added to a 40 mL VOA vial already containing approximately 10 mls of clean hexane. The solution is swirled for 2 minutes and 1 mL of the hexane withdrawn for GC/MS confirmation of the absence of target agent material as per procedures analytical procedures detailed in R3-QA5004. If the results the CAOs are to contact the CAHO or the SHEM Manager.
- 15.4.2 Option B) Waste concentration is determined by generator knowledge. Determine the total ug of material in G102 UDA refrigerators (1-3) when the current waste accumulation was begun. Determine the total ug of material delivered to G102 since the current accumulation was begun. Determine the total weight of agent from initial starting material and deliveries. Determine the total ug of Agent material remaining in UDA Ref. #1-3: when the current waste accumulation is stopped. Determine the total MAXIMUM amount of Agent material in the current waste pails (if none had been destroyed by the chlorine treatment).
- 15.5 Any waste solvent is disposed of in the liquid decontamination solution container (Caution-add solvent to the "decon" solution slowly and not in large amounts because of the heat generated. All waste pickups from the UDAL must be requested by the CAO's, i.e., there are no automatic pickups.
- 15.6 The AM completes the "Agent Manager Checklist" and "R3 Satellite Area Weekly Checklist" each week to help document proper storage of hazardous waste as described in SOP R3-QA5002.
- 15.7 Waste flow chart is found in Appendix B.

## 16 References

**Note:** The most current version of the following documents is referenced. The most current listing of OASQA quality system documents is maintained by the QAO.

- 16.1 US EPA Region III, OASQA Laboratory Quality Manual.
- 16.2 US EPA Region III, ESC Occupant Emergency Plan (OEP), Emergency Procedures and Hazardous Materials Spills.
- 16.3 US EPA Region III, ESC Chemical Hygiene Plan (including Appendix A, Dilute Solution Hygiene Plan).
- 16.4 R3QA063, Laboratory Notebooks.
- 16.5 R3-QA5002, Accountability Procedures for Ultra Dilute Chemical Warfare Agent (UDA).
- 16.6 R3-QA5003, Procedures for Opening Ultra-Dilute Chemical Warfare Agent (UDA) Vials and Preparation of Standards for Calibration of GC/MS.
- 16.7 R3-QA5004, GC/MS Analysis of Ultra-Dilute Chemical Warfare Agent (UDA) Standards and Samples.
- 16.8 National Environmental Laboratory Accreditation Program (NELAP) Standards.
- 16.9 Introduction to the Chemical Agent Dilute Solution Hygiene Plan, Midwest Research Institute, NEMC-01, July 2007.
- 16.10 General Operating Procedures for Chemical Agent Dilute Solution, Midwest Research Institute, NEMC-02, July 2007.
- 16.11 Design and Operating Requirements for Chemical Agent Dilute Solution Laboratories, Midwest Research Institute, NEMC-03, July 2007.
- 16.12 Laboratory Ventilation and Engineering Controls for Chemical Agent Dilute Solution Laboratories, Midwest Research Institute, NEMC-04, July 2007.
- 16.13 Training for Chemical Agent RDTE and Ultra-Dilute and RDTE Dilute Solution Laboratories, Midwest Research Institute, NEMC-05, July 2007.
- 16.14 Storage Requirements and Hazard Communication for Chemical Agent Dilute Solution Laboratories, Midwest Research Institute, NEMC-06, July 2007.
- 16.15 Physical Security Plan for the Chemical Agent Dilute Solutions Laboratories, Midwest Research Institute, NEMC-07, July 2007.
- 16.16 Procedures for Control of Locks, Keys, and Combinations Designated for Use in the Chemical Agent Dilute Solution Facilities, Midwest Research Institute, NEMC-08, July 2007.

- 16.17 Accountability Procedures for Ultra-dilute Chemical Agent Solutions and RDTE Dilute Solutions, Midwest Research Institute, NEMC-09, July 2007.
- 16.18 Interagency Agreement (IAA) between EPA and DoD dated November 22, 2006.
- 16.19 ECBC Guidelines for Managing a Research, Development, Testing, Evaluation (RDTE) Laboratory (September 2005).
- 16.20 Region 1, General Operating Procedures for NERL-Dilute Chemical Agent Laboratories, 3/20/08, Revision 0, DRAFT.
- 16.21 R3QA065, Calibration and Maintenance of Laboratory Support Equipment.
- 16.22 Appendix E of "Final Programmatic Environmental Impact Statement: Transportable Treatment Systems for Non-Stockpile Chemical Warfare Material, Volume III, February 2001. "The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products", Nancy B. Munro, Sylvia S. Talmage, Guy D. Griffin, Larry C. Waters, Annetta P. Watson, Joseph F. King, and Veronique Hauschild.
- 16.23 Site Security Plan, Environmental Science Center.
- 16.24 ESC Occupant Emergency Plan (OEP).
- 16.25 Draft Standard Analytical Protocol for Extractable Semivolatile Organic Compounds, September 30, 2008 (Provided by CS and the EPA Working Group).
- 16.26 Study Specific Instructions for Phase I Multi-laboratory Validation of Procedures to Measure Semi-volatile Agents in Environmental Samples using Gas Chromatography/Mass Spectrometry (GC/MS), Draft for Review, Rev. 0.5, November 21, 2008.
- 16.27 Study Plan for Multi-laboratory Validation of Procedures to Measure Semi-Volatile Chemical Warfare Agents in Environmental Samples using Gas Chromatography / Mass Spectrometry (GS/MS), October 23, 2008.

## **17 Tables, Diagrams, Flowcharts and Validation Data**

### **17.1 Notebooks**

**Note:** The most current version of the following notebooks is referenced. The most current listing of OASQA quality system documents is maintained by the QAO.

SNB 327 (B), UDA Delivery & Accountability Assessment Notebook (UDAL). This includes: records of coordination of UDA deliveries from supplier of chemical agent, carrier

deliver receipts, COC, chemical agent supplier provided records (such as purity and volume statements & MSDS sheets) and accountability checks and summary reports.
SNB 354 (A), UDA Refrigerator-1, Primary UDA Solutions, Entry & Temperature Log.
SNB 326 (B), UDA Refrigerator-2, Secondary UDA Solutions, Entry & Temperature Log.
SNB 353 (A), UDA Refrigerator-3, UDA Sample Extract Solutions, Entry & Temperature Log.
SNB 328 (A), UDA Safety Checklist (Beginning/End of Day) & Hood Reports Log (UDAL). This contains daily safety checklist forms completed by the CAOs (before work starts and end of day checks), as well as, any notes on hood operations.
SNB 330, UDA SOPs and Quality System Documents (UDAL). This contains UDA SOPs, Laboratory Quality Manual, ESC CHP and other references).
SNB 332, Instrument Maintenance, Purelab Deionization Polishing Unit.
PNB 199, UDA Accountability/Standard/Reagent Preparation Log (UDAL).
PNB 192 (A), UDA Sample Preparation Log

## 17.2 Attachments

### Attachment #1: Refrigerator Access (UDAL G-102)

#### Refrigerator #1, Primary UDA Solutions:

##### Physical key for lock/key:

Primary- AM.

Backup#1- LBC.

##### Electronic refrigerator card and code:

EPA CAOs.

#### Refrigerator #2, Secondary UDA Solutions:

##### Physical key for lock/key:

Primary- EPA CAO #1.

Backup#1- AM.

##### Electronic refrigerator card and code:

LBC.

EPA CAO #2 & ESAT CAO.

#### Refrigerator #3, Secondary UDA Solutions (Sample & Spiked Sample Extracts):

##### Physical key for lock/key:

Primary- EPA CAO #1.

Backup#1- AM.

Ultra-Dilute Chemical Warfare Agent (UDA) Standard Reference Material (Shipment Coordination, Receipt, Initial  
Accountability, Storage and Disposal Procedures)

Effective Date: 06-16-14

Page 24 of 35

Electronic refrigerator card and code:

LBC.

EPA CAO #2 & ESAT CAO.

**Attachment 2: Hazard Analysis:**

**Hazard Analysis  
 Preoperational Checklist and Transfers In and Out of Hood**

Operation description	Location(s) identified within operation	Effects of hazards on the operation	Risk <sup>a</sup> Assessment Code (RAC)	Recommended actions to reduce the hazards	Resulting RAC code
Checking hood function	Lab	Due to malfunctioning, magnahelic indicates acceptable flow when it is out of range. Lab staff exposed.	Low	Check face velocity with hanging vane velometer prior to use.	Low
Checking hood function	Lab	Due to malfunctioning magnahelic or hood alarms, hood failure occurs without warning. Lab staff exposed.	Medium	Perform routine maintenance on hoods. Check face velocity with hanging vane velometer. Test hood alarms periodically and perform needed maintenance.	Low
Glove check	Lab	Improper check, operator misses hole in gloves. Exposed staff initiates the emergency response alarm.	Low	100% glove check. Use two pair of gloves.	Low
Transfer in or out of a hood	Hood/Lab	Spill outside or inside of ventilation control. Staff exposed to agent. Initiate alarm.	Medium	Use of secondary containers and spill trays. Caution and focus on task at hand (no distractions). Verification run SOP steps prior to working with chemical agent. PPE worn as specified. Emergency PPE and decontamination equipment/reagents available. "Buddy" verifies safety procedures and is available to assist with emergency response.	Low



R3QA5001-061614

Ultra-Dilute Chemical Warfare Agent (UDA) Standard Reference Material (Shipment Coordination, Receipt, Initial Accountability, Storage and Disposal  
Procedures)

Effective Date: 06-16-14

Page 26 of 35

Operation description	Location(s) identified within operation	Effects of hazards on the operation	Risk <sup>a</sup> Assessment Code (RAC)	Recommended actions to reduce the hazards	Resulting RAC code
Preparing & using decontamination solutions	Hood/Lab	Splatter or spill of caustic such as solid or liquid sodium hydroxide, HTH, sodium carbonate.  Inhalation hazard.  Dermal hazard.  Respiratory distress.  Skin irritation.  Caustic burns (delayed) on operator's hands, arms, face, and eyes.	High	PPE—goggles or face shield worn over safety glasses with side shields, gloves, lab coat, or coveralls with rubber apron.  Weigh caustics in hood.  Attentiveness to task (no distractions).  Purchase Clorox or HTH in small containers.  Use hood while pouring Clorox or scooping solid HTH.  Wear respirator when scooping HTH solids out of large container. Requires training and testing for fit.	Medium
Transferring waste to processing room	Lab	Operator drops waste container in lab.  Exposure to residual agent solution.  Splatter of caustic.  Burns to lab personnel (delayed).	Medium	Double-bagging (standard practice).  Caution (e.g., check to make sure there are no obstructions in path, etc.).  Use lab cart to transport items.	Low

Operation description	Location(s) identified within operation	Effects of hazards on the operation	Risk <sup>a</sup> Assessment Code (RAC)	Recommended actions to reduce the hazards	Resulting RAC code
<p><b>Human Factors:</b></p> <p>Stress associated with working with CA (especially when performing operations for the first time) may result in accidents.</p> <p>Ergonomics issues may result in accidents. Working in a hood creates unnatural posture and movements. Laboratory work may require repetitive movements resulting in tiring of specific muscles, cramping, and skeletal fatigue. Accidents have resulted from an indifferent attitude, failure to use common sense, or failure to follow instructions.</p>	Hoods and laboratory	<p>Chemical agent exposure, injury, and property damage.</p> <p>Trips, slips, falls, spills, etc.</p>	High	<p>Ensure that the operator and buddy are prepared for each operation, and review the SOP prior to beginning work.</p> <p>Any questions about the procedure should be adequately addressed and answered prior to beginning the operation.</p> <p>If the operator or buddy is not feeling well, do not start the operation. Think about what is required of the procedure and ensure that the operator and buddy can complete the tasks required.</p> <p>Give some thought to ergonomics. Adjust body posture for comfort. Strive to maintain movements within the hood that match natural movements. If fatigue or cramping occurs, schedule breaks as part of the activities (at an appropriate time).</p> <p>Always be aware of what your coworkers are doing in your immediate area because you can be a victim of their mistakes. Do not hesitate to point out to fellow workers if they are engaging in unsafe practices or operations. Variations in established procedures, including changes in quantities or reagents, may be dangerous. If necessary, consult the Chemical Agent Hygiene Officer.</p>	Low
Recovery from engineering and/or power failures.	Hoods and operations in UDAL	Chemical agent exposure and injury	High	Practice drills conducted to include shut down of operations associated with engineering failures such as hood failure and power outages.	

<sup>a</sup> All risk assessment codes were determined only after considering human factors such as indifferent attitude, failure to use common sense, and failure to follow instructions.

**Attachment 3: Example Chemical Agent Shipment Condition Report Form:**

**SHIPMENT CONDITION REPORT:**

**A. SHIPMENT NUMBER:**

**B. NUMBER OF STANDARD VIALS FOR THE DAY:**

**C. SHIPMENT RECEIVED BY:**

**D. DATE/TIME RECEIVED BY:**

**E. PHYSICAL CONDITION OF SHIPMENT: Note any unacceptable conditions**

**F. TRANSFER DOCUMENT NUMBER(S):**

***Form Retained in UDA Delivery & Accountability Assessment Notebook SNG 327.***

### Attachment #4: Example UDA Accountability Form

# Chemical Warfare Agent 1<sup>o</sup> Standard Receipt

**Shipping tracking numbers:** **Fed Express #** \_\_\_\_\_

LLNL #

**Physical condition (good / broken):**

**Date Received:** 1 / 1 **Received by:** AM CAO CAO

**Lot number (If multiple Lots note #s in comments column):**

**Volume (e.g., 1.2 mL):** \_\_\_\_\_ **Concentration: "Mix":** GB & GF at 10 ug/mL and GD & HD at 5 ug/mL and "Vx" at 10 ug/mL or indicate below in comments column)

**COC Form competed & copy returned (Y/N):**

**Condition of Receipt form completed & returned (Y/N):**

[illegible]

LLNL = Lawrence Livermore National Laboratory.

Reviewed by: \_\_\_\_\_

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

***Form Retained in UDA Delivery & Accountability Assessment Notebook SNB 327.***

**Attachment 5: Safety Checklist (Beginning & End-of-Day)****All items are to be checked and found satisfactory prior to any laboratory operations in UDAL:****I. Beginning of each working day -prior to beginning any work with ANY UDA in UDAL:**

Date	M	Tu	W	T	F
CAO's Initials					
Time					
	Y/N*	Y/N*	Y/N*	Y/N*	Y/N*
Labs at negative pressure relative to the hallway and no hood alarm/s?					
Hood flow $\geq 100$ LFM via anemometer and hood emergency purge tested?					
Both 5% and and fresh 0.5% solution available and prepared?					
PPE including gloves and respirator available?					
2-way radios available and operational?					
UDA refrigerator temperatures $4 \pm 2^\circ \text{C}$ ?					
"Stop" sign posted on the outside of UDAL door and cell phones turned off while in UDA laboratories?					
White board in hallway updated with activity, etc?					
For receipt of delivery of UDA reference material, prepare welled cart available with all material per checklist on cart, if applicable?					

**II. End of each working day - prior to ending all work with ANY UDA in UDAL:**

Date	M	Tu	W	T	F
CAO's Initials					
Time					
	Y/N*	Y/N*	Y/N*	Y/N*	Y/N*
Labs at negative pressure relative to the hallway and no hood alarm/s?					
Hood flow ok ( $\geq 100$ LFM via anemometer) and hood emergency purge tested?					
UDA refrigerator temperatures $4 \pm 2^\circ \text{C}$ ?					
Log books complete?					
All solutions capped and properly labeled and in 2ndary containment?					
All primary solutions locked in Refrigerator-1.					
Work surfaces washed down and decon as needed?					
Extra (~50 mL) 0.5-0.6% decontamination solution added to decon. buckets and solid material is cover by decon. solution?					
Decontamination solutions and containers closed and no leaks?					
Hood sashes at hood level mark (open be protective of CA breathing zone and to assure lab negative pressure to hall)?					
UDA refrigerator locked (key, electronic and wall cable)?					
Work area clean? All PPE removed and appropriately disposed and wash hands before leaving UDA Labs?					
If waste pickup is needed, has call been placed for pickup?					
If applicable, move "Stop" sign to the inside of UDAL door?					
All access/egress doors locked?					
This completed checklist placed in the UDA Safety Checklist & Hood Report Log in UDAL, if applicable?					
2-way radios off and charging?					
White board in hallway updated with activity, etc?					
For receipt of delivery of UDA reference material, prepare welled cart available with all material per checklist on cart, if applicable?					

**Form Retained in UDA Safety Notebook SNB 328.**

**Attachment 6: Example COC Form**

MATERIEL COURIER RECEIPT		INTEGRITY CONFIRMATION NO.		PRIVACY ACT STATEMENT	
CARRIER <b>Shawn Heinlein,</b>		ECB-CB-PI-OP-CO-8079-0260		<small>Authority: 5 U.S.C., Sec. 552a (p) (3) (A)            PURPOSE: To provide a receipt for transfer of controlled materials. The use of the form is mandatory to provide proper accountability of the materials receiving for the material.            ROUTING: To document transfer of material from a supplier to a receiver, return to sender, or other location.            DISCLOSURE: IS VOLUNTARY. Should the form be used, it is to provide a receipt for transfer of materials and not for other purposes.            Form design breaking the material is prohibited by law of the form.</small>	
DESTINATION C. Koster, LLNL, Livermore, CA 925-422-6880		SUPPLY ACCOUNT NUMBER			
I certify by my signature that I received the material from the carrier and am aware of the applicable safety and security requirements.					
SHIPMENT DESCRIPTION					
				LINE NUMBER	QUANTITY
SHIPMENT TRANSFERS					
FIRST LOCATION OF TRANSFER DATE (MM/DD/YYYY)				1	10ml
RECEIVER'S PRINTED NAME (LAST, FIRST, MI)					
SIGNATURE					
ORIGIN OR ACCOUNT NO.				2	10ml
SOCIAL SECURITY NUMBER					
SECOND LOCATION OF TRANSFER DATE (MM/DD/YYYY)					
RECEIVER'S PRINTED NAME (LAST, FIRST, MI)				3	10ml
SIGNATURE					
ORIGIN OR ACCOUNT NO.				4	10ml
SOCIAL SECURITY NUMBER					
THIRD LOCATION OF TRANSFER DATE (MM/DD/YYYY)				5	10ml
RECEIVER'S PRINTED NAME (LAST, FIRST, MI)					
SIGNATURE					
ORIGIN OR ACCOUNT NO.				6	10ml
SOCIAL SECURITY NUMBER					
FOURTH LOCATION OF TRANSFER DATE (MM/DD/YYYY)					
RECEIVER'S PRINTED NAME (LAST, FIRST, MI)					
SIGNATURE					
ORIGIN OR ACCOUNT NO.					
SOCIAL SECURITY NUMBER					
FIFTH LOCATION OF TRANSFER DATE (MM/DD/YYYY)					
RECEIVER'S PRINTED NAME (LAST, FIRST, MI)					
SIGNATURE					
ORIGIN OR ACCOUNT NO.					
SOCIAL SECURITY NUMBER					

DD FORM 1911, MAY 82

PREVIOUS EDITION MAY BE USED UNTIL 31 DEC 02

UNOFFICIAL

**Form Retained in UDA Delivery & Accountability Assessment Notebook SNB 327.**

## UDA Refrigerator # \_\_\_\_\_

Page: 1 of 1

[illegible]


***Forms Retained in UDA Refrigerator #1, #2 and #3 logs (SNB 354, 326 and 353).***

**Appendix A**

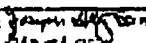
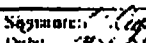

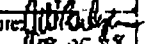
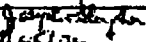
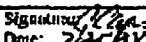

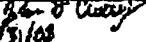


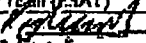



COPY

DCN: R3-QA5001.0

Effective Date: July 25, 2008

Page 1 of 27

SOP Approvals:			
Preparation/Analyst	Primary Technical Reviewer	Safety/Health Review	Quality System Review
Name: Joseph Slayton Technical Director/ Agent Manager (AM)	Name: Cynthia Caporale Laboratory Branch Chief (LBC)	Name: Charles Weisberg ESC SHER Manager	Name: Jill Bilyou Quality Assurance Officer
Signature:  Date: 7/25/08	Signature:  Date: 7/25/08	Signature:  Date: 7/25/08	Signature:  Date: 7/25/08
<b>Hazard Analysis (See Attachment to SOP):</b>			
Technical Director/ Agent Manager	LBC	SHER Manager	
Name: Joseph Slayton	Name: Cynthia Caporale	Name: Charles Weisberg	
Signature:  Date: 7/25/08	Signature:  Date: 7/25/08	Signature:  Date: 7/25/08	
<b>Dry Run:</b>			
Chemical Agent Operator:	LBC:	ESC SHER Manager:	
Name: John Cury	Name: Cynthia Caporale	Name: Charles Weisberg	
Signature:  Date: 7/25/08	Signature:  Date: 7/25/08	Signature:  Date: 7/25/08	
Chemical Agent Operator:	Technical Director/AM:		
Name: Kristians Rughweer Environmental Services Architectural Team (ESAT)	Name: Joseph Slayton		
Signature:  Date: 7/25/08	Signature:  Date: 7/25/08		

**Ultra-Dilute Chemical Warfare Agent (UDA) Standard Reference Material  
(Shipment Coordination, Receipt, Initial Accountability and Disposal Procedures)**

**1 Scope and Application**

This standard operating procedure (SOP) describes shipment coordination and receipt procedures for UDA standard reference material at the Office of Analytical Services and Quality Assurance (OASQA) laboratory in Fort Meade, Maryland.

**2 Summary of Method**

Log-in is the procedure by which submitted UDA materials are introduced into the laboratory. The documentation recorded during log-in of reference materials includes: agent name and ID number, origin and quantity (concentration and volume per vial and number of vials). Upon receipt, the accompanying documentation (chain of custody sheets and certificates), preservation and shipping conditions are documented by manual entry into a notebook. Procedures for use of the UDA reference solutions in preparation of calibration standards and quality control checks and other more dilute solutions are described in SOP R3-QA5003.0, GC/MS Analysis of UDA.

```

graph TD
    Start([Materials (solid, liq or soln)  
Or  
Sample(s)]) --> Decision{Contains agent?}
    Decision -- No --> Samples[Samples]
    Samples --> W1[W]
    Decision -- No --> Other[Other lab waste]
    Other --> NonContaminated[Non-Contaminated  
LQA Waste]
    NonContaminated --> W2[W]
    Decision -- Yes --> Samples2[Samples, Solids, extraction  
rejection slats]
    Samples2 --> Deter[Deter process]
    Deter --> Extraction[Extraction  
slat]
    Extraction --> NonContaminated2[Non-Contaminated  
LQA Waste]
    NonContaminated2 --> W3[W]
    Deter --> Solid[Solid - bleach  
into 2.5 gal  
bucket]
    Solid --> pH1[pH > 12.5  
LQA Solid Waste  
D002/F002/F003/MD02]
    pH1 --> W4[W]
    Samples2 --> Liquid[Liquid]
    Liquid --> Bleach[Liquid - bleach  
into 5 gal  
bucket]
    Bleach --> pH2[pH > 12.5  
LQA Liquid Waste  
D001/D002/F002/F003/MD01]
    pH2 --> W5[W]
  
```

WASTE AND READY-TO-DISPOSE PROCEDURE	W
SAMPLE DISPOSAL PROCEDURE	S

**CWA, Generated Waste  
Prohibited Waste  
January 2011**

CWA  
Rec'd  
07/16/14

# SIGMA-ALDRICH

sigma-aldrich.com

## SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 4.0 Revision Date 12.03.2010

Print Date 26.04.2010

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

### 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product name	Dichloromethane
Product Number	D65100
Brand	Sigma-Aldrich
Company	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone	+18003255832
Fax	+18003255052
Emergency Phone #	(314) 776-6555

### 2. HAZARDS IDENTIFICATION

#### Classification of the substance or mixture

According to Regulation (EC) No1272/2008

Carcinogenicity (Category 2)

According to European Directive 67/548/EEC as amended.

Limited evidence of a carcinogenic effect.

#### Label elements

##### Pictogram



##### Signal word

Warning

##### Hazard statement(s)

H351

Suspected of causing cancer.

##### Precautionary statement(s)

P281

Use personal protective equipment as required.

##### Hazard symbol(s)

Xn

Harmful

##### R-phrases(s)

R40

Limited evidence of a carcinogenic effect.

##### S-phrases(s)

S23

Do not breathe gas/fumes/vapour/spray.

S24/25

Avoid contact with skin and eyes.

S36/37

Wear suitable protective clothing and gloves.

Other hazards - none

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms	Methylene chloride
Formula	CH <sub>2</sub> Cl <sub>2</sub>
Molecular Weight	84.93 g/mol

CAS-No.	EC-No.	Index-No.	Classification	Concentration
<b>Methylene chloride</b>				
75-09-2	200-838-9	602-004-00-3	Carc. 2; H351 Xn, Carc.Cat.3, R40	>= 99,9 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

#### 4. FIRST AID MEASURES

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

##### If inhaled

If breathed in, move person into fresh air. If not breathing give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 5. FIRE-FIGHTING MEASURES

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

##### Special protective equipment for fire-fighters

Wear self contained breathing apparatus for fire fighting if necessary.

#### 6. ACCIDENTAL RELEASE MEASURES

##### Personal precautions

Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation.

##### Environmental precautions

Do not let product enter drains.

##### Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

#### 7. HANDLING AND STORAGE

##### Precautions for safe handling

Avoid inhalation of vapour or mist.

Normal measures for preventive fire protection.

##### Conditions for safe storage

Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

Heat sensitive. Store under inert gas.

#### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

##### Personal protective equipment

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### **Hand protection**

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Handle with gloves.

#### **Eye protection**

Face shield and safety glasses

#### **Skin and body protection**

Choose body protection according to the amount and concentration of the dangerous substance at the work place.

#### **Hygiene measures**

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

---

### **9. PHYSICAL AND CHEMICAL PROPERTIES**

#### **Appearance**

Form	liquid
Colour	colourless

#### **Safety data**

pH	no data available
Melting point	97 °C - lit.
Boiling point	39,8 - 40 °C - lit.
Flash point	no data available
Ignition temperature	556,1 °C -
Lower explosion limit	12 %(V)
Upper explosion limit	19 %(V)
Vapour pressure	470,8 hPa at 20,0 °C 1.687,3 hPa at 55,0 °C 57,99 hPa at 25 °C
Density	1,325 g/mL at 25 °C
Water solubility	slightly soluble
Partition coefficient: n-octanol/water	log Pow: 1,25
Relative vapour density	2,93 - (Air = 1.0)
Evaporation rate	0,71

---

### **10. STABILITY AND REACTIVITY**

#### **Chemical stability**

Stable under recommended storage conditions.

#### **Conditions to avoid**

Heat, flames and sparks. Exposure to sunlight.

#### **Materials to avoid**

Alkali metals, Aluminum, Strong oxidizing agents, Bases, Amines, Magnesium, Strong acids and strong bases, Vinyl compounds

**Hazardous decomposition products**

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

---

**11. TOXICOLOGICAL INFORMATION****Acute toxicity**

LD50 Oral - rat - 1.600 mg/kg

Remarks: Behavioral:Ataxia.

LC50 Inhalation - rat - 52.000 mg/m3

**Skin corrosion/irritation**

Skin - rabbit - Skin irritation - 24 h

**Serious eye damage/eye irritation**

Eyes - rabbit - Mild eye irritation - 24 h

**Respiratory or skin sensitization**

no data available

**Germ cell mutagenicity**

Genotoxicity in vivo - rat - Oral

DNA damage

**Carcinogenicity**

Carcinogenicity - rat - Inhalation

Tumorigenic:Carcinogenic by RTECS criteria. Endocrine:Tumors.

This product is or contains a component that has been reported to be possibly carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Methylene chloride)

**Reproductive toxicity**

no data available

no data available

**Specific target organ toxicity - single exposure**

no data available

**Specific target organ toxicity - repeated exposure**

no data available

**Aspiration hazard**

no data available

**Potential health effects****Inhalation**

May be harmful if inhaled. May cause respiratory tract irritation.

**Ingestion**

May be harmful if swallowed.

**Skin**

May be harmful if absorbed through skin. May cause skin irritation.

**Eyes**

May cause eye irritation.

**Signs and Symptoms of Exposure**

**Additional Information**  
RTECS: PA8050000

## Toxicity

**Toxicity to daphnia and other aquatic invertebrates.** EC50 - *Daphnia magna* (Water flea) - 1.682,00 mg/l - 48 h

**Bioaccumulative potential**  
no data available

**Mobility in soil**  
no data available

**PBT and vPvB assessment**  
no data available

**Other adverse effects**  
no data available

**Product**

Observe all federal, state, and local environmental regulations. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**  
Dispose of as unused product.

**ADR/RID**

UN-Number: 1593 Class: 6.1 Packing group: III  
Proper shipping name: DICHLOROMETHANE

IMDG

UN-Number: 1593 Class: 6.1 Packing group: III EMS-No: F-A, S-A  
Proper shipping name: DICHLOROMETHANE  
Marine pollutant: No

**IATA**

UN-Number: 1593 Class: 6.1 Packing group: III  
Proper shipping name: Dichloromethane

**Sigma-Aldrich - D65100**

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

---

## 16. OTHER INFORMATION

### Text of H-code(s) and R-phrase(s) mentioned in Section 3

Carc.	Carcinogenicity
H351	Suspected of causing cancer.
Xn	Harmful
R40	Limited evidence of a carcinogenic effect.

### Further information

Copyright 2010 Sigma-Aldrich Co. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Co., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

---



# Material Safety Data Sheet

## Mixture Lethal Nerve Agent (GB) in Hexane

Revised: 11 June 2007

### Section I - General Information

Manufacturer's Address:  
U.S. Army Edgewood Chemical Biological Center (ECBC)  
ATTN: AMSRD-ECB-CB-CR  
Aberdeen Proving Ground, MD 21010-5424  
Business Phone: 410-436-4411 or 4414, Monday through Friday during the hours of 8:00 AM to 4:30 PM EDT

Chemical Name: Isopropyl methylphosphonofluoridate and Hexane

Trade name and synonyms:  
GB in solvent  
CASARM GB  
RDTR Dilute GB

Chemical Family: Mixture of a fluorinated organophosphorus compound and flammable solvent

Molecular Formula GB:  $C_3H_7FPO_2$   
Molecular Formula Hexane:  $C_6H_{14}$

NFPA 704 Signal: Health - 4  
Flammability - 4  
Special - 0



### Section II - Ingredients

Ingredients/Name: GB & Hexane  
Concentration: Dilute GB concentrations vary from 1.0 mg of GB per milliliter of Hexane to 0.012 µg of GB per milliliter of Hexane

### Section III - Physical Data

Appearance and Odor of GB: Colorless liquid. Odorless in pure form.

NOTE: Due to low concentrations of agent in Dilute GB the remaining physical properties given are those of the Hexane, for additional GB properties refer to the neat GB MSDS.

Appearance and Odor: Colorless liquid with a mild solvent type odor.

Boiling Point @ 760 mm Hg: 69° C

Vapor Pressure (mm Hg): 151 @ 25° C

Vapor Density (Air=1): 2.97

Specific Gravity (H<sub>2</sub>O=1): 0.66

Viscosity: 0.31 mPas @ 20° C

Molecular Weight (g/mol): 36.18

Freezing/Melting Point: -95° C

### Section IV - Fire and Explosion Data

NOTE: GB is not known to be flammable. Information given for fire and explosion data comes from the flammable solvent, Hexane

Flash Point: -7 °F (-22 °C)

Lower Explosive Limit: 1.1%

Upper Explosive Limit: 7.5%

Autoignition Temperature: 437 °F (225 °C)

Extinguishing Media: For small fires, use dry chemical powder, CO<sub>2</sub> and alcohol-resistant foam. Water may be ineffective. Avoid use of extinguishing methods that will cause splashing or spreading of solvent.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires should be contained to prevent spreading to uncontrolled areas. When responding to a fire alarm in buildings or areas containing solvents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during fire fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full-face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. Use water spray to cool fire-exposed containers.

NOTE: Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid GB or vapors can be fatal.

Unusual fire and Explosion Hazards: Vapor may travel considerable distance to source of ignition and flash back. Container explosion may occur under fire conditions. Material is lighter than water and may be spread by the use of water.

### Section V - Health Hazard Data

Airborne Exposure Limits (AEL):

Mixture GB-Hex Page 2 of 10

CWB  
Rec'd  
07/14/18

For GB<sup>1</sup>:

Worker Population Limit (WPL) 8-hr TWA <sup>1</sup> mg/m <sup>3</sup>	STEL 15-min TWA <sup>1</sup> mg/m <sup>3</sup>	IDLH <sup>4</sup> mg/m <sup>3</sup>	General Population Limit (GPL) 12-hr TWA <sup>1</sup> mg/m <sup>3</sup>
0.0003	0.0001	0.1	0.00001

<sup>1</sup> These values can be found in the DA, Office of the Assistant Secretary, Installations and Environment memo, subject: Implementation Guidance Policy for New Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT, 18 June 2004.

<sup>2</sup> To date, the Occupational Safety and Health Administration (OSHA) have not promulgated a permissible exposure concentration for GB.

For Hexane:

Threshold Limit Value (TLV): The TLV for hexane is 50 ppm or 180 mg/m<sup>3</sup> as an eight-hour time-weighted average (TWA).

PEL: 500 ppm or 1800 mg/m<sup>3</sup> TWA.

This mixture is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

The mixture should be treated as a poisonous and flammable liquid. Personnel should avoid contact with the mixture and use appropriate types/levels of protective clothing and equipment.

**NOTE:** There is presently no toxicity data for the mixture of GB and Hexane. The information provided here is taken from the most GB MSDS.

**Routes of Entry:** The primary routes of exposure for GB are inhalation and ocular exposure of vapor and liquid contact with skin. A secondary and less likely route of entry can be through ingestion.

**Effects of Exposure:** Nerve agents are readily absorbed and are hazardous through all routes of exposure. The most prominent physiological effects result from the inhibition of AChE in the central nervous system. The result produces effects including miosis, rhinorrhea, bronchoconstriction, increased gastrointestinal motility, muscle fasciculations, weakness, flaccid paralysis, difficulty in concentrating, anxiety, insomnia, restlessness, depression of the respiratory center, convulsions and death.

**Signs and Symptoms:** The onset of the signs and symptoms following exposure to nerve agents may occur within seconds, minutes, or hours, depending upon concentration, dosage, and route of entry, as well as the type and physical state of the nerve agent.

GB poses primarily a vapor hazard to the unprotected worker. The first noticeable effects are miosis, tight chest and/or rhinorrhea. These signs can occur in the absence of measurable AChE inhibition in the blood. Later, mild signs and symptoms of vapor exposure include conjunctival injection, pain behind the eyes, dimness or blurred vision and excessive salivation.

Moderate signs and symptoms of vapor exposure may include mild signs and symptoms of exposure plus: increased shortness of breath, coughing, wheezing, voluminous bronchorrhea, nausea, vomiting and diarrhea.

Severe signs and symptoms of vapor exposure may include moderate signs and symptoms of exposure plus: generalized weakness or fasciculations/twitching, loss of consciousness (within seconds), convulsions (within

minutes), severe respiratory distress, flaccid paralysis and apnea.

Effects from liquid percutaneous exposures to nerve agents are slower to develop and slower to reach their peak when compared to vapor exposures of the eyes or respiratory tract. Mild signs and symptoms of liquid nerve agent skin exposure include localized sweating at the site of exposure and fine muscle fasciculations/twitching. (NOTE: Miosis is not an early sign of liquid skin exposure. This is only true for exposures that include contact with airborne vapor with the eyes. In cases of nerve agent exposure not involving vapor contact with the eyes, miosis may be one of the last effects to occur. In such cases, the dosages of liquid exposure which produces miosis are not significantly different than lethal doses.)

Toxicity Values:

**Vapor (Gaseous/Decay)<sup>1,2</sup>**  
EC50 (Mild) = 1 mg-min/m<sup>3</sup>  
EC50 (Severe) = 25 mg-min/m<sup>3</sup>  
LC50 = 35 mg-min/m<sup>3</sup>

**Vapor (Particulate)<sup>1,2</sup>**  
EC50 (Threshold) = ~1200 mg-min/m<sup>3</sup>  
EC50 (Severe) = 8000 mg-min/m<sup>3</sup>  
LC50 = 12000 mg-min/m<sup>3</sup>

**Liquid (Percutaneous)**  
BD50 = 1000 mg/70 kg man  
LD50 = 1700 mg/70 kg man

<sup>1</sup> Estimates for inhalation vapor exposure are based on a minute volume (MV) of 15 liters and a 2 minute exposure. The effective dosages will increase with lower MV and decrease for a higher MV. The concentration-time profile is described by the toxic load model (C<sup>n</sup>t-k). The toxic load exponent (n) is 1.5. The dose-response curve is very steep.

<sup>2</sup> Based on recent studies estimates for this value, dosage may actually be 0.4 mg-min/m<sup>3</sup>.

<sup>3</sup> Severe effects may also include death.

<sup>4</sup> Personnel are masked.

<sup>5</sup> Values for percutaneous vapor are for moderate temperatures (85 °F and below). The effective dosages for hot temperatures (85 °F and above) will be less by at least a factor of 2.

<sup>6</sup> Threshold refers to a slight AChE inhibition.

**Emergency and First Aid Procedures:**

**NOTE:** When seeking medical attention, inform medical personnel that this is an organophosphorus mixture.

**Vapor Exposure:** Immediately leave area of contamination. Vapor exposed nerve agent casualties should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor off-gassing.

**Liquid Skin Exposure:** Leave area of contamination as quickly as possible. Remove clothing in a clean air environment and wash the skin surface and hair in warm or hot water at least three times. The rapid physical removal of a chemical agent is essential. Scrubbing of exposed skin with a stiff brush or bristles is discouraged, because skin damage may occur and may increase absorption of agent. Use liquid soap (dispose of container after use and replace), copious amounts of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse with copious amounts of warm or hot water. Shampoo can be used to wash the hair. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water. Two permissible alternative skin decontaminants include the M291 Skin Decontaminating Kit (SDK) and a 0.5% sodium hypochlorite solution. (NOTE: The use of the M291

SDK and/or 0.5% sodium hypochlorite on skin is appropriate in situations where soap and water may not be as efficacious in physically removing particular types of nerve agents, such as those used in certain research and development laboratories. Neither soap and water, 0.5% sodium hypochlorite or the M291 SDK have been shown to be more efficacious than the other for physically removing every type of nerve agent from the skin. If used, the 0.5% sodium hypochlorite should be applied with mild to moderate friction, with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse to remove any residual sodium hypochlorite with copious amounts of warm or hot water.

**Eye Contact:** Immediately leave area of contamination and begin flushing eyes, mucous membranes, or open wounds with sterile saline or water. Flush the eyes immediately with sterile saline or water by tilting the head to the side, pulling the eyelids apart with gloved fingers and pouring slowly into the eyes. A Morgan lens may also be used for continuous eye irrigation. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken immediately to a medical treatment facility for observation.

**Ingestion:** Do not induce vomiting. First symptoms are likely to be gastrointestinal. Immediately administer Nerve Agent Antidote Kit, Mark I. Seek medical attention immediately. Do not handle vomited material to avoid further contamination.

**Inhalation:** If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention immediately.

**Nerve Emergency Treatment:** An individual who has received a known nerve agent exposure and has progressive signs and symptoms of nerve agent exposure may receive up to three sets of the Nerve Agent Antidote Kit (Mark I). Injections may be administered at 5 to 20 minute intervals, no more than three (3) injector sets will be given unless directed by medical personnel. If severe signs of agent exposure appear [signs and symptoms of moderate exposure, plus generalized weakness or fasciculation/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea], immediately administer, in rapid succession, all three sets of the Mark I. In addition, a record will be maintained of all injections given.

#### Health Hazard Data for Hexame:

**Target organ(s):** Central nervous system, eyes, skin, respiratory system, and peripheral nervous system

#### Effects of Exposure:

**Inhalation:** Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.

**Ingestion:** May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.

**Skin Contact:** May cause redness, irritation, with dryness, cracking.

**Eye Contact:** Vapors may cause irritation. Splashes may cause redness and pain.

**Chronic Exposure:** Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

**Aggravation of Pre-existing Conditions:** Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

#### Emergency and First Aid Procedures:

**Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:** Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Contact:** Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

### Section VI - Reactivity Data

**Stability:** The mixture has been found to be stable in sealed containers for up to 12 months at or below 4° C. Use of the mixture and storage above 4° C will hasten the degradation of the GB within the mixture.

#### Reactivity Data for GB:

**Decomposition Temperature:** Decomposes completely at 150°C within 2 ½ hours. Rate of Hydrolysis: Varies with pH and temperature. At 20 °C,  $t_{1/2}$  = 27 min @ pH 1;  $t_{1/2}$  = 3 ½ hr @ pH 2;  $t_{1/2}$  = 80 hr @ pH 7;  $t_{1/2}$  = 5.4 min @ pH 10 and  $t_{1/2}$  = 0.6 min @ pH 11.

**Hydrolysis Products:** Under acidic conditions, hydrogen fluoride (HF) and isopropyl methylphosphonic acid (IMPA) are formed which further hydrolyze to produce methylphosphonic acid (MPA) and isopropanol. Under alkaline conditions, methylfluorophosphonic acid (MFPA) and isopropyl alcohol are formed and further hydrolyze to produce MPA and HF.

**Hazardous Polymerization:** Does not occur.

#### Reactivity Data for Hexame:

**Incompatibility:** Strong Oxidizers

**Hazardous Polymerization:** Will not occur.

**Hazardous Decomposition:** Emits toxic fumes of: Carbon Monoxide, Carbon Dioxide and acrid smoke.

**Conditions to avoid:** Ignition sources, excess heat and electrical spark.

### Section VII - Spill, Leak, And Disposal Procedures

**Steps to be Taken in Case Material is Released or Spilled:** Evacuate area. Wear appropriate protection equipment as specified in section (See Section VIII). Keep unprotected and unnecessary personnel from entering area. See Section V for emergency and first aid instructions.

Shut off all sources of ignition. Ventilate area of leak or spill. Use inert material to absorb spill (e.g. vermiculite).

sand or earth). Decontaminate with sodium hydroxide. Scoop up all material and place in a DOT approved container. Cover the contents with sodium hydroxide. After sealing, decontaminate the exterior container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminant according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the AELs (See Sections V and VIII).

**Waste Disposal Method:** Open pit burning or burying of GB or items containing or contaminated with GB in any quantity is prohibited. Waste GB and associated decontamination solutions may be Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes due to a State listing of the chemical agent, or the characteristics of the waste, to include contaminants. An evaluation of the Federal and State waste disposal regulations must be conducted to determine the appropriate disposal method.

## Section VIII - Special Protection Information

The information provided here is taken from the neat GB MSDS. At the highest concentrations of Dilute GB this information applies in whole. For lower concentrations of Dilute GB, the information provided here is for guidance and the specific use of protective clothing and equipment should be based on the risk assessment approach in accordance with good safety and industrial hygiene principles.

### Exposure Limits for Respiratory Protection for GB:

#### Unprotected Workers:

Concentration (mg/m <sup>3</sup> )	Time Limit
Less than or equal to 0.00003 <sup>1</sup>	8 hours
Up to or less than 0.00006	4 hours <sup>2</sup>

#### Protected Workers:

##### Type of Respiratory Protection Worn (based on monitoring results).

##### 1. M40 Military Mask, CBRN NIOSH Approved Full Face Air Purifying Respirator

Concentration (mg/m <sup>3</sup> )	Time Limit
Not greater than 0.0015	Up to 8 hours <sup>3</sup>
Greater than 0.0015 and less than 0.002	Up to 6 hours
Greater than 0.002 and less than 0.003	Up to 4 hours
Not greater than 0.005	Up to 15 minutes <sup>4</sup>

##### 2. Pressure Demand Supplied Air Respirator with Full Face Respirator

Concentration (mg/m <sup>3</sup> )	Time Limit <sup>4</sup>
0.00003 to 0.1 <sup>5</sup>	Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for

personal protective equipment and clothing

### 3. Pressure Demand Supplied Air Respirator with Full Face Respirator in combination with an Auxiliary Self-contained Breathing Apparatus (SCBA) or just SCBA

Concentration (mg/m <sup>3</sup> )	Time Limit <sup>4</sup>
Greater than 0.1	These concentrations should be expected only in emergency situations. Operations should not be conducted at these concentrations.

<sup>1</sup> As an 8-hr TWA average

<sup>2</sup> Maximum continuous time at this concentration. Equivalent to 8-hr TWA. Source: Implementation Guidance Policy for Revised Airborne Exposures Limits for GB, GA, GD, GP, VX, J1, J2, and HT, Dept of Army, Office of the Assistant Secretary of the Army Installations and Environment, 18 June 2004. See Table 2.

<sup>3</sup> Canister for M40 Mask must be changed out every 6 hours of use.

<sup>4</sup> Based on APF of 50 times the STEL (0.0001 mg/m<sup>3</sup>), which is a 15 minute TWA. Only 4 excursions to this concentration with a 60 minute interval between each one is allowed during an 8 hour workday.

<sup>5</sup> The Immediately Dangerous to Life and Health Value.

<sup>6</sup> For SCBA wearers, time limit is constrained by life of the air cylinder (maximum of 30 to 45 minutes). For Air Supply wearers, time limits should be kept to a minimum. Should use of the auxiliary SCBA be necessary, time limit will be constrained by the life of the breathing air cylinder, and egress from the area must be performed before its expiration.

**Personal Respiratory Protection for Hexane:** If the exposure limits are exceeded and engineering controls are not feasible use a NIOSH approved respirator.

#### Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.

**Special:** Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm).

+/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed to assess the ability of the hood to contain agent.

**Other:** Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

**Protective Gloves for Neat GB:** Butyl Rubber Glove M3 and M6  
Norton, Chemical Protective Glove Set

Decontaminate and change butyl rubber gloves in the event of contact with liquid Hexane since Hexane degrades butyl rubber.

**Eye Protection:** At a minimum safety glasses with side shields will be worn. For splash hazards use goggles and face shield. Maintain eyewash facilities in work area.

**Other Protective Equipment:** For laboratory operations, recommend wearing impervious protective clothing including boots, gloves, lab coat, apron or coveralls, as appropriate to prevent skin contact. In the case of a spill the minimum protective clothing should be donned after the site has been evaluated.

**Monitoring:** Available monitoring equipment for agent GB is the MB/M9 detector paper, detector ticket, M256/M256A1 kit, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), MB/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

### **Section IX - Special Precautions**

**Precautions To Be Taken In Handling and Storing:** When handling mixture the buddy system should be incorporated. No smoking, eating, or drinking in areas containing agents/solvents is permitted. Containers should be periodically inspected for leaks. Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Entry must be designed to permit rapid evacuation. Chemical showers, eyewash stations, personal cleanliness facilities, and fire extinguishers must be provided. Wash hands before meals and, as appropriate, shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

**Other Precautions:** Mixture should be stored in an explosion proof refrigerator with a low temperature alarm. Keep tightly closed. Keep away from heat, sparks, and open flame. No smoking. Take precautionary measures against static discharges.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX", and DA Implementation Guidance Policy for New Airborne Exposures Limits for GB, GA, GD, GF, VX, H, HD, and HT dated 18 June 2004.

### **Section X - Transportation Data**

**Shipping as a Flammable Liquid:**

This mixture is considered a Flammable Liquid for Dilute GB concentrations at or below 0.13 mg/ml.

**Proper Shipping Name:** Flammable liquids, Toxic, n.o.s. (Hexane and Isopropyl methylphosphonofluoridate)

**UN ID Number:** UN1992

**Dot Hazard Class:** 3, 6.1, Packing Group I

**Dot Label:** Flammable Liquid/Toxic

**Dot Marking:** Flammable liquids, Toxic, n.o.s. (Hexane and Isopropyl methylphosphonofluoridate) UN1992

**Dot Placard:** Flammable and Poison if placard is required

**Shipping as a Toxic Liquid:**

This mixture is considered a Toxic Liquid for Dilute GB concentrations greater than 0.13 mg/ml and less than or equal to 2.0 mg/ml.

**Proper Shipping Name:** Toxic by inhalation liquid, flammable, n.o.s. (Hexane and Isopropyl methylphosphonofluoridate)

**UN ID Number:** UN3384

**Dot Hazard Class:** 6.1, 3, Packing Group I, Inhalation Hazard Zone B

**DOT Label:** Poison Inhalation Hazard or Toxic Inhalation Hazard. See 49 CFR 172.400(a)(3) for exceptions to unit packaging labeling and 173.7(b) for other exceptions when material is transported by Technical Escort Units.

**NOTE:** "Poison" and "Toxic" are used interchangeably for all markings, labels and placards in continental US transportation. "Toxic" is required for international transportation.

**Dot Marking:** Toxic by inhalation liquid, flammable, n.o.s. (Hexane and Isopropyl methylphosphonofluoridate) UN3384, Inhalation Hazard Zone B

**DOT Placard:** Poison Inhalation Hazard or Toxic Inhalation Hazard

**Emergency Accident Precautions and Procedures:** See Sections IV, VII and VIII

**Precautions To Be Taken In Transportation:** Motor vehicles will be placarded per DOD 4500.9-R. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the result of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

## Material Safety Data Sheet

### Mixture Lethal Nerve Agent (GD) in Hexane

Revised: 11 June 2007

#### Section I - General Information

##### Manufacturer's Address:

US Army Edgewood Chemical Biological Center (ECBC)

ATTN: AMSRD-RCB-CB-CR

Aberdeen Proving Ground, MD 21010-5424

Business Phone: 410-436-4411 or 4414, Monday through Friday during the hours of 8:00 AM to 4:30 PM EDT

CAS Registry Numbers: None known for the mixture

Chemical Name: Pinacolyl methyl phosphonofluoridate and Hexane

##### Trade Name and Synonyms:

GD in solvent

CASARM GD

RDTE Dilute GD

Chemical Family: Mixture of a fluorinated organophosphorus compound and flammable solvent

Molecular Formula GD:  $C_7H_{16}F_2O_2P$

Molecular Formula Hexane:  $C_6H_{14}$

##### NFPA 704 Signal:

Health 1

Flammability 4

Reactivity 0

Special - 0



#### Section II - Ingredients

Ingredients/Name: GD & Hexane

Concentration: Dilute GD solutions vary in concentration from 2.0 mg of GD per milliliter of Hexane to 0.012 µg of GD per milliliter of Hexane

#### Section III - Physical Data

Appearance and Odor of GD: When pure, colorless liquid with a fruity odor. With impurities, amber or dark brown with oil of camphor odor.

NOTE: Due to low concentrations of agent in Dilute GD the remaining physical properties given are those of the Hexane, for additional GD properties refer to the best GD MSDS.

Appearance and Odor: Colorless liquid with a mild solvent type odor.

Boiling Point @ 760 mm Hg: 69° C

Vapor Pressure (mm Hg): 151 @ 25° C

Vapor Density (Air=1): 2.97

Specific Gravity ( $H_2O=1$ ): 0.66

Viscosity: 0.11 mPas @ 20° C

Molecular Weight (g/mol): 86.18

Freezing/Melting Point: -95° C

#### Section IV - Fire and Explosion Data

NOTE: GD is not known to be flammable. Information given for fire and explosion data comes from the flammable solvent, Hexane.

Flash Point: -7 °F (-22 °C)

Lower Explosive Limit: 1.1%

Upper Explosive Limit: 7.5%

Autoignition Temperature: 437 °F (225 °C)

Extinguishing Media: For small fires, use dry chemical powder, CO<sub>2</sub>, and alcohol-resistant foam. Water may be ineffective. Avoid use of extinguishing methods that will cause splashing or spreading of solvent.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires should be contained to prevent spreading to uncontrolled areas. When responding to a fire alarm in buildings or areas containing solvents, fire-fighting personnel should wear full firefighter protective clothing (hazmat resistant) during fire fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full-face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. Use water spray to cool fire-exposed containers.

NOTE: Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid GD or vapors can be fatal.

Universal fire and Explosion Hazards: Vapor may travel considerable distance to source of ignition and flash back. Container explosion may occur under fire conditions. Material is lighter than water and may be spread by the use of water.

## Section V - Health Hazard Data

### Airborne Exposure Limits (AEL):

For GD<sup>1</sup>:

Worker Population Limit (WPL) 8-hr TWA <sup>1</sup> mg/m <sup>3</sup>	STEL 15-min TWA <sup>1</sup> mg/m <sup>3</sup>	IDLH <sup>1</sup> mg/m <sup>3</sup>	General Population Limit (GPL) 12-hr TWA <sup>1</sup> mg/m <sup>3</sup>
0.00003	0.00005	0.05	0.000001

<sup>1</sup> These values can be found in the DA, Office of the Assistant Secretary, Installations and Environment memo, subject: Implementation Guidance Policy for New Airborne Exposure Limits for GB, GA, GD, GP, VX, H, HD, and HT, 18 June 2004.

<sup>2</sup> To date, the Occupational Safety and Health Administration (OSHA) have not promulgated a permissible exposure concentration for GD.

<sup>3</sup> This value can be found in the DA, Office of the Surgeon General memo, subject: Nerve Agent Percutaneous Exposure Criteria and Airborne Exposure Levels (AELs) for GD/GP for use in Interim DA Guidance on Implementation of the new AELs, 22 June 2004.

For Hexane:

**Threshold Limit Value (TLV):** The TLV for hexane is 50 ppm or 180 mg/m<sup>3</sup> as an eight-hour time-weighted average (TWA).

**PEL:** 500 ppm or 1800 mg/m<sup>3</sup> TWA.

This mixture is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

The mixture should be treated as a poisonous and flammable liquid. Personnel should avoid contact with the mixture and use appropriate types/levels of protective clothing and equipment.

**NOTE:** There is presently no toxicity data for the mixture of GD and Hexane. The information provided here is taken from the most GD MSDS.

**Routes of Entry:** The primary routes of exposure for GD are inhalation and ocular exposure of vapor and liquid contact with skin. A secondary and less likely route of entry can be through ingestion.

**Effects of Exposure:** Nerve agents are readily absorbed and are hazardous through all routes of exposure. The most prominent physiological effects result from the inhibition of ChE in the central nervous system. The result produces effects including miosis, rhinorrhea, bronchoconstriction, increased gastrointestinal motility, muscle fasciculations, weakness, flaccid paralysis, difficulty in concentrating, anxiety, incoordination, restlessness, depression of the respiratory center, convulsions and death.

**Signs and Symptoms:** The onset of the signs and symptoms following exposure to nerve agents may occur within seconds, minutes, or hours, depending upon concentration, dosage, and route of entry, as well as the type and physical state of the nerve agent.

GD poses both a vapor and liquid hazard to the unprotected worker. The first noticeable effects from vapor are miosis, tight chest and/or rhinorrhea. These signs can occur in the absence of measurable ChE inhibition in the blood. Later, mild signs and symptoms of vapor exposure include conjunctival injection, pain behind the eyes,

dimness or blurred vision and excessive salivation.

Moderate signs and symptoms of vapor exposure may include mild signs and symptoms of exposure plus: increased shortness of breath, coughing, wheezing, voluminous bronchorrhea, nausea, vomiting and diarrhea.

Severe signs and symptoms of vapor exposure may include moderate signs and symptoms of exposure plus: generalized weakness or fasciculations/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea.

Effects from liquid percutaneous exposures to nerve agents are slower to develop and slower to reach their peak when compared to vapor exposures of the eyes or respiratory tract. Mild signs and symptoms of liquid nerve agent skin exposure include localized sweating at the site of exposure and fine muscle fasciculations/twitching. (NOTE: Miosis is not an early sign of liquid skin exposure. This is only true for exposures that include contact with airborne vapor with the eyes. In cases of nerve agent exposure not involving vapor contact with the eyes, miosis may be one of the last effects to occur. In such cases, the dosages of liquid exposure which produces miosis are not significantly different than lethal doses.)

**Toxicity Values:**

**Vapor (Inhalation/Ocular):**<sup>1</sup>  
EC150 (Mild) = 0.4 mg-min/m<sup>3</sup><sup>2,3</sup>  
EC150 (Severe) = 25 mg-min/m<sup>3</sup>  
LC150 = 35 mg-min/m<sup>3</sup>

**Vapor (Percutaneous):**<sup>4a</sup>  
EC150 (Threshold) = 300 mg-min/m<sup>3</sup>  
EC150 (Severe) = 2000 mg-min/m<sup>3</sup>  
LC150 = 3000 mg-min/m<sup>3</sup>

**Liquid (Percutaneous):**  
HD50 = 200 mg/70 kg man  
LD50 = 350 mg/70 kg man

<sup>1</sup> Estimates for inhalation vapor exposure are based on a minute volume (MV) of 15 liters and a 2 minute exposure. The effective dosages will increase with lower MV and decrease for a higher MV. The concentration-time profile is described by the toxic load model (C<sup>n</sup>t=k). The toxic load exponent (n) is 1.25. The dose-response curve is very steep.

<sup>2</sup> Based on recent studies estimates for this value, dosage may actually be 0.2 mg-min/m<sup>3</sup>.

<sup>3</sup> Severe effects may also include death.

<sup>4</sup> Personnel are masked.

<sup>5</sup> Values for percutaneous vapor are for moderate temperatures (85 °F and below). The effective dosages for hot temperatures (85 °F and above) will be less by at least a factor of 2.

<sup>6</sup> Threshold refers to a slight ChE inhibition.

**Emergency and First Aid Procedures for Mixture:**

**NOTE:** When seeking medical attention, inform medical personnel that this is an organophosphorus mixture.

**Emergency and First Aid Procedures for GD:**

**Vapor Exposure:** Immediately leave area of contamination. Vapor exposed nerve agent casualties should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor off gassing.

**Liquid Skin Exposure:** Leave area of contamination as quickly as possible. Remove clothing in a clean air environment and wash the skin surface and hair in warm or hot water at least three times. The rapid physical removal of a chemical agent is essential. Scrubbing of exposed skin with a stiff brush or bristles is discouraged, because skin damage may occur and may increase absorption of agent. Use liquid soap (dispose of container after use and replace), copious amounts of water and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse with copious amounts of warm or hot water. Shampoo can be used to wash the hair. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water. Two permissible alternative skin decontaminants include the M291 Skin Decontaminating Kit (SDK) and a 0.5% sodium hypochlorite solution. (NOTE: The use of the M291 SDK and/or 0.5% sodium hypochlorite on skin is appropriate in situations where soap and water may not be as efficacious in physically removing particular types of nerve agents, such as those used in certain research and development laboratories. Neither soap and water, 0.5% sodium hypochlorite or the M291 SDK have been shown to be more efficacious than the other for physically removing every type of nerve agent from the skin.) If used, the 0.5% sodium hypochlorite should be applied with mild to moderate friction, with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse to remove any residual sodium hypochlorite with copious amounts of warm or hot water.

**Eye Contact:** Immediately leave area of contamination and begin flushing eyes, mucous membranes, or open wounds with sterile saline or water. Flush the eyes immediately with sterile saline or water by tilting the head to the side, pulling the eyelids apart with gloved fingers and pouring slowly into the eyes. A Morgan lens may also be used for continuous eye irrigation. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken immediately to a medical treatment facility for observation.

**Ingestion:** Do not induce vomiting. First symptoms are likely to be gastrointestinal. Immediately administer Nerve Agent Antidote Kit, Mark I. Seek medical attention immediately. Do not handle vomited material to avoid further contamination.

**Inhalation:** If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention immediately.

**Nerve Emergency Treatment:** An individual who has received a known nerve agent exposure and has progressive signs and symptoms of nerve agent exposure may receive up to three sets of the Nerve Agent Antidote Kit (Mark I). Injections may be administered at 5 to 20 minute intervals; no more than three (3) injector sets will be given unless directed by medical personnel. If severe signs of nerve agent exposure appear (signs and symptoms of moderate exposure, plus generalized weakness or fasciculation/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea), immediately administer, in rapid succession, all three sets of the Mark I. In addition, a record will be maintained of all injections given.

#### **Health Hazard Data for Hexane:**

**Target organ(s):** Central nervous system, eyes, skin, respiratory system, and peripheral nervous system

#### **Effects of Exposure:**

**Inhalation:** Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.

**Ingestion:** May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.

**Skin Contact:** May cause redness, irritation, with dryness, cracking.

**Eye Contact:** Vapors may cause irritation. Splashes may cause redness and pain.

**Chronic Exposure:** Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

**Aggravation of Pre-existing Conditions:** Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

#### **Emergency and First Aid Procedures:**

**Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:** Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Contact:** Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

### **Section VI - Reactivity Data**

**Stability:** The mixture has been found to be stable in sealed containers for up to 12 months at or below 4° C. Use of the mixture and storage above 4° C will hasten the degradation of the GD within the mixture.

#### **Reactivity Data for GD:**

**Decomposition Temperature:** Stabilized GD decomposes in 200 hours at 130 °C. Unstabilized GD decomposes in 4 hours at 130 °C.

**Rate of Hydrolysis:** Varies with pH. At 25 °C,  $t_{1/2} = 3 \text{ hr @ pH } 2$ ,  $t_{1/2} = 45 \text{ hr @ pH } 6.65$ ,  $t_{1/2} > 60 \text{ hr @ pH } 10$ , complete hydrolysis occurs in less than 5 minutes in a 5% NaOH solution.

**Hydrolysis Products:** Pinacolyl methylphosphonic acid (PMPA) and hydrogen fluoride (HF).

**Hazardous Polymerization:** Does not occur.

#### **Reactivity Data for Hexane:**

**Incompatibility:** Strong Oxidizers

**Hazardous Polymerization:** Will not occur

**Hazardous Decomposition:** Emits toxic fumes of Carbon Monoxide, Carbon Dioxide and acid smoke.

**Conditions to avoid:** Ignition sources, excess heat and electrical spark.

### **Section VII - Spill, Leak, And Disposal Procedures**



Steps to be Taken in Case Material is Released or Spilled: Evacuate area. Wear appropriate protection equipment as specified in section (See Section VIII). Keep unprotected and unnecessary personnel from entering area. See Section V for emergency and first aid instructions.

Shut off all sources of ignition. Ventilate area of leak or spill. Use inert material to absorb spill (e.g. vermiculite, sand or earth). Decontaminate with sodium hydroxide. Scoop up all material and place in a DOT approved container. Cover the contents with sodium hydroxide. After sealing, decontaminate the exterior container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminant according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the AELs (See Sections V and VIII).

Waste Disposal Method: Open pit burning or burying of GD or items containing or contaminated with GD in any quantity is prohibited. Waste GD and associated decontamination solutions may be Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes due to a State listing of the chemical agent, or the characteristics of the waste, to include contaminants. An evaluation of the Federal and State waste disposal regulations must be conducted to determine the appropriate disposal method.

### Section VIII - Special Protection Information

The information provided here is taken from the neat GD MSDS. At the highest concentrations of Dilute GD this information applies in whole. For lower concentrations of Dilute GD, the information provided here are for guidance and the specific use of protective clothing and equipment should be based on the risk assessment approach in accordance with good safety and industrial hygiene principles.

#### Exposure Limits for Respiratory Protection for GD:

##### Unprotected Workers:

Concentration (mg/m <sup>3</sup> )	Time Limit <sup>1</sup>
Less than or equal to 0.00003 <sup>1</sup>	8 hours
Up to or less than 0.00012	2 hours <sup>2</sup>

##### Protected Workers:

Type of Respiratory Protection Worn (based on monitoring results):

##### 1. M40 Military Mask, CBRN NIOSH Approved Full Face Air Purifying Respirator

Concentration (mg/m <sup>3</sup> )	Time Limit
Not greater than 0.0015	Up to 8 hours <sup>1</sup>
Greater than 0.0015 and less than 0.002	Up to 6 hours
Greater than 0.002 and less than 0.0025	Up to 4 hours
Not greater than 0.0025	Up to 15 minutes <sup>3</sup>

##### 2. Pressure Demand Supplied Air Respirator with Full Face Respirator

#### Concentration (mg/m<sup>3</sup>)

0.00003 to 0.001<sup>1</sup>

#### Time Limit<sup>1</sup>

Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing.

#### 3. Pressure Demand Supplied Air Respirator with Full Face Respirator in combination with an Auxiliary Self-contained Breathing Apparatus (SCBA) or just SCBA

#### Concentration (mg/m<sup>3</sup>)

Greater than 0.05

#### Time Limit<sup>1</sup>

These concentrations should be expected only in emergency situations. Operations should not be conducted at these concentrations.

<sup>1</sup> As an 8-hr TWA average.

<sup>2</sup> Maximum continuous time at this concentration. Equivalent to 8-hr TWA. Source: Implementation Guidance Policy for Revised Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT, Dept of Army, Office of the Assistant Secretary of the Army Installations and Environment, 18 June 2004. See Table 3.

<sup>3</sup> Canister for M40 Mask must be changed out every 6 hours of use.

<sup>4</sup> Based on APF of 50 times the STEL (0.00005 mg/m<sup>3</sup>), which is a 15 minute TWA. Only 4 excursions to this concentration with a 60 minute interval between each one is allowed during an 8 hour workday.

<sup>5</sup> The Immediately Dangerous to Life and Health Value.

<sup>6</sup> For SCBA wearers, time limit is constrained by life of the air cylinder (maximum of 30 to 45 minutes). For Air Supply wearers, time limits should be kept to a minimum. Should use of the auxiliary SCBA be necessary, time limit will be constrained by the life of the breathing air cylinder, and egress from the area must be performed before its expiration.

Personal Respiratory Protection for Hazards: If the exposure limits are exceeded and engineering controls are not feasible use a NIOSH approved respirator.

#### Ventilation Systems:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.

Specials: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent.

Other: Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

Protective Gloves for Neat GD: Butyl Rubber Glove M3 and M4

Neelon, Chemical Protective Glove Set  
Decontaminate and change butyl rubber gloves in the event of contact with liquid Hexane since Hexane degrades butyl rubber

**Eye Protection:** At a minimum safety glasses with side shields will be worn. For splash hazards use goggles and face shield. Maintain eyewash facilities in work area.

**Other Protective Equipment:** For laboratory operations, recommend wearing impervious protective clothing including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. In the case of a spill, the minimum protective clothing should be donned after the site has been evaluated.

**Monitoring:** Available monitoring equipment for agent GD is the MB/M<sup>2</sup> detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), MB/M43, M&A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

### Section IX - Special Precautions

**Precautions To Be Taken In Handling and Storage:** When handling mixture the buddy system should be incorporated. No smoking, eating, or drinking in areas containing agents/solvents is permitted. Containers should be periodically inspected for leaks. Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, personal cleanliness facilities, and fire extinguishers must be provided. Wash hands before meals and, as appropriate, shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

**Other Precautions:** Mixture should be stored in an explosion proof refrigerator with a low temperature alarm. Keep tightly closed. Keep away from heat, sparks, and open flame. No smoking. Take precautionary measures against static discharges.

For additional information see "AR 185-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61 Toxic Chemical Agent Safety Standards," and "DA Pam 49-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX," and DA Implementation Guidance Policy for New Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT dated 18 June 2004.

### Section X - Transportation Data

**Shipping as a Flammable Liquid:**

This mixture is considered a Flammable Liquid for Dilute GD concentrations at or below 0.14 mg/ml.

**Proper Shipping Name:** Flammable Liquids, Toxic, n.o.s. (Hexane and Pinacolyl methyl phosphonofluoridate)

**UN ID Number:** UN1992

**Dot Hazard Class:** 3, o.s., Packing Group I

**Dot Label:** Flammable Liquid/Toxic

Mixture GD-Hex Page 9 of 10

**Dot Marking:** Flammable liquids, Toxic, n.o.s. (Hexane and Pinacolyl methyl phosphonofluoridate) UN1992

**Dot Placard:** Flammable and Poison if placard is required

**Shipping as a Toxic Liquid:**

This mixture is considered a Toxic Liquid for Dilute GD concentrations greater than 0.14 mg/ml and less than or equal to 2.0 mg/ml.

**Proper Shipping Name:** Toxic by inhalation liquid, flammable, n.o.s. (Hexane and Pinacolyl methyl phosphonofluoridate)

**UN ID Number:** UN3184

**Dot Hazard Class:** 6.1, 3, Packing Group I, Inhalation Hazard Zone B

**DOT Label:** Poison Inhalation Hazard or Toxic Inhalation Hazard. See 49 CFR 172.400(a)(1) for exceptions to unit packaging labeling and 173.7(b) for other exceptions when material is transported by Technical Escort Units.

**NOTE:** "Poison" and "Toxic" are used interchangeably for all markings, labels and placards in continental US transportation. "Toxic" is required for international transportation.

**Dot Marking:** Toxic by inhalation liquid, flammable, n.o.s. (Hexane and Pinacolyl methyl phosphonofluoridate) UN3184, Inhalation Hazard Zone B

**DOT Placard:** Poison Inhalation Hazard or Toxic Inhalation Hazard

**Emergency Accident Precautions and Procedures:** See Sections IV, VII and VIII

**Precautions To Be Taken In Transportation:** Motor vehicles will be placarded per DOD 4500 9-R. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Mixture GD-Hex Page 10 of 10

# Material Safety Data Sheet

## Lethal Nerve Agent (GF) in Hexane

Revised: 11 June 2007

### Section I - General Information

Manufacturer's Address:  
U S Army Edgewood Chemical Biological Center (ECBC)  
ATTN: AMSRD-ECB-CB-CR  
Aberdeen Proving Ground, MD 21010-5424  
Business Phone: 410-436-4411 or 4414, Monday through Friday during the hours of 8:00 AM to 4:10 PM EDT

CAS Registry Numbers: None known for the mixture

Chemical Name: Cyclohexyl methylphosphonofluoridate and Hexane.

Trade Name and Synonyms:  
GF in solvent  
CASARM GF  
RDTE Dilute GF

Chemical Family: Mixture of a fluorinated organophosphorus compound and flammable solvent

Molecular Formula GF:  $C_6H_{11}PF_2O_2$   
Molecular Formula Hexane:  $C_6H_{14}$

### NFPA 704 Signal:

Health: 4  
Flammability: 3  
Special: U



### Section II - Ingredients

Ingredients/Name: GF & Hexane  
Concentration: Dilute GF solutions vary in concentration from 2.0 mg of GF per milliliter of Hexane to 0.012 µg of GF per milliliter of Hexane.

### Section III - Physical Data

Appearance and Odor of GF: Colorless liquid, no odor if pure.

NOTE: Due to low concentrations of agent in Dilute GF the remaining physical properties given are those of the Hexane. For additional GF properties refer to the neat GF MSDS.

Appearance and Odor: Colorless liquid with a mild solvent type odor

Boiling Point @ 760 mm Hg: 69° C

Vapor Pressure (mm Hg): 151 @ 25° C

Vapor Density (Air=1): 2.97

Specific Gravity (H<sub>2</sub>O=1): 0.66

Viscosity: 0.31 mPas @ 20° C

Molecular Weight (g/mol): 86.18

Freezing/Melting Point: -95° C

### Section IV - Fire and Explosion Data

NOTE: GF is not known to be flammable. Information given for fire and explosion data comes from the flammable solvent, Hexane.

Flash Point: -7°F (-22°C)

Lower Explosive Limit: 1.1%

Upper Explosive Limit: 7.5%

Autoignition Temperature: 437°F (225°C)

Extinguishing Media: For small fires, use dry chemical powder, CO<sub>2</sub> and alcohol-resistant foam. Water may be ineffective. Avoid use of extinguishing methods that will cause splashing or spreading of solvent.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires should be contained to prevent spreading to uncontrolled areas. When responding to a fire alarm in buildings or areas containing solvents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during fire fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full-face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. Use water spray to cool fire-exposed containers.

NOTE: Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid GF or vapors can be fatal.

Unusual fire and Explosion Hazards: Vapor may travel considerable distance to source of ignition and flash back. Container explosion may occur under fire conditions. Material is lighter than water and may be spread by the use of water.

CWA  
Rec'd  
07/16/14

## Section V - Health Hazard Data

### Airborne Exposure Limits (AEL):

For GP<sup>1</sup>:

Worker Population Limit (WPL) 8-hr TWA <sup>1</sup> mg/m	STEL 15-min TWA mg/m	IDLH <sup>1</sup> mg/m	General Population Limit (GPL) 12-hr TWA <sup>1</sup> mg/m
0.00003	0.00003	0.05	0.000001

<sup>1</sup> These values can be found in the DA, Office of the Assistant Secretary, Installations and Environment memo, subject: Implementation Guidance Policy for New Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT, 18 June 2004

<sup>2</sup> To date, the Occupational Safety and Health Administration (OSHA) have not promulgated a permissible exposure concentration for GP

<sup>3</sup> This value can be found in the DA, Office of the Surgeon General memo, subject: Nerve Agent Percutaneous Exposure Criteria and Airborne Exposure Levels (AELs) for GD/GF for use in Interim DA Guidance on Implementation of the new AELs, 20 June 2004.

For Hexane:

Threshold Limit Value (TLV): The TLV for hexane is 50 ppm or 180 mg/m<sup>3</sup> as an eight-hour time-weighted average (TWA)

PEL: 500 ppm or 1800 mg/m<sup>3</sup> TWA

This mixture is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

The mixture should be treated as a poisonous and flammable liquid. Personnel should avoid contact with the mixture and use appropriate types/levels of protective clothing and equipment.

**NOTE:** There is presently no toxicity data for the mixture of GP and Hexane. The information provided here is taken from the neat GP MSDS.

**Routes of Entry:** The primary routes of exposure for GP are inhalation and ocular exposure of vapor and liquid contact with skin. A secondary and less likely route of entry can be through ingestion.

**Effects of Exposure:** Nerve agents are readily absorbed and are hazardous through all routes of exposure. The most prominent physiological effects result from the inhibition of ChE in the central nervous system. The result produces effects including miosis, rhinorrhea, bronchoconstriction, increased gastrointestinal motility, muscle fasciculations, weakness, flaccid paralysis, difficulty in concentrating, anxiety, insomnia, restlessness, depression of the respiratory center, convulsions and death.

**Signs and Symptoms:** The onset of the signs and symptoms following exposure to nerve agents may occur within seconds, minutes, or hours, depending upon concentration, dosage, and route of entry, as well as the type and physical state of the nerve agent.

GP poses both a vapor and liquid hazard to the unprotected worker. The first noticeable effects from vapor are miosis, tight chest and/or rhinorrhea. These signs can occur in the absence of measurable ChE inhibition in the blood. Later, mild signs and symptoms of vapor exposure include conjunctival injection, pain behind the eyes,

dimness or blurred vision and excessive salivation.

Moderate signs and symptoms of vapor exposure may include mild signs and symptoms of exposure plus increased shortness of breath, coughing, wheezing, voluminous bronchorrhea, nausea, vomiting and diarrhea.

Severe signs and symptoms of vapor exposure may include moderate signs and symptoms of exposure plus: generalized weakness or fasciculations/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea.

Effects from liquid percutaneous exposures to nerve agents are slower to develop and slower to reach their peak when compared to vapor exposures of the eyes or respiratory tract. Mild signs and symptoms of liquid nerve agent skin exposure include localized sweating at the site of exposure and fine muscle fasciculations/twitching. (NOTE: Miosis is not an early sign of liquid skin exposure. This is only true for exposures that include contact with airborne vapor with the eyes. In cases of nerve agent exposure not involving vapor contact with the eyes, miosis may be one of the last effects to occur. In such cases, the dosages of liquid exposure which produces miosis are not significantly different than lethal doses.)

Moderate signs and symptoms include nausea, vomiting, diarrhea, headache, and feeling of general weakness.

Severe signs and symptoms include generalized fasciculations and twitching, respiratory secretions, unconsciousness, convulsions, flaccid muscle paralysis, apnea and respiratory failure.

### Toxicity Values:

#### Vapor (Inhalation/Ocular)<sup>1</sup>

EC50 (Mild) = 0.4 mg-min/m<sup>3</sup>  
EC150 (Severe) = 25 mg-min/m<sup>3</sup>  
LC150 = 35 mg-min/m<sup>3</sup>

#### Vapor (Percutaneous)<sup>1d</sup>

EC150 (Threshold) = 300 mg-min/m<sup>2</sup>  
EC150 (Severe) = 2000 mg-min/m<sup>2</sup>  
LC150 = 3000 mg-min/m<sup>2</sup>

#### Liquid (Percutaneous)

ED50 = 200 mg/70 kg man  
LD50 = 350 mg/70 kg man

<sup>1</sup> Estimates for inhalation vapor exposure are based on a minute volume (MV) of 15 liters and a 2 minute exposure. The effective dosages will increase with lower MV and decrease for a higher MV. The concentration-time profile is described by the toxic load model (C<sup>n</sup>t=k). The toxic load exponent (n) is 1.25. The dose-response curve is very steep.

<sup>2</sup> Severe effects may also include death.

<sup>3</sup> Personnel are masked.

<sup>4</sup> Values for percutaneous vapor are for moderate temperatures (15 °F and below). The effective dosages for hot temperatures (85 °F and above) will be less by at least a factor of 2.

<sup>5</sup> Threshold refers to a slight ChE inhibition.

### Emergency and First Aid Procedures for Mixture:

**NOTE:** When seeking medical attention, inform medical personnel that this is a fluorinated organophosphorus mixture.

### Emergency and First Aid Procedures for GP:

**Vapor Exposure:** Immediately leave area of contamination. Vapor exposed nerve agent casualties should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor off gassing.

**Liquid Skin Exposure:** Leave area of contamination as quickly as possible. Remove clothing in a clean air environment and wash the skin surface and hair in warm or hot water at least three times. The rapid physical removal of a chemical agent is essential. Scrubbing of exposed skin with a stiff brush or bristles is discouraged, because skin damage may occur and may increase absorption of agent. Use liquid soap (dispose of container after use and replace), copious amounts of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse with copious amounts of warm or hot water. Shampoo can be used to wash the hair. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water. Two permissible alternative skin decontaminants include the M291 Skin Decontaminating Kit (SDK) and a 0.5% sodium hypochlorite solution (NOTE: The use of the M291 SDK and/or 0.5% sodium hypochlorite on skin is appropriate in situations where soap and water may not be as efficacious in physically removing particular types of nerve agents such as those used in certain research and development laboratories. Neither soap and water, 0.5% sodium hypochlorite or the M291 SDK have been shown to be more efficacious than the other for physically removing every type of nerve agent from the skin.) If used, the 0.5% sodium hypochlorite should be applied with mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse to remove any residual sodium hypochlorite with copious amounts of warm or hot water.

**Eye Contact:** Immediately leave area of contamination and begin flushing eyes, mucous membranes, or open wounds with sterile saline or water. Flush the eyes immediately with sterile saline or water by tilting the head to the side, pulling the eyelids apart with gloved fingers and pouring slowly into the eyes. A Morgan lens may also be used for continuous eye irrigation. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an insertion will not be administered when miosis is the only sign present. Instead, the individual will be taken immediately to a medical treatment facility for observation.

**Ingestion:** Do not induce vomiting. First symptoms are likely to be gastrointestinal. Immediately administer Nerve Agent Antidote Kit, Mark I. Seek medical attention immediately. Do not handle vomited material to avoid further contamination.

**Inhalation:** If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention immediately.

**Nerve Emergency Treatment:** An individual who has received a known nerve agent exposure and has progressive signs and symptoms of nerve agent exposure may receive up to three sets of the Nerve Agent Antidote Kit (Mark I). Injections may be administered at 5 to 20 minute intervals, no more than three (3) injector sets will be given unless directed by medical personnel. If severe signs of nerve agent exposure appear (signs and symptoms of moderate exposure, plus generalized weakness or fasciculation/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea), immediately administer, in rapid succession, all three sets of the Mark I. In addition, a record will be maintained of all injections given.

#### **Health Hazard Data for Hexame:**

**Target organ(s):** Central nervous system, eyes, skin, respiratory system, and peripheral nervous system

#### **Effects of Exposure:**

**Inhalation:** Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities,

unconsciousness and death.

**Ingestion:** May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.

**Skin Contact:** May cause redness, irritation, with dryness, cracking.

**Eye Contact:** Vapors may cause irritation. Splashes may cause redness and pain.

**Chronic Exposure:** Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

**Aggravation of Pre-existing Conditions:** Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

#### **Emergency and First Aid Procedures:**

**Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:** Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Contact:** Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

## **Section VI - Reactivity Data**

**Stability:** The mixture has been found to be stable in sealed containers for up to 12 months at or below 4° C. Use of the mixture and storage above 4° C will hasten the degradation of the GF within the mixture.

#### **Reactivity Data for GF:**

**Decomposition Temperature:** Completely decomposes within 2 hr @ 150°C.

**Rate of Hydrolysis:**  $t_{1/2} \sim 42$  hr @ 25°C in distilled water.

**Hydrolysis Products:** Hydrogen fluoride (HF) and cyclohexyl methylphosphonic acid.

**Hazardous Polymerization:** Data not available.

#### **Reactivity Data for Hexame:**

**Incompatibility:** Strong Oxidizers

**Hazardous Polymerization:** Will not occur.

**Hazardous Decomposition:** Emits toxic fumes of Carbon Monoxide, Carbon Dioxide and acrid smoke.

**Conditions to avoid:** Ignition sources, excess heat and electrical spark.

## Section VII - Spill, Leak, And Disposal Procedures

**Steps to be Taken in Case Material is Released or Spilled:** Evacuate area. Wear appropriate protection equipment as specified in section (See Section VIII). Keep unprotected and unnecessary personnel from entering area. See Section V for emergency and first aid instructions.

Shut off all sources of ignition. Ventilate area of leak or spill. Use inert material to absorb spill (e.g. vermiculite, sand or earth). Decontaminate with sodium hydroxide. Scoop up all material and place in a DOT approved container. Cover the contents with sodium hydroxide. After sealing, decontaminate the exterior container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminants according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the AELs (See Sections V and VIII).

**Waste Disposal Method:** Open pit burning or burying of GF or items containing or contaminated with GF in any quantity is prohibited. Waste GF and associated decontamination solutions may be Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes due to a State listing of the chemical agent, or the characteristics of the waste, to include contaminants. An evaluation of the Federal and State waste disposal regulations must be conducted to determine the appropriate disposal method.

## Section VIII - Special Protection Information

The information provided here is taken from the most recent GF MSDS. At the highest concentrations of Dilute GF this information applies in whole. For lower concentrations of Dilute GF, the information provided here is for guidance and the specific use of protective clothing and equipment should be based on the risk assessment approach in accordance with good safety and industrial hygiene principles.

### Exposure Limits for Respiratory Protection for GF:

#### Unprotected Workers:

Concentration (mg/m <sup>3</sup> )	Time Limits
Less than or equal to 0.00003 <sup>1</sup>	8 hours
Up to or less than 0.00012	2 hours <sup>2</sup>

#### Protected Workers:

Type of Respiratory Protection Worn (based on monitoring results):

1 M40 Military Mask, CBRN NIOSH Approved Full Face Air Purifying Respirator

Concentration (mg/m <sup>3</sup> )	Time Limits
Not greater than 0.0015	Up to 8 hours <sup>1</sup>
Greater than 0.0015 and less than 0.002	Up to 6 hours
Greater than 0.002 and less than 0.0025	Up to 4 hours

Mixture GF-Hex Page 7 of 10

Not greater than 0.0025

Up to 15 minutes<sup>4</sup>

2 Pressure Demand Supplied Air Respirator with Full Face Respirator

Concentration (mg/m<sup>3</sup>)

0.00003 to 0.05<sup>3</sup>

Time Limits<sup>4</sup>

Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing.

3 Pressure Demand Supplied Air Respirator with Full Face Respirator in combination with an Auxiliary Self-contained Breathing Apparatus (SCBA) or just SCBA

Concentration (mg/m<sup>3</sup>)

Greater than 0.05

Time Limits<sup>5</sup>

These concentrations should be expected only in emergency situations. Operations should not be conducted at these concentrations.

<sup>1</sup> As an 8-hr TWA average

<sup>2</sup> Maximum continuous time at this concentration. Equivalent to 8-hr TWA. Source: Implementation Guidance Policy for Revised Airborne Exposure Limits for GB, GA, GD, GP, VX, H, HD, and HT, Dept of Army, Office of the Assistant Secretary of the Army Installations and Environment, 18 June 2004. See Table 3.

<sup>3</sup> Canister for M40 Mask must be changed out every 6 hours of use.

<sup>4</sup> Based on APF of 50 times the STEL (0.00005 mg/m<sup>3</sup>), which is a 15 minute TWA. Only 4 excursions to this concentration with a 60 minute interval between each one is allowed during an 8 hour workday.

<sup>5</sup> The Immediately Dangerous to Life and Health Value.

<sup>6</sup> For SCBA wearers, time limit is constrained by life of the air cylinder (maximum of 30 to 45 minutes). For Air Supply wearers, time limits should be kept to a minimum. Should use of the auxiliary SCBA be necessary, time limit will be constrained by the life of the breathing air cylinder, and egress from the area must be performed before its expiration.

**Personal Respiratory Protection for Hexane:** If the exposure limits are exceeded and engineering controls are not feasible use a NIOSH approved respirator.

#### Ventilation Systems:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.

**Special:** Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm). +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent.

**Other:** Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20

Mixture GF-Hex Page 8 of 10

centimeters inside hood face

**Protective Gloves for Neat GF:** Butyl Rubber Glove M1 and M4  
Norton, Chemical Protective Glove Set

Decontaminate and change butyl rubber gloves in the event of contact with liquid Hexane since Hexane degrades butyl rubber

**Eye Protection:** At a minimum safety glasses with side shields will be worn. For splash hazards use goggles and face shield. Maintain eyewash facilities in work area

**Other Protective Equipment:** For laboratory operations, recommend wearing impervious protective clothing including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. In the case of a spill, the minimum protective clothing should be donned after the site has been evaluated

**Monitoring:** Available monitoring equipment for agent GF is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (D/CAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP)

### Section IX - Special Precautions

**Precautions To Be Taken In Handling and Storing:** When handling mixture the buddy system should be incorporated. No smoking, eating, or drinking in areas containing agents/solvents is permitted. Containers should be periodically inspected for leaks. Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, personal cleanliness facilities, and fire extinguishers must be provided. Wash hands before meals and, as appropriate, shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday

**Other Precautions:** Mixture should be stored in an explosion proof refrigerator with a low temperature alarm. Keep tightly closed. Keep away from heat, sparks and open flame. No smoking. Take precautionary measures against static discharges

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX", and DA Implementation Guidance Policy for New Airborne Exposures Limits for GB, GA, GD, GF, VX, H, HD, and HT dated 18 June 2004.

### Section X - Transportation Data

**Shipping as a Flammable Liquid:**

This mixture is considered a Flammable Liquid for Dilute GF concentrations at or below 0.14 mg/ml

**Proper Shipping Name:** Flammable Liquids, Toxic, n.o.s. (Hexane and Cyclohexyl methylphosphonofluoridate)

**UN ID Number:** UN1992

**Dot Hazard Class:** 3, 6.1, Packing Group I

Mixture GF-Hex Page 9 of 10

**Dot Label:** Flammable Liquid-Toxic

**Dot Marking:** Flammable liquids, Toxic, n.o.s. (Hexane and Cyclohexyl methylphosphonofluoridate) UN1992

**Dot Placard:** Flammable and Poison if placard is required

**Shipping as a Toxic Liquid:**

This mixture is considered a Toxic Liquid for Dilute GF concentrations greater than 0.14 mg/ml and less than or equal to 2.0 mg/ml

**Proper Shipping Name:** Toxic by inhalation liquid, flammable, n.o.s. (Hexane and Cyclohexyl methylphosphonofluoridate)

**UN ID Number:** UN3384

**Dot Hazard Class:** 6.1, 3, Packing Group I, Inhalation Hazard Zone B

**DOT Label:** Poison Inhalation Hazard or Toxic Inhalation Hazard. See 49 CFR 172.400(a)(3) for exceptions to unit packaging labeling and 173.7(b) for other exceptions when material is transported by Technical Escort Units.

**NOTE:** "Poison" and "Toxic" are used interchangeably for all markings, labels and placards in continental US transportation. "Toxic" is required for international transportation

**Dot Marking:** Toxic by inhalation liquid, flammable, n.o.s. (Hexane and Cyclohexyl methylphosphonofluoridate) UN3384, Inhalation Hazard Zone B

**DOT Placard:** Poison Inhalation Hazard or Toxic Inhalation Hazard

**Emergency Accident Precautions and Procedures:** See Sections IV, VII and VIII

**Precautions To Be Taken In Transportation:** Motor vehicles will be placarded per DOD 4500.9-R. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Mixture GF-Hex Page 10 of 10

# Material Safety Data Sheet

## Mixture Distilled Mustard (HD) in Hexane

Revised: 11 June 2007

### Section I - General Information

#### Manufacturer's Address:

U.S. Army Edgewood Chemical Biological Center (ECBC)

ATTN: AMSRD-ECB-CB-CR

Aberdeen Proving Ground, MD 21010-5424

Business Phone: 410-436-4411 or 4414, Monday through Friday during the hours of 8:00 AM to 4:10 PM EDT

CAS Registry Numbers: None known for the mixture

Chemical Name: Bis-(2-chloroethyl) sulfide and Hexane

#### Trade name and synonyms:

HD in solvent

CASARM HD

RDTE Dilute HD

Chemical Family: Mixture of a chlorinated sulfur compound and flammable solvent

Molecular Formula HD:  $C_4H_8Cl_2S$

Molecular Formula Hexane:  $C_6H_{14}$

#### NIHA 704 Signal:

Health 4

Flammability 1

Special - 0



### Section II - Ingredients

Ingredients/Name: Distilled Mustard & Hexane

Concentration: Dilute HD solutions vary in concentration from 10.0 mg of HD per milliliter of Hexane to 0.140 mg of HD per milliliter of Hexane

### Section III - Physical Data

Appearance and Odor of HD: Pale yellow to dark brown oily liquid; colorless when pure. Garlic-like or horseradish odor.

NOTE: Due to low concentrations of agent in Dilute HD the remaining physical properties given are those of the Hexane, for additional HD properties refer to the neat HD MSDS

Appearance and Odor: Colorless liquid with a mild solvent type odor.

Boiling Point @ 760 mm Hg: 69° C

Vapor Pressure (mm Hg): (5) @ 25° C

Vapor Density (Air=1): 2.97

Specific Gravity (H<sub>2</sub>O=1): 0.66

Viscosity: 0.31 mPas @ 20° C

Molecular Weight (g/mol): 86.18

Freezing/Melting Point: -95° C

### Section IV - Fire and Explosion Data

NOTE: Distilled Mustard is not known to be flammable. Information given for fire and explosion data comes from the flammable solvent, Hexane

Flash Point: -7 °F (-22 °C)

Lower Explosive Limit: 1.1%

Upper Explosive Limit: 7.5%

Autoignition Temperature: 437 °F (225 °C)

Extinguishing Media: For small fires, use dry chemical powder, CO<sub>2</sub> and alcohol-resistant foam. Water may be ineffective. Avoid use of extinguishing methods that will cause splashing or spreading of solvent.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires should be contained to prevent spreading to uncontrolled areas. When responding to a fire alarm in buildings or areas containing solvents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during fire fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full-face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. Use water spray to cool fire-exposed containers.

NOTE: Do not breathe fumes. Skin contact with mustard must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid HD or vapors can be fatal.

Unusual fire and Explosion Hazards: Vapor may travel considerable distance to source of ignition and flash back. Container explosion may occur under fire conditions. Material is lighter than water and may be spread by the use of water.

Cur  
Rec'd  
07/16/14



## Section V - Health Hazard Data

### Airborne Exposure Limits (AEL):

#### AEL for HD<sup>1</sup>:

Worker Population Limit (WPL) 8-hr TWA <sup>1</sup>	STEL 15-min TWA <sup>1</sup>	IDLH <sup>1</sup>	General Population Limit (GPL) 12-hr TWA <sup>1</sup>
mg/m	mg/m	mg/m	mg/m
0.0004	0.001	0.7	0.00002

<sup>1</sup> These values can be found in the DA, Office of the Assistant Secretary, Installations and Environment memo, subject: Implementation Guidance Policy for New Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT, 18 June 2004.

<sup>2</sup> To date, the Occupational Safety and Health Administration (OSHA) have not promulgated a permissible exposure concentration for HD.

#### AEL for Hexame:

**Threshold Limit Value (TLV):** The TLV for hexame is 50 ppm or 140 mg/m<sup>3</sup> as an eight-hour time-weighted average (TWA).

**PEL:** 500 ppm or 1800 mg/m<sup>3</sup> TWA

This mixture can contain greater than 0.1 percent of a known International Agency for Research on Cancer (IARC) listed carcinogen, HD. Therefore the entire mixture should be treated as a carcinogen. HD has also been shown to be mutagenic in animals.

The mixture should be treated as a poisonous and flammable liquid. Personnel should avoid contact with the mixture and use appropriate types/levels of protective clothing and equipment.

**NOTE:** There is presently no toxicity data for the mixture of HD and Hexame. The information provided here is taken from the neat HD MSDS.

#### Health Hazard Data for HD:

**Routes of Entry:** The routes of entry for mustard agents are inhalation and ingestion, as well as eye and skin contact.

**Effects Of Exposure:** HD is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues, which are especially sensitive. The rate of detoxification of HD in the body is very slow and repeated exposures produce a cumulative effect.

**Signs and Symptoms:** The acute signs and symptoms following mustard exposure are not immediate; they are delayed in appearance. The duration of the latent period and the degree of injury are both dependent on the severity of exposure as well as organs affected. The delay of onset is dose-dependent and may range from hours to days. The latency period for ocular (eye) effects is shorter than that for other tissues.

Mild eye exposure symptoms to mustard include inflammation, conjunctivitis possibly with lacrimation, grittiness in the eye, and erythema (reddening) of the lids and conjunctiva. Severe symptoms include photophobia, blepharospasm, pain, corneal erosion, edema, conjunctival vascularization, ulceration and corneal opacification

(blindness)

Skin exposure to mustard vapor is marked by delayed appearance. Mild symptoms include erythema, edema, itching, burning and pain. Severe symptoms include vesication or blisters. Liquid mustard exposure on skin may result in an area of gray-white necrotic skin surrounded by erythema and vesication.

Inhalation of mustard vapor causes damage primarily to the nasopharyngeal, laryngeal and tracheobronchial mucosa. Respiratory symptoms to mustard vapor vary in degree of onset and intensity related to the degree of exposure. Mild symptoms to the airway include hoarseness, inflammation of the respiratory mucosa, congestion, coughing and edema. Severe symptoms include necrosis, sloughing of the mucosa and chemical pneumonitis. Repeated exposures or prolonged inhalation can cause bronchiectasis or chronic bronchitis.

Gastrointestinal symptoms of intense mustard exposure include nausea and vomiting.

Like other alkylating agents, systemic absorption results in injury to the bone marrow, lymph nodes, and spleen producing leukopenia and thrombocytopenia. Other systemic effects include: fever, CNS depression, bradycardia or cardiac irregularities; hemocoagulation; and shock.

**Chronic Exposure:** Chronic mustard-induced illnesses are most common in the eyes, skin, respiratory track or bone marrow. Delayed, recurrent keratoconjunctivitis of the eyes has been documented in some cases as long as 45 years from original exposure. Healing of mustard blisters may result in skin exfoliation and areas of hypo- or hyperpigmentation. Exposure can cause chronic lung impairment (productive cough, shortness of breath, chest pain, frequent pulmonary infections and bronchitis). Prolonged human exposure has been associated with cancer of the tongue, paranasal sinus, larynx, bronchus, lung, and mediastinum (cavity between the right and left lung). Tumors observed have been of squamous (scale like) or undifferentiated (altered) cell types. Consider the possibility of skin cancer because of the frequency of this lesion in animal studies. Since sulfur mustard agent is similar in its effects to nitrogen mustard, which has been associated with human leukemia, this disease might also be expected to occur in humans chronically exposed to mustard.

#### Toxicity Values:

**Vapor (Inhalation/Oral):**<sup>1</sup>  
 EC150 (Mild) = 25 mg-min/m<sup>3</sup>  
 EC150 (Severe)<sup>2</sup> = 100 mg-min/m<sup>3</sup> (\*)  
 LC50 = 1000 mg-min/m<sup>3</sup>

**Vapor (Percutaneous):**<sup>3,4</sup>  
 EC150 (Mild) = 50 mg-min/m<sup>2</sup>  
 EC150 (Severe)<sup>2</sup> = 500 mg-min/m<sup>2</sup>  
 LC50 = 10000 mg-min/m<sup>2</sup>

**Liquid (Percutaneous)**  
 ED50 = 600 mg/70 kg man  
 LD50 = 1400 mg/70 kg man

<sup>1</sup> Estimates for inhalation vapor exposure are based on a minute volume (MV) of 15 liters. The exposure time is 2 minutes. The concentration-time profile for lethality is described by the toxic load model (C<sup>n</sup>t=k). The toxic load exponent (n) for lethality is 1.5.

<sup>2</sup> Based on ocular (eye) effects.

<sup>3</sup> Recent analysis of archival human data has indicated that this value may be 75 mg-min/m<sup>2</sup>.

<sup>4</sup> Personnel are masked.

<sup>5</sup> Values for percutaneous vapor are for moderate temperatures (85 °F and below). The effective dosages for hot temperatures (85 °F and above) will be less by at least a factor of 2.

#### **Emergency and First Aid Procedures for HD:**

**Vapor Exposure:** Immediately leave area of contamination. Vapor-exposed mustard agent casualties should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor off-gassing.

**Liquid Exposure:** Immediately leave area of contamination. Wash the skin surface and hair in warm or hot water at least three times. The rapid physical removal of a chemical agent is essential. Scrubbing of exposed skin with a stiff brush or brushes is discouraged because skin damage may occur and may increase absorption of agent. Use liquid soap (dispose of container after use and replace), copious amounts of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse with copious amounts of warm or hot water. Shampoo can be used to wash the hair. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water. Two permissible alternative skin decontaminants include the M291 Skin Decontaminating Kit (SDK) and a 0.5% sodium hypochlorite solution (NOTE: The use of the M291 SDK and/or 0.5% sodium hypochlorite on skin is appropriate in situations where soap and water may not be as efficacious in physically removing particular types of mustard agents, such as those used in certain research and development laboratories. Neither soap and water, 0.5% sodium hypochlorite or the M291 SDK have been shown to be more efficacious than the other for physically removing every type of mustard agent from the skin.) If used, the 0.5% sodium hypochlorite should be applied with mild to moderate friction, with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse to remove any residual sodium hypochlorite with copious amounts of warm or hot water.

**Eye Contact:** Immediately leave area of contamination and begin flushing eyes, mucous membranes, or open wounds with sterile saline or water. Flush the eyes immediately with sterile saline or water by tilting the head to the side, pulling the eyelids apart with gloved fingers and prunning slowly into the eyes. A Morgan lens may also be used for continuous eye irrigation.

**Ingestion:** Do not induce vomiting. First symptoms are likely to be gastrointestinal. Seek medical attention immediately. Do not handle vomited material to avoid further contamination.

**Inhalation:** If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention immediately.

#### **Health Hazard Data for Hexane:**

**Target organ(s):** Central nervous system, eyes, skin, respiratory system, and peripheral nervous system.

#### **Effects of Exposure:**

**Inhalation:** Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.

**Ingestion:** May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.

**Skin Contact:** May cause redness, irritation, with dryness, cracking.

**Eye Contact:** Vapors may cause irritation. Splashes may cause redness and pain.

**Chronic Exposure:** Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

**Aggravation of Pre-existing Conditions:** Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

#### **Emergency and First Aid Procedures:**

**Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:** Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Contact:** Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

## **Section VI - Reactivity Data**

**Stability:** The mixture has been found to be stable in sealed containers for up to 12 months at or below 4° C. Use of the mixture and storage above 4° C will hasten the degradation of the HD within the mixture.

#### **Reactivity Data for HD:**

**Decomposition Temperature:** 180 °C

**Rate of Hydrolysis:** HD on or under water undergoes hydrolysis only if dissolved. The rate of HD hydrolysis is controlled by the rate of mass transfer and is very slow.

**Hydrolysis Products:** Hydrogen chloride, thiodiglycol and sulfonium ion aggregates one of which is also very toxic.

**Hazardous Polymerization:** Does not occur.

#### **Reactivity Data for Hexane:**

**Incompatibility:** Strong Oxidizers

**Hazardous Polymerization:** Will not occur.

**Hazardous Decomposition:** Emits toxic fumes of Carbon Monoxide, Carbon Dioxide and acid smoke.

**Conditions to avoid:** Ignition sources, excess heat and electrical spark.

## **Section VII - Spill, Leak, And Disposal Procedures**

**Steps to be Taken in Case Material is Released or Spilled:** Evacuate area. Wear appropriate protection equipment as specified in section (See Section VIII). Keep unprotected and unnecessary personnel from entering area. See Section V for emergency and first aid instructions.

Shut off all sources of ignition. Ventilate area of leak or spill. Use inert material to absorb spill (e.g. vermiculite).

and/or earth). Decontaminate with copious amounts of a 5% bleach solution. Scoop up all material and place in a DOT approved container. Cover the contents with copious amounts of a 5% bleach solution. After sealing, decontaminate the exterior container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminant according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the ABLs (See Sections V and VIII).

**Waste Disposal Method:** Open pit burning or burying of HD or items containing or contaminated with HD in any quantity is prohibited. Waste HD and associated decontamination solutions may be Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes due to a State listing of the chemical agent, or the characteristics of the waste, to include contaminants. An evaluation of the Federal and State waste disposal regulations must be conducted to determine the appropriate disposal method.

## Section VIII - Special Protection Information

**NOTE:** The information provided here is taken from the neat HD MSDS. At the highest concentrations of Dilute HD this information applies in whole. For lower concentrations of Dilute HD, the information provided here are for guidance and the specific use of protective clothing and equipment should be based on the risk assessment approach in accordance with good safety and industrial hygiene principles.

### Exposure Limits for Respiratory Protection for HD:

#### Unprotected Workers:

Concentration (mg/m <sup>3</sup> )	Time Limit
Less than or equal to 0.0004 <sup>1</sup>	8 hours
Up to or less than 0.0016	2 hours <sup>2</sup>

#### Protected Workers:

Type of Respiratory Protection Worn (based on air monitoring results)

##### 1. M40 Military Mask, CBRN NIOSH Approved Full Face Air Purifying Respirator

Concentration (mg/m <sup>3</sup> )	Time Limits
≤ 0.003	Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing <sup>3</sup>

##### 2. Pressure Demand Supplied Air Respirator with Full Face Respirator

Concentration (mg/m <sup>3</sup> )	Time Limits <sup>4</sup>
0.0004 to 0.7 <sup>5</sup>	Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing

3. Pressure Demand Supplied Air Respirator with Full Face Respirator in combination with an Auxiliary Self-contained Breathing Apparatus (SCBA) or just SCBA

#### Concentration (mg/m<sup>3</sup>)

Greater than 0.7

#### Time Limits<sup>6</sup>

These concentrations should be expected only in emergency situations. Operations should not be conducted at these concentrations.

<sup>1</sup> As an 8-hr TWA average

<sup>2</sup> Maximum continuous time at this concentration. Equivalent to 8-hr TWA. Source: Implementation Guidance Policy for Revised Airborne Limits for GB, GA, GD, GF, VX, II, HD, and ITT, Dept of Army, Office of the Assistant Secretary of the Army Installations and Environment, 18 June 2004. See Table 5.

<sup>3</sup> The M40 mask may be used for escape from environments containing concentrations above the STEL. The M40 mask may be used for routine entry with real-time monitoring for the STEL and historical monitoring for the WPL. The M40 mask will not be used for routine protection above the STEL or in the absence of WPL monitoring.

<sup>4</sup> For SCBA wearers, time limit is constrained by life of the air cylinder (maximum of 30 to 45 minutes). For Air Supply wearers, time limits should be kept to a minimum. Should use of the auxiliary SCBA be necessary, time limit will be constrained by the life of the breathing air cylinder, and egress from the area must be performed before its expiration.

<sup>5</sup> The Immediately Dangerous to Life and Health Value.

**Personal Respiratory Protection for Hexane:** If the exposure limits are exceeded and engineering controls are not feasible use a NIOSH approved respirator.

#### Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.

**Special:** Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent.

**Other:** Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

#### Protective Gloves for Neat HD: Butyl Rubber Glove M3 and M4

Norton, Chemical Protective Glove Set

Decontaminate and change butyl rubber gloves in the event of contact with liquid Hexane since Hexane degrades butyl rubber.

**Eye Protection:** At a minimum safety glasses with side shields will be worn. For splash hazards use goggles and face shield. Maintain eyewash facilities in work area.

**Other Protective Equipment:** For laboratory operations, recommend wearing impervious protective clothing including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. In the case of a spill, the minimum protective clothing should be donned after the site has been evaluated.

**Monitoring:** Available monitoring equipment for agent HD is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8-M43, M9A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

### **Section IX - Special Precautions**

**Precautions To Be Taken In Handling and Storing:** When handling mixture the buddy system should be incorporated. No smoking, eating, or drinking in areas containing agents/solvents is permitted. Containers should be periodically inspected for leaks. Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, personal cleanliness facilities and fire extinguishers must be provided. Wash hands before meals and, as appropriate, shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

**Other Precautions:** Mixture should be stored in an explosion proof refrigerator with a low temperature alarm. Keep tightly closed. Keep away from heat, sparks and open flame. No smoking. Take precautionary measures against static discharges.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT," and DA Implementation Guidance Policy for New Airborne Exposures Limits for GB, GA, GD, GP, VX, H, HD, and HT dated 18 June 2004.

### **Section X - Transportation Data**

#### **Shipping as a Flammable Liquid:**

This mixture is considered a Flammable Liquid for Dilute HD concentrations at or below 2.9 mg/ml.

**Proper Shipping Name:** Flammable Liquids, Toxic n.o.s. (Hexane and Bis-(2-chloroethyl) sulfide)

**UN ID Number:** UN1992

**Dot Hazard Class:** 3, 6.1, Packing Group I

**Dot Label:** Flammable Liquid /Toxic

**Dot Marking:** Flammable Liquids, Toxic, n.o.s. (Hexane and Bis-(2-chloroethyl) sulfide) UN 1992

**Dot Placard:** Flammable and Poison if placard is required

#### **Shipping as a Toxic Liquid:**

This mixture is considered a Toxic Liquid for Dilute HD concentrations greater than 2.9 mg/ml and less than or equal to 10.0 mg/ml.

**Proper Shipping Name:** Toxic by Inhalation Liquid, flammable, n.o.s. (Hexane and Bis-(2-chloroethyl) sulfide)

**UN ID Number:** UN1184

**Dot Hazard Class:** 6.1, 3, Packing Group I, Inhalation Hazard Zone B

**DOT Label:** Poison Inhalation Hazard or Toxic Inhalation Hazard. See 49 CFR 172.400a(a)(3) for exceptions to unit packaging labeling and 172.7(b) for other exceptions when material is transported by Technical Escort Units.

**NOTE:** "Poison" and "Toxic" are used interchangeably for all markings, labels and placards in continental US transportation. "Toxic" is required for international transportation.

**Dot Marking:** Toxic by Inhalation Liquid, flammable, n.o.s. (Hexane and Bis-(2-chloroethyl) sulfide) UN 1184, Inhalation Hazard Zone B

**DOT Placard:** Poison Inhalation Hazard or Toxic Inhalation Hazard

**Emergency Accident Precautions and Procedures:** See Sections IV, VII and VIII

**Precautions To Be Taken In Transportation:** Motor vehicles will be placarded per DOD 4500.9-R. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

# Material Safety Data Sheet

## Mixture Lethal Nerve Agent (VX) in Isopropyl Alcohol

Revised: 12 June 2007

### Section I - General Information

#### Manufacturer's Address:

U.S. Army Edgewood Chemical Biological Center (ECBC)

ATTN: AMSRD-ECB-CB-CB

Aberdeen Proving Ground, MD 21010-5424

Business Phone: 410-436-4411 or 4414, Monday through Friday during the hours of 8:00 AM to 4:30 PM EDT

Chemical Name: O-ethyl-S-(2-diisopropylaminoethyl) methyl phosphonate and Isopropyl Alcohol

#### Trade name and synonyms:

VX in solvent

CASARM VX

RDTE Dilute VX

Chemical Family: Mixture of a sulfonated organophosphorus compound and flammable solvent

Molecular Formula VX:  $C_{11}H_{25}N_2O_2PS$

Molecular Formula Isopropyl Alcohol:  $C_3H_8O$

NFPA 704 Signal: Health - 4  
Flammability - 1  
Special - 0



### Section II - Ingredients

Ingredients/Name: VX & Isopropyl Alcohol

Concentration: Dilute VX concentrations vary from 1.0 mg of VX per milliliter of Isopropyl Alcohol to 0.012 µg of VX per milliliter of Isopropyl Alcohol

### Section III - Physical Data

Appearance and Odor of VX: Colorless liquid when pure Odorless when pure

NOTE: Due to low concentrations of agent in Dilute VX the remaining physical properties given are those of the Isopropyl Alcohol, for additional VX properties refer to the next VX MSDS.

Appearance and Odor: Colorless liquid with a mild rubbing alcohol odor.

Boiling Point @ 760 mm Hg: 82° C

Vapor Pressure (mm Hg): 44 @ 25° C

Vapor Density (Air=1): 2.1

Specific Gravity (H<sub>2</sub>O=1): 0.79

Viscosity: 2.27 mPas @ 20° C

Molecular Weight (g/mol): 60.1

Freezing/Melting Point: -89° C

### Section IV - Fire and Explosion Data

NOTE: VX is not known to be flammable. Information given for fire and explosion data comes from the flammable solvent, Isopropyl Alcohol

Flash Point: 54 °F (12 °C)

Lower Explosive Limit: 2.0%

Upper Explosive Limit: 12.7%

Autoignition Temperature: 750 ° F (399 °C)

Extinguishing Media: For small fires, use water spray, dry chemical powder, CO<sub>2</sub> and foam. Avoid use of extinguishing methods that will cause splashing or spreading of solvent.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires should be contained to prevent spreading to uncontrolled areas. When responding to a fire alarm in buildings or areas containing solvents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during fire fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full-face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. Use water spray to cool fire-exposed containers.

NOTE: Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid VX or vapors can be fatal.

Unusual Fire and Explosion Hazards: Vapor may travel considerable distance to source of ignition and flash back. Sensitive to static discharge.

### Section V - Health Hazard Data

Airborne Exposure Limits (AEL):

For VX<sup>1</sup>:

Mixture of VX-IPA Page 2 of 10

CWA

Rec'd  
07/16/14

Worker Population Limit (WPL) 8-hr TWA <sup>1</sup> mg/m <sup>3</sup>	STEL 15-min TWA <sup>1</sup> mg/m <sup>3</sup>	IDLH <sup>1</sup> mg/m <sup>3</sup>	General Population Limit (GPL) 12-hr TWA <sup>1</sup> mg/m <sup>3</sup>
0.000001	0.00001	0.003	0.0000006

<sup>1</sup> These values can be found in the DA, Office of the Assistant Secretary, Installations and Environment memo, subject: Implementation Guidance Policy for New Airborne Exposures Limits for GB, GA, GD, GF, VX, IT, HD, and HT, 18 June 2004.

<sup>2</sup> To date, the Occupational Safety and Health Administration (OSHA) have not promulgated a permissible exposure concentration for VX.

#### For Isopropyl Alcohol:

**Threshold Limit Value (TLV):** The TLV for Isopropyl Alcohol is 400 ppm or 980 mg/m<sup>3</sup> as an eight-hour time-weighted average (TWA)

**PEL:** 400 ppm or 980 mg/m<sup>3</sup> as a TWA

The mixture is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

The mixture should be treated as a poisonous and flammable liquid. Personnel should avoid contact with the mixture and use appropriate types/levels of protective clothing and equipment.

**NOTE:** There is presently no toxicity data for the mixture of VX and Isopropyl Alcohol. The information provided here is taken from the neat VX MSDS.

**Routes of Entry:** Primary route of entry for VX is often thought to be liquid contact with skin. Although, it is less volatile than other nerve agents, it is extremely potent and even very low concentrations of airborne vapor are extremely hazardous. Additionally, a secondary route of entry can be through ingestion.

**Effects of Exposure:** Nerve agents are readily absorbed and are hazardous through all routes of exposure. The most prominent physiological effects result from the inhibition of ChE in the central nervous system. The result produces effects including miosis, rhinorrhea, bronchoconstriction, increased gastrointestinal motility, muscle fasciculations, weakness, flaccid paralysis, difficulty in concentrating, anxiety, incontinence, restlessness, depression of the respiratory center, convulsions and death.

**Signs and Symptoms:** The onset of the signs and symptoms following exposure to nerve agents may occur within seconds, minutes, or hours, depending upon concentration, dosage, and route of entry, as well as the type and physical state of the nerve agent.

VX poses both a liquid and vapor hazard to the unprotected worker. The first noticeable vapor effects are miosis, tight chest and/or rhinorrhea. These signs can occur in the absence of measurable ChE inhibition in the blood. Later, mild signs and symptoms of vapor exposure include conjunctival injection, pain behind the eyes, dimness or blurred vision and excessive salivation.

Moderate signs and symptoms of vapor exposure may include mild signs and symptoms of exposure plus: increased shortness of breath, coughing, wheezing, voluminous bronchorrhea, nausea, vomiting and diarrhea.

Severe signs and symptoms of vapor exposure may include moderate signs and symptoms of exposure plus: generalized weakness or fasciculations/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea.

Effects from liquid percutaneous exposures to nerve agents are slower to develop and slower to reach their peak when compared to vapor exposures of the eyes or respiratory tract. Mild signs and symptoms of liquid nerve agent skin exposure include localized sweating at the site of exposure and fine muscle fasciculations/twitching. (**NOTE:** Miosis is not an early sign of liquid skin exposure. This is only true for exposures that include contact with airborne vapor with the eyes. In cases of nerve agent exposure not involving vapor contact with the eyes, miosis may be one of the last effects to occur. In such cases, the dosages of liquid exposure which produces miosis are not significantly different than lethal doses.)

#### Toxicity Values:

**Vapor (Inhalation/Oral)<sup>1</sup>**  
EC50 (Nifed) = 0.1 mg-min/m<sup>3</sup><sup>(a)</sup>  
EC50 (Severe)<sup>2</sup> = 10 mg-min/m<sup>3</sup>  
LC50 = 15 mg-min/m<sup>3</sup>

**Vapor (Percutaneous)<sup>(a)</sup>**  
EC50 (Threshold)<sup>3</sup> = 10 mg-min/m<sup>3</sup>  
EC50 (Severe)<sup>2</sup> = 25 mg-min/m<sup>3</sup>  
LC50 = 150 mg-min/m<sup>3</sup>

**Liquid (Percutaneous)**  
ED50 = 2 mg/70 kg man  
LD50 = 5 mg/70 kg man<sup>4</sup>

<sup>1</sup> Estimates for inhalation vapor exposure are based on a minute volume (MV) of 15 liters. The exposure time is 2 minutes.

<sup>2</sup> Recent data indicate that this value may be as low as 0.04 mg-min/m<sup>3</sup>.

<sup>3</sup> Severe effects may also include death.

<sup>4</sup> Personnel are masked.

<sup>5</sup> Values for percutaneous vapor are for moderate temperatures (85 °F and below). The effective dosages for hot temperatures (85 °F and above) will be less by at least a factor of 2.

<sup>6</sup> Threshold refers to a slight ChE inhibition.

<sup>7</sup> Recent modeling of the VX Data indicates that the LD50 could be as low as 2 mg/70 kg man.

#### Emergency and First Aid Procedures:

**NOTE:** When seeking medical attention, inform medical personnel that this is an organophosphorus mixture.

**Vapor Exposure:** Immediately leave area of contamination. Vapor exposed nerve agent casualties should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor off gassing.

**Liquid Skin Exposure:** Leave area of contamination as quickly as possible. Remove clothing in a clean air environment and wash the skin surface and hair in warm or hot water at least three times. The rapid physical removal of a chemical agent is essential. Scrubbing of exposed skin with a stiff brush or bristles is discouraged, because skin damage may occur and may increase absorption of agent. Use liquid soap (dispose of container after use and replace), copious amounts of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse with copious amounts of warm or hot water. Shampoo can be used to wash the hair. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water. Two permissible alternative skin decontaminants include the M291 Skin Decontaminating Kit (SDK) and a 0.5% sodium hypochlorite solution. (**NOTE:** The use of the M291 SDK and/or 0.5% sodium hypochlorite on skin is appropriate in situations where soap and water may not be as efficacious in physically removing particular types of nerve agents, such as those used in certain research and

development laboratories. Neither soap and water, 0.5% sodium hypochlorite or the M201 SDK have been shown to be more efficacious than the other for physically removing every type of nerve agent from the skin.) If used, the 0.5% sodium hypochlorite should be applied with mild to moderate friction, with a single-use sponge or washcloth in the first and second washes. The third wash should be a rinse to remove any residual sodium hypochlorite with copious amounts of warm or hot water.

**Eye Contact:** Immediately leave area of contamination and begin flushing eyes, mucous membranes, or open wounds with sterile saline or water. Flush the eyes immediately with sterile saline or water by tilting the head to the side, pulling the eyelids apart with gloved fingers and pouring slowly into the eyes. A Morgan lens may also be used for continuous eye irrigation. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken immediately to a medical treatment facility for observation.

**Ingestion:** Do not induce vomiting. First symptoms are likely to be gastrointestinal. Immediately administer Nerve Agent Antidote Kit, Mark I. Seek medical attention immediately. Do not handle vomited material to avoid further contamination.

**Inhalation:** If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention immediately.

**Nerve Emergency Treatment:** An individual who has received a known nerve agent exposure and has progressive signs and symptoms of nerve agent exposure may receive up to three sets of the Nerve Agent Antidote Kit (Mark I). Injections may be administered at 5 to 20 minute intervals, no more than three (3) injector sets will be given unless directed by medical personnel. If severe signs of agent exposure appear (signs and symptoms of moderate exposure, plus generalized weakness or fasciculation/twitching, loss of consciousness (within seconds), convulsions (within minutes), severe respiratory distress, flaccid paralysis and apnea), immediately administer, in rapid succession, all three sets of the Mark I. In addition, a record will be maintained of all injections given.

#### Health Hazard Data for Isopropyl Alcohol:

**Target organ(s):** Respiratory system, central nervous system, eyes and skin

#### Effects of Exposure:

**Inhalation:** Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.

**Ingestion:** Can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result.

**Skin Contact:** May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.

**Eye Contact:** Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.

**Chronic Exposure:** Chronic effects of exposure to isopropyl alcohol have not been reported in humans, except for rare instances of eczema and skin sensitization.

**Aggravation of Pre-existing Conditions:** Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

#### Emergency and First Aid Procedures:

**Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

**Ingestion:** Aspiration hazard. Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Contact:** In case of contact, flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical aid if irritation develops and persists. Wash clothing before reuse.

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

### Section VI - Reactivity Data

**Stability:** The mixture has been found to be stable in sealed containers for up to 12 months at or below 4° C. Use of the mixture and storage above 4° C will hasten the degradation of the VX within the mixture.

#### Reactivity Data for VX:

**Decomposition Temperature:**  $t_{1/2}$  = 502 days @ 71° C;  $t_{1/2}$  = 41 days @ 100° C;  $t_{1/2}$  = 34.5 hr @ 150° C;  $t_{1/2}$  = 10 hr @ 170° C;  $t_{1/2}$  = 1.6 hr @ 200° C;  $t_{1/2}$  = 4 min @ 250° C;  $t_{1/2}$  = 36 sec @ 295° C.

**Rate of Hydrolysis:** Hydrolysis rate of VX varies with temperature and concentration. At 22° C  $t_{1/2}$  = 1.8 min in 1.21M NaOH;  $t_{1/2}$  = 10.8 min in 0.25M NaOH;  $t_{1/2}$  = 31 min in 0.10M NaOH;  $t_{1/2}$  = 3.1 hr in 0.01M NaOH and  $t_{1/2}$  = 60 hr in pure water.

**Hydrolysis Products:** VX hydrolyzes via three different pathways (P-S, P-O and C-S), which vary significantly with temperature and pH. At pH below 12, the P-O bond cleavage path produces ethyl methylphosphonate (EMPA) and the toxic S-[2-diisopropylaminoethyl] methylphosphonothiolate ion (BA 2192). At room temperature BA 2192 reacts slowly with OH<sup>-</sup> [EA 2192,  $t_{1/2}$  = 7.4 days in 1.0M NaOH], eventually producing less toxic products. Using an equimolar ratio of VX and water at elevated temperatures appears to reduce the persistency of EA 2192.

**Hazardous Polymerization:** Does not occur

#### Reactivity Data for Isopropyl Alcohol:

**Stability:** Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.

**Hazardous Decomposition Products:** Carbon dioxide and carbon monoxide may form when heated to decomposition.

**Hazardous Polymerization:** Will not occur

**Incompatibilities:** Heat, flame, strong oxidizers, acetaldehyde, acids, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, aluminum, oleum and perchloric acid.

**Conditions to Avoid:** Heat, flames, ignition sources and incompatibles.

### Section VII - Spill, Leak, And Disposal Procedures

**Steps to be Taken in Case Material is Released or Spilled:** Evacuate area. Wear appropriate protection equipment as specified in section (See Section VIII). Keep unprotected and unnecessary personnel from entering area. See Section V for emergency and first aid instructions.

Shut off all sources of ignition. Ventilate area of leak or spill. Use inert material to absorb spill (e.g. vermiculite, sand or earth). Decontaminate with copious amounts of a 5% bleach solution. Scoop up all material and place in a DOT approved container. Cover the contents with copious amounts of a 5% bleach solution. After sealing, decontaminate the exterior container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminants according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the AEIs (See Sections V and VIII).

**Waste Disposal Method:** Open pit burning or burying of VX or items containing or contaminated with VX in any quantity is prohibited. Waste VX and associated decontamination solutions may be Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes due to a State listing of the chemical agent, or the characteristics of the waste, to include contaminants. An evaluation of the Federal and State waste disposal regulations must be conducted to determine the appropriate disposal method.

## Section VIII - Special Protection Information

The information provided here is taken from the new VX MSDS. At the highest concentrations of Dilute VX this information applies in whole. For lower concentrations of Dilute VX, the information provided here is for guidance and the specific use of protective clothing and equipment should be based on the risk assessment approach in accordance with good safety and industrial hygiene principles.

### Exposure Limits for Respiratory Protection for VX:

#### Unprotected Workers:

Concentration (mg/m <sup>3</sup> )	Time Limits
Less than or equal to 0.000001 <sup>1</sup>	8 hours
Up to or less than 0.000004	2 hours <sup>2</sup>

#### Protected Workers:

Type of Respiratory Protection Worn (based on monitoring results):

##### 1. M40 Military Mask, CBRN NIOSH Approved Full Face Air Purifying Respirator

Concentration (mg/m <sup>3</sup> )	Time Limits
Not greater than 0.00005	Up to 8 hours <sup>3</sup>
Greater than 0.00005 and less than 0.00007	Up to 6 hours
Greater than 0.00007 and less than 0.0001	Up to 4 hours
Greater than 0.0001 and less than 0.0002	Up to 2 hours
Not greater than 0.0005	Up to 15 minutes <sup>4</sup>

Mixture of VX-IPA Page 7 of 10

##### 2. Pressure Demand Supplied Air Respirator with Full Face Respirator

Concentration (mg/m <sup>3</sup> )	Time Limit <sup>5</sup>
0.000001 to 0.003 <sup>1</sup>	Time limit will be kept at a minimum to perform the operation, and will be dictated by the local Heat Stress Program for personal protective equipment and clothing.

##### 3. Pressure Demand Supplied Air Respirator with Full Face Respirator in combination with an Auxiliary Self-contained Breathing Apparatus (SCBA) or just SCBA

Concentration (mg/m <sup>3</sup> )	Time Limit <sup>6</sup>
Greater than 0.003	These concentrations should be expected only in emergency situations. Operations should not be conducted at these concentrations.

<sup>1</sup> As an 8-hr TWA average

<sup>2</sup> Maximum continuous time at this concentration. Equivalent to 8-hr TWA. Source: Implementation Guidance Policy for Revised Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and ITT, Dept of Army, Office of the Assistant Secretary of the Army Installations and Environment, 18 June 2004. See Table 4.

<sup>3</sup> Canister for M40 Mask must be changed out every 6 hours of use.

<sup>4</sup> Based on APF of 50 times the STEL (0.00001 mg/m<sup>3</sup>), which is a 15 minute TWA. Only one excursion to this concentration is allowed during an 8 hour workday.

<sup>5</sup> The Immediately Dangerous to Life and Health Value.

<sup>6</sup> For SCBA wearers, time limit is constrained by life of the air cylinder (maximum of 30 to 45 minutes). For Air Supply wearers, time limits should be kept to a minimum. Should use of the auxiliary SCBA be necessary, time limit will be constrained by the life of the breathing air cylinder, and egress from the area must be performed before its expiration.

**Personal Respiratory Protection for Isopropyl Alcohol:** If the exposure limits are exceeded and engineering controls are not feasible use a NIOSH approved respirator.

#### Ventilation Systems:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.

**Special:** Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent.

**Other:** Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

**Protective Gloves for Neat VX:** Butyl Rubber Glove M3 and M4  
Norton, Chemical Protective Glove Set

Mixture of VX-IPA Page 8 of 10



**Eye Protection:** At a minimum safety glasses with side shields will be worn. For splash hazards use goggles and face shield. Maintain eyewash facilities in work area.

**Other Protective Equipment:** For laboratory operations, recommend wearing impervious protective clothing including gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. In the case of a spill, the minimum protective clothing should be donned after the site has been evaluated.

**Monitoring:** Available monitoring equipment for agent VX is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demineralization Chemical Agent Concentrator (DCAC), M8/M41, M8A1/M41A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

### **Section IX - Special Precautions**

**Precautions To Be Taken In Handling and Storing:** When handling mixture the buddy system should be incorporated. No smoking, eating, or drinking in areas containing agents/solvents is permitted. Containers should be periodically inspected for leaks. Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, personal cleanliness facilities, and fire extinguishers must be provided. Wash hands before meals and, as appropriate, shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

**Other Precautions:** Mixture should be stored in an explosion proof refrigerator with a low temperature alarm. Keep tightly closed. Keep away from heat, sparks, and open flame. No smoking. Take precautionary measures against static discharges.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX"; and DA Implementation Guidance Policy for New Airborne Exposures Limits for GB, GA, GD, GF, VX, H, HD, and HT dated 18 June 2004.

### **Section X - Transportation Data**

**Proper Shipping Name:** Flammable Liquids, Toxic, n.o.s. (Isopropyl Alcohol and O-Ethyl-S-(2-ditopropylaminoethyl) methyl phosphonothiolate)

**UN ID Number:** UN1992

**Dot Hazard Class:** 3 6 1. Packing Group I

**Dot Label:** Flammable Liquid/Toxic

**Dot Marking:** Flammable Liquids, Toxic, n.o.s. (Isopropyl Alcohol and O-Ethyl-S-(2-ditopropylaminoethyl) methyl phosphonothiolate) UN1992

**Dot Placard:** Flammable and Poison if placard is required

**Emergency Accident Precautions and Procedures:** See Sections IV, VII and VIII.

**Precautions To Be Taken In Transportation:** Motor vehicles will be placarded per DOD 4500 9-R. Drivers will

Mixture of VX-IPA Page 9 of 10

be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Mixture of VX-IPA Page 10 of 10

# **PARTICIPANT FEEDBACK FORM**

**FORT MEADE CWA EXERCISE**

**AUGUST 20, 2014**

## PARTICIPANT FEEDBACK FORM

Exercise Name: ESC CWA Exercise

Exercise Date: August 20, 2014

Participant Name: \_\_\_\_\_

Title: \_\_\_\_\_

Agency: \_\_\_\_\_

Role:      ☐ Player                      ☐ Controller  
             ☐ Evaluator                      ☐ Observer

### PART I: RECOMMENDATIONS AND ACTION STEPS

1. Based on the exercise today and the tasks identified, list the top 3 issues and/or areas that need improvement.

---

---

---

---

2. Identify the action steps that should be taken to address the issues identified above. For each action step, indicate if it is a high, medium, or low priority.

---

---

---

---

3. Describe the action steps that should be taken in your area of responsibility.

---

---

---



---

**Who should be assigned responsibility for each action item?**

---



---



---



---

- 4. List the equipment, training or plans/procedures that should be reviewed, revised, or developed. Indicate the priority level for each.**

---



---



---



---

## **PART II: EXERCISE DESIGN AND CONDUCT**

### **1. What is your assessment of the exercise design and conduct?**

*Please rate, on a scale of 1 to 5, your overall assessment of the exercise relative to the statements provided below, with 1 indicating **strong disagreement** with the statement and 5 indicating **strong agreement**.*

<u><b>Assessment Factor</b></u>	<b>Rating of Satisfaction with Exercise</b>				
	<b>Strongly Disagree</b>				<b>Strongly Agree</b>
a. The exercise was well structured and organized.	1	2	3	4	5
b. The exercise scenario was plausible and realistic.	1	2	3	4	5
c. The documentation used during the exercise was a valuable tool throughout the exercise.	1	2	3	4	5
d. Participation in the exercise was appropriate for someone in my position.	1	2	3	4	5
e. The participants included the right people in terms of level and mix of disciplines.	1	2	3	4	5

**2. What changes would you make to improve this exercise?**

*Please provide any recommendations on how this exercise or future exercise could be improved or enhanced.*

---

---

---

---

---

---

---

---

---

---