



**US ARMY CHEMICAL MATERIALS AGENCY**

# **Critical Components of Risk Based RCRA Closure as Implemented at Chemical Weapons Destruction Facilities**

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# Battelle's Role in the Chemical Demilitarization Process

- Battelle is responsible for managing the air monitoring and laboratory support operations at the following Chemical Demilitarization facilities
  - Tooele Chemical Agent Disposal Facility (TOCDF)
  - Chemical Agent Munitions Destruction System (CAMDS)
  - Anniston Chemical Agent Disposal Facility (ANCDF)
  - Pueblo Chemical Agent Destruction Pilot Plant (PCAPP)
- Engineering (Process, Design, and Environmental)
  - Battelle Eastern Science and Technology Center (BESTC)
  - Battelle Columbus Operations
- Resource Conservation and Recovery Act (RCRA) Support
  - Embedded positions at client sites
  - Battelle Columbus Operations
- Chemical Agent Testing and Analytical Method Development
  - Battelle Columbus Operations
  - Hazardous Materials Research Center (HMRC)

# Demilitarization Facility Closure Basics – TOCDF and CAMDS

- The Tooele Chemical Agent Disposal Facility (TOCDF) interacts with multiple stakeholders during the closure phase
  - US Federal and State Environmental regulatory bodies – RCRA and Title V (Clean air act) implementation
  - US Army Chemical Materials Agency (CMA)
  - Deseret Chemical Depot
  - Federal safety and health boards (Centers for Disease Control and Prevention (CDC), Center for Health Promotion and Preventive Medicine)
  - Local Residents
- Stakeholder concerns must be addressed to successfully meet closure objectives
- This presentation will focus on the steps taken to assure that both CMA and State of Utah environmental regulations are met in a safe achievable manner

# Regulatory Oversight

- Chemical agent destruction and facility closure operations are governed by State of Utah Department of Environmental Quality (UT DEQ) RCRA and Title V operating permits
  - UT DEQ administers two agent specific waste codes – F999 and P999 in the classification of chemical agent derived hazardous wastes
  - Federal guidance regarding the classification of chemical agent related hazardous waste is absent: there are no published land disposal restriction (LDRs) for chemical agents
- Army guidance comes from the Toxic Chemical Agent Safety Standards (DA-PAM 385-61) document
  - Additional guidance has been provided through official Army communications
- Airborne exposure limits (AELs), recommended for implementation by the CDC and published in the Federal Register, represent the only federally mandated compliance points.

# Airborne Exposure Limits (AELs)

Table 2-1  
Airborne exposure limits

Airborne exposure limits airborne exposure limits for unprotected worker and general population					
Agent	Notes	GPL [mg/m <sup>3</sup> ]	WPL [mg/m <sup>3</sup> ]	STEL [mg/m <sup>3</sup> ]	IDLH [mg/m <sup>3</sup> ]
GA, GB	1, 2, 3, 6, 7	0.000001 (1 x 10 <sup>-6</sup> )	0.00003 (3 x 10 <sup>-5</sup> )	0.0001 (1 x 10 <sup>-4</sup> )	0.1 (1 x 10 <sup>-1</sup> )
GD, GF	1, 2, 3, 6, 7	0.000001 (1 x 10 <sup>-6</sup> )	0.00003 (3 x 10 <sup>-5</sup> )	0.00005 (5 x 10 <sup>-5</sup> )	0.05 (5 x 10 <sup>-2</sup> )
VX	1, 2, 4, 6, 7	0.0000006 (6 x 10 <sup>-7</sup> )	0.000001 (1 x 10 <sup>-6</sup> )	0.00001 (1 x 10 <sup>-5</sup> )	0.003 (3 x 10 <sup>-3</sup> )
HD, H, HT	1, 2, 5, 6, 8, 10	0.00002 (2 x 10 <sup>-5</sup> )	0.0004 (4 x 10 <sup>-4</sup> )	0.003 (3 x 10 <sup>-3</sup> )	0.7 (7 x 10 <sup>-1</sup> )
L, HL	1, 2, 5, 6, 9, 11		0.003 (3 x 10 <sup>-3</sup> )	0.003 (3 x 10 <sup>-3</sup> )	0.003 (3 x 10 <sup>-3</sup> )

Notes:

<sup>1</sup> The worker population limit (WPL) is an 8-hour time-weighted average (TWA). Exposure below the WPL is safe and not expected to produce any adverse health effect. Acute or sub-chronic exposure above the WPL is also not expected to produce any adverse health effect since the WPL is a chronic exposure limit.

<sup>2</sup> The short-term exposure limit (STEL) is a 15-minute TWA.

<sup>3</sup> For G-series nerve agent, exposure at the STEL should not be longer than 15 minutes and should not occur more than 4 times per day, and at least 60 minutes should elapse between successive exposures in this range.

<sup>4</sup> For VX nerve agent, exposure at the STEL should not be longer than 15 minutes and should not occur more than once per day.

<sup>5</sup> For sulfur mustards and lewisite, exposure at the STEL should be as short as practical (but not longer than 15 minutes) and should not occur more than once per day.

<sup>6</sup> Immediately dangerous to life or health (IDLH) is a 30-minute TWA. The 30-minute period is not meant to imply that anyone should stay in the environment any longer than necessary; in fact, every effort should be made to exit immediately.

<sup>7</sup> For nerve agents, the general population limit (GPL) is a 24-hour TWA.

<sup>8</sup> For sulfur mustards, the GPL is a 12-hour TWA.

<sup>9</sup> Since IDLH values are used solely for the purpose of establishing the concentrations at which self-contained breathing apparatus (SCBA) or supplied-air respirators are required, it is not necessary to formally establish IDLH values for L because workers will already be required to wear this level of respirator protection at concentrations much lower than what is considered IDLH for L because of concerns over carcinogenicity.

<sup>10</sup> HT is measured as HD.

<sup>11</sup> All concentrations measured as Lewisite.

From DA PAM 385-61  
Toxic Chemical Agent  
Safety Standards

## Application of Closure Requirements at CAMDS & TOCDF

- The Chemical Agent Munitions Destruction System (CAMDS) and Tooele Chemical Agent Disposal Facility (TOCDF) facilities have completed their chemical warfare material destruction missions
- Decontamination, decommissioning, and RCRA closure must be conducted safely and should be efficient
- In the absence of published LDRs, how can the operator determine the facilities are dispositioned appropriately?

Is direct quantification of all agent molecules needed if the health risk has been fully characterized ?

# Potential Agent Hazards During Closure

- There are two primary forms of agent hazard during facility demolition and disposition
  - Contact (dermal) hazards
  - Inhalation (vapor) hazards
- Protection against contact hazard is achieved through remediation of gross contamination, inspection for liquid agent sources, and workforce restrictions (access and personal protective equipment requirements) during demolition operations
- Protection against vapor hazard is achieved through measurement of residual agent vapor sources
  - Airborne exposure limits published in 2004 by the CDC provide CMA and its clients a new tool for safely screening waste and materials
  - Measure “off-gas” rates (OGR) are mitigated through forced air or natural ventilation

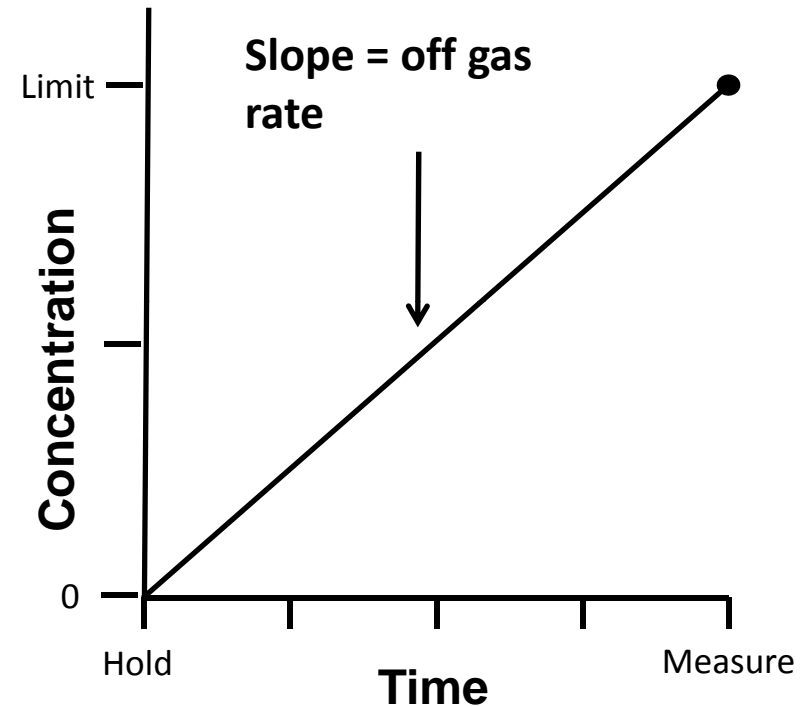
# Techniques to Ensure Safe Remediation

- Work processes eliminate liquid chemical agent in the facility
  - Gross decontamination and disassembly
  - Occluded space identification and remediation
- Air/headspace monitoring is the best tool for as-you-go checks to ensure decontamination activities are effective
  - Evaluates progress using the same measure as the final success/disposition criteria: Off-gas rate
- UMT combine hold-time, area volume, and target vapor concentration to determine an agent vapor OGR



# Off-Gas Rate Determination

- Empirical measurement of agent vapor concentration is used to determine the off-gas rate
- The formula used to determine OGR has three components – vapor concentration alone does not determine test success



$$\text{Agent OGR} \left( \frac{\text{mg}}{\text{min}} \right) = \frac{\text{Agent Concentration} \left( \frac{\text{mg}}{\text{m}^3} \right) \times \text{Unventilated Volume} (\text{m}^3)}{\text{Hold Time} (\text{min})}$$

# Unventilated Monitoring Testing (UMT)

- UMTs combine hold-time, area volume, and target vapor concentration to determine an agent vapor OGR
  - Areas to be tested are clean and effectively ready for demolition
  - Air-flow in and out of buildings is limited
  - Ventilation (heating, ventilation, and air conditioning (HVAC)) is stopped for a set period of time
  - Monitoring at the end of the hold-time to determine agent vapor concentration with 1 vapor screening limit as the target concentration
- Facility configuration drives the number and nature of UMTs
  - One UMT per building for CAMDS
  - Multiple UMTs planned within the TOCDF munitions demilitarization building

# Building preparation to limit air flow/exchanges



# Chemical Agent Vapor Detection Instrumentation

Depot Area Air Monitoring System  
(DAAMS) manifolds  
↓



Automatic Continuous Air  
Monitoring System (ACAMS) ↑

Flame photometric  
detector (FPD)  
MINICAMS®



Halogen specific  
detector (XSD)  
MINICAMS®

## Off-Gas Rate Modeling

- The OGR allows for conservative evaluation of downstream vapor exposure scenarios
- Pad emission calculations has been performed for CAMDS and TOCDF
  - Dispersion calculations use the measured OGR as a source term
  - No worker protection limit exposure to workers during demolition, general population limit levels not exceeded at depot perimeter
- Interior exposure to vapor emissions
  - OGR for each CAMDS building evaluated with regard to wind-driven ventilation for specific buildings at CAMDS
  - OGR for individuals areas within the TOCDF Munitions Demilitarization Building evaluated with regard to supplemental (forced air) ventilation

# CAMDS HVAC Isolation



# Summary

- Multiple stakeholders drive the demilitarization facility closure process
  - Different regulators/clients may have different requirements
- Airborne Exposure Limits (AELs) published in the Federal Register are used to drive the demilitarization closure process
  - Decontamination and work activities remove the potential for liquid contamination
  - Air monitoring is used as an indicator of residual hazard
- Identification of an off-gas rate (OGR) for facilities are determined using measurements and conservative assumptions
- Unventilated Monitoring Tests (UMTs) are used to determine the OGR.
- The OGR is used in various exposure modeling scenarios to ensure worker protection

Questions?