UMCD STORAGE UNIT OPERATIONS AND MANAGEMENT PLAN

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UMCD Storage Unit Operations and Management Plan

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ACRONYM LIST

Army Regulation	AR
Chemical Accident/Incident Response and Assistance	CAIRA
Chemical Materials Agency	CMA
Code of Federal Regulations	CFR
Controlled Unclassified Information	CUI
Department of Defense	DoD
Department of Defense Directive	DoDD
Depot Area Air Monitoring System	DAAMS
Environmental Protection Agency	EPA
Flame Photometric Detector	FPD
For Official Use Only	FOUO
Freedom of Information Act	FOIA
Gas Chromatograph	GC
General Population Limit	GPL
Hazardous Waste Management Unit	HWMU
High-Efficiency Particulate Air	HEPA
Immediately Dangerous to Life and Health	IDLH
Material Handling Equipment	MHE
Miniature Continuous Air Monitoring System	MINICAM
Mustard Igloo Temperature Conditioning System	MITECS
Oregon Administrative Rule	OAR
Oregon Department of Environmental Quality	DEQ
Preconcentrator tube	PCT
Quality Assurance	QA
Real-Time Analytical Platform	RTAP
Reportable Limit	RL
Resource Conservation and Recovery Act	RCRA
Science Applications International Corporation	SAIC
Secondary Steel Container	SSC
Standing Operating Procedure	SOP
Single-Round Container	SRC
Site Specific Monitoring Plan	SSMP
Storage Unit Operations and Management Plan	SUOMP
Surveillance Program, Lethal Chemical Agents and Munitions	SUPLECAM
Trinitrotoluene	TNT
Umatilla Chemical Depot	UMCD
Umatilla Chemical Agent Disposal Facility	UMCDF
Vapor Screening Level	VSL

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I. INTRODUCTION

A. Background

The Umatilla Chemical Depot (UMCD) stores bulk chemical agent and agent-containing munitions as part of the overall U.S. Army chemical munitions stockpile with oversight from the U.S. Army Chemical Materials Agency (CMA). Under the Chemical Weapons Convention ratified by the U.S. Congress in 1997, the U.S. has committed to demilitarizing its chemical stockpile. The UMCD is the third storage facility at which demilitarization activities have commenced. Originally, the UMCD stored munitions and bulk containers of the nerve agents GB and VX and bulk containers of the blister agent HD (Mustard). As of November 2008, the GB and VX munitions have been destroyed. All that remains are the HD bulk containers. The hazardous waste management units (HWMUs), called igloos, are located in I- and K-Blocks. Igloos that previously contained chemical agent munitions and bulk containers are required by federal and state law to undergo Resource Conservation and Recovery Act (RCRA) closure. The UMCD initiated RCRA closure activities beginning in 2003 with the closure of Building 659 in the K-Block. Currently, all igloos used as HWMUs in I-Block are in RCRA closure status; therefore, they no longer fall under the requirements of the SUOMP. After the K-Block closure plan is accepted by the Oregon Department of Environmental Quality (DEQ), K-Block empty igloos will also go into RCRA closure status.

B. Regulatory Requirements

The State of Oregon has been authorized by the Environmental Protection Agency (EPA) to administer the RCRA program within its borders. The administering agency for the state of Oregon is the Oregon Department of Environmental Quality (DEQ). Relevant federal regulatory requirements are contained in Title 40 Code of Federal Regulations (CFR) Parts 264 through 270. The primary storage requirements for the K-Block storage units are found in 40 CFR 264 Subpart EE (Hazardous Waste Munitions and Explosives Storage) and 266 Subpart M (Military Munitions).

On 09 March 2001, the State of Oregon Environmental Quality Commission adopted new regulations pertaining specifically to UMCD chemical agent storage. The central purpose of the new rules is to increase the level of protection for the public, chemical workers, and the environment above the preexisting federal protections outlined in the Military Munitions Rule and employed at the UMCD. The rules:

- declare all chemical agent munitions and bulk items a solid and hazardous waste;

- eliminate the options of outdoor or open storage areas for chemical agent munitions and bulk items;
- establish an interpretation of "no migration" for containment of chemical agent in the storage unit;
- define chemical agent as a hazardous waste and require reporting of a spill/release of any quantity of agent; and
- establish additional operating and design standards for the storage of chemical agent munitions and bulk items under the requirements of 40 CFR 264 Subpart EE, including an operations and management plan to be approved by DEQ.

As part of the permit application process, the UMCD is required to prepare a storage unit operations and management plan (SUOMP), per Oregon Administrative Rule (OAR) 340-104-1201(1)(a). The content and implementation of the SUOMP must be approved by the DEQ prior to issuance of a RCRA storage permit.

The purpose of the SUOMP is to document how each chemical agent munition or bulk item storage unit at UMCD will be operated and maintained to comply with the requirements of 40 CFR Subpart EE (Hazardous Waste Munitions and Explosives Storage) and OAR 340-104-1201. The SUOMP must:

- define the monitoring, management, and control measures that will be used to achieve "no migration" standard of chemical agents outside the storage unit;
- document the applicable management approaches for the chemical agent munition and/or bulk item storage units; and
- address the specific characteristics of the munitions, type of chemical agent, and storage configuration.

Per DEQ guidance, the SUOMP focuses on K-Block storage units containing military munitions and will not apply to J-Block storage units containing secondary waste or the Building 203 hazardous waste storage facility containing nonagent-contaminated wastes.

II. CHEMICAL AGENT AND MUNITION CHARACTERISTICS AFFECTING RELEASE POTENTIAL

A. Agent Descriptions

The chemical munitions and bulk items stored at the UMCD are, or were, filled with one of the two nerve agents GB (Sarin) or VX, or the blister agent HD (Mustard). The State of Oregon has designated the following waste codes specific to the chemical agents: P998 (HD) and P999 (GB, VX). Characteristics of these chemical agents are discussed below. Table II-1summarizes the physical

characteristics of the chemical agents and provides a comparison of the physical characteristics of the agents with those of water and #2 fuel oil.

The usage of the term "persistency" in this document is based on the use of chemical agents in combat, where persistency is measured in hours or days. Generally speaking, the three agents discussed herein would be considered non-persistent in the environmental vernacular, where persistency is typically measured in months or years.

1. Nerve Agents

   Nerve agents are organophosphorus compounds chemically related to pesticides, and include G and V compounds. The G agents were developed to attack through the respiratory system; the V compounds were developed to act by absorption through the skin. All nerve agents injure and kill by binding to cholinesterase, an enzyme that is essential for functioning of the nervous system.

   a. GB

      GB (Sarin) is a rapid-acting nerve agent that works by inactivating the body's cholinesterase. The primary hazard from GB is vapor absorption through the respiratory tract, although it can be absorbed through any part of the skin, eyes, or mucous membranes by contact, and the gastrointestinal tract by ingestion. When dispersed as large droplets, GB is moderately persistent; it is nonpersistent when disseminated as a cloud of very fine particles.

   b. VX

      VX is a rapid-acting nerve agent that inactivates cholinesterase. Because VX does not evaporate quickly, the primary VX hazard is liquid absorption through the skin. However, VX can be absorbed through the respiratory tract as a vapor or aerosol and through the gastrointestinal tract by ingestion. VX is generally more persistent than GB.

Table II-1 Physical Properties of Chemical Agents and Reference Materials

Physical Property	GB	VX	HD	Water	Diesel Fuel #2
Chemical Name	Sarin	Methylphosphono-thiolate	Sulfur Mustard	Hydrogen oxide	Normal Petroleum Hydrocarbon
Chemical Formula	$C_4H_{10}FO_2P$	$C_{11}H_{26}NO_2PS$	$C_4H_8Cl_2S$	H_2O	C_8H_{18} to $C_{10}H_{22}$ mixture
Molecular Weight	140.10	267.37	159.08	18	Approximately 114 to 142
Vapor Density (Air = 1 at STP)	4.83	9.2	5.5	.0000154	4.7
Specific Gravity (at 25°C)	1.0919	1.0113	1.27	1	0.87 to 0.90.
Volatility	22,000 (mg/m^3 at 25°C)	8.9 (mg/m^3 at 25°C)	600 (mg/m^3 at 20°C)	18.5 (mg/m^3 at 25°C)	Not available
Freezing Point	-56°C -69°F	-50°C -58°F	14.5°C 58.1°F	0° C 32 º F	-18° C -0.4º F
Boiling Point	158°C 316°F	298° C 568° F	217.5°C 212°F 423.5° F (decomposed)	100° C 212 º F	171° C to 360° C 288º F to 680 º F
Vapor Pressure (mm Hg at 25°C)	2.9	0.00063	0.11	23.8	1 mm Hg at 20° C
Flash Point	Does not Flash	159°C 318°F	105°C 221°F	Does not flash	>126° F > 52° C
Viscosity (centipoises at 25° C)	1.283	10	5.17	0.8904	0.294 (Hexane at 25° C)
Color	Clear	Clear to Straw	Amber to Black (can be clear if purity is high)	Clear	Clear to brown
Odor	None	None	Garlic or horseradish odor	None	Hydrocarbon
Special Properties	None	None	Permeates ordinary rubber	None	None
Solubility Properties	Miscible with water; Readily soluble in all organic solvents	Best solvents are dilute mineral acids	Completely soluble in acetone, tetrachloroethane, ethyl benzoate, and ether	N/A	Soluble in organic solvents. Low solubility in water
Physical State	Viscous Liquid	Viscous Liquid (similar to motor oil)	Viscous Liquid	Non-viscous liquid between 0° C and 100° C	Light oil at 25° C

[1]Source: Material Safety Data Sheets, issued by U. S. Army SBCCOM, Aberdeen Proving Ground, MD.
Handbook of Chemistry and Physics, 51st edition, 1970-1971, Robert C. Weast, ed., The Chemical Rubber Company, Cleveland, OH
STP = Standard temperature and pressure
°C = degrees centigrade (celsius)
°F = degrees Fahrenheit
Hg = mercury
mg = milligram
mm^3 = cubic millimeter
mm = millimeter

2. Blister Agents

Blister agents are persistent agents that act on the eyes, lungs, and skin to burn and blister the skin or any other part of the body they contact. HD (mustard) is a blister agent that causes intense inflammation and severe blistering of both skin and mucous membranes by contact with both liquid and vapor forms of the agent. HD is only moderately volatile and is a known carcinogen.

B. Agent Characteristics Affecting the Potential for Release

1. HD

HD has a moderate volatility, and consequently poses a moderate risk of vapor release. Of the health hazards posed by either a HD vapor or liquid release, the larger hazard is a liquid release. HD may persist on non-porous surfaces as liquid contamination for extended periods of time. It can also wick into porous surfaces and emit vapor over time. Personnel can transfer mustard from contaminated surfaces by direct contact. Both vapor and liquid leaks are highly improbable when temperatures are below 58ºF, the freezing point of HD.

HD's mustard-like odor is noticeable at the time of first detection, but becomes less apparent as airborne exposure persists because the agent desensitizes the olfactory nerves.

2. VX

Of the two nerve agents stored at the UMCD, VX has a lower evaporation rate, approximately 1/1,500th of that of GB, a higher viscosity, and a higher toxicity. It is also more stable than GB. For these reasons, a spill of liquid VX presents a higher hazard to health and the environment than a release of vapor. VX in the liquid form can persist for weeks or months, depending upon its exposure to water from rain or other sources. Because of its relatively higher viscosity than that of GB, it may remain concentrated in the same area, rather than disperse and become diluted.

Because of the low volatility of VX, it is difficult to recognize and isolate VX vapor leaks when they occur. VX has a high vapor density causing the agent in the vapor form to tend to sink in air. Because VX has no odor, it is difficult to detect an airborne release without the use of sophisticated sampling equipment.

3. GB

Because of the higher volatility of GB, it is easier to recognize and isolate a GB leak when it occurs than it is to recognize and isolate a VX leak. GB

persistence in the environment is typically measured in hours or days. Liquid evaporates as fast as kerosene but less readily than water. In general, it is assumed that an area exposed to liquid GB agent will decontaminate itself in a few hours or days due to the agent's volatility. Warmer temperatures and contact with water can reduce GB persistency to hours.

C. Munitions Properties and Factors Influencing Potential for Release

Each type of munition stored at UMCD has a different potential for leak development. Refer to Table II-2 or a summary of the most recent leaks detected, by munition. Most leaks have been vapor leaks; liquid leaks are small in volume and rare. HD ton containers that develop leaks will be repaired in place.

Some munition property description information is For Official Use Only (FOUO) and is located in Appendix B.

Table II-3 summarizes the leak occurrences at UMCD between 1973 and 2008 according to munition type.

Table II-2 Most Recent Leak Occurrences at the UMCD by Munition Type Between 1977 and 2008

Munition Type	Leaks	Year[1]
M55 GB Rockets	2	2004
155-mm GB Projectiles	7	2004
8-in. GB Projectiles	1	2003
MC-1, 750-lb. GB Bomb	1	2004
MK 94-0, 500-lb. GB Bomb	2	1991
GB Rocket Warheads	0	N/A
GB Ton Containers	1	2001
HD Ton Containers	2	2008
155-mm VX Projectiles	1	2001
8-in. VX Projectiles	1	1977
M23, VX Mines	8	1980
VX Spray Tanks	0	N/A
M55 VX Rockets	0	N/A
VX Rocket Warheads	0	N/A
GB Overpacks	4	2000

[1]Cut-off date for the data provided is October 1, 2008.

Table II-3 Leak Occurrences at the UMCD by Munition Type (Historic 1973- 2008)

Agent	Item	Leaks
HD	Ton Containers	38
GB	Ton Containers	5
	155mm Projectiles	76
	8-inch Projectiles	4
	M55 Rockets	248
	M56 Warhead	0
	500-lb Bombs	3
	750-lb Bombs	20
VX	Ton Containers	0
	155mm Projectiles	3
	8-inch Projectiles	1
	Mines	22
	M55 Rockets	0
	M56 Warhead	0
	Spray Tanks	0
	Overpacks	46
Total		**465**

III. STORAGE UNITS

A. K-Block and I-Block Igloos

1. Description

Details of munition storage unit design specifications are FOUO and are located in Appendix B.

The K-Block storage includes permitted units for storage of HD ton containers managed as hazardous waste in accordance with OAR 340-101-0030 and 340-104-1201; and certain agent-contaminated wastes. Since standing operating procedures (SOPs) require that leaking HD ton containers be repaired in place, there is no designated HD leaker igloo. Ton containers unable to be processed by the UMCDF because of operational constraints will be returned to K-Block. The specific igloo to be used for this purpose will be determined if the need arises.

The I-Block igloos were permitted for the storage of ton containers of HD. The ton containers were moved to K-Block in 2006. I-Block is in RCRA closure status and has no agent munitions or ton containers.

2. Containment Mechanisms

a. Liquid Containment

K-Block igloos have sloping floors and a gutter on each side of the structure. The gutters lead to floor drains and outlets to the front of the igloo. The Army has designed and installed drain plugs on all K-Block igloos storing chemical agent to prevent liquid and vapor migration outside of the igloo. The plugs have been designed to accommodate air-sampling lines, so headwall sampling can be accomplished without removing the drain plugs. Appendix A shows the drain plug design features.

b. Planned Engineering and Containment Measures

Vapor containment improvements have been installed on igloos storing chemical agent. The igloos were designed with two air vents open to the atmosphere during normal storage. The front vent is on the door and measures 4 x 27 in. (10.2 x 68.6 cm). The rear stack vent measures 24 x 24 in. (61 x 61 cm). The design allows air to enter through the vent on the door at the front of the igloo and flow through the igloo to the rear vent stack. See figure of igloo filtration units in Appendix A.

The main entrance door is sealed with neoprene gaskets. The entrance door vent is also augmented with a filter assembly containing a prefilter and two carbon filters in series. The rear stack vent is equipped with a filter unit containing a high-efficiency particulate air (HEPA) filter and two carbon filters in series. The two-bed igloo exhaust filter was originally designed to fully capture an unlikely GB liquid spill of 0.26 gal (1.0 L), or 0.13 gal (0.50 L) in each bed. A spill of this magnitude has never occurred at the UMCD. A vapor leak is the more likely event. The filter will withstand a sustained GB vapor concentration of 60 times the vapor screening level (VSL) for over a century. Thus, a 0.26 gal (1.0 L) design capacity criterion (0.13 gal [0.50 L] per bed) will provide a substantial margin of safety. For VX, the margin is even greater since the rate of evaporation of VX is orders of magnitude less than for GB. The two-bed igloo inlet filter is designed with one-fourth the capacity of the exhaust filter and functions in the manner of a check valve to capture agent during a reverse flow event. Such events are infrequent and normally of short duration.

3. Seasonal Closure of Igloo Fire Dampers

Following installation of the passive filter system, it was discovered that due to the reduced air flow there was an increase in relative humidity inside the igloos during cooler periods of the year. That led to condensation in the filter

housing and moisture buildup in the filter carbon. The "Final Assessment of Water Loading on UMCD Igloo Filters and Potential Filter Systems Upgrades, Final Report" and "Igloo Containment System, UMCD, Design Basis" were submitted to DEQ in November 2004. The studies proposed the following solutions:

a. Close the igloo front door fire damper to prevent the passage of ambient air through the front vent;

b. Close the rear fire damper to eliminate the movement of igloo air upward into the rear filter unit;

c. Install a cover over the rear filter unit discharge duct opening to prevent the migration of ambient vapor into the rear filter unit.

These measures will minimize filter unit media exposure to condensate buildup. Approval was received from DEQ and the dampers were immediately closed. Seasonal closure will occur from October 1 through April 15 in accordance with DEQ letter dated November 10, 2004, DEQ Item No. 04-1860 (1131).

The fire dampers will remain closed on empty igloos.

Note: While using MITECS, the igloo fire dampers will not need to be closed, because heating will alleviate the moisture build-up problem that was originally associated with the passive filters in the winter. Also, the dampers will need to be open in order to allow the ventilation-filter system to function.

IV. GROUPING OF STORAGE UNITS

A. Purpose

Per DEQ guidance, Section IV of the SUOMP describes in detail individual storage units or groups of storage units to which a specific set of storage containment and surveillance measures apply. Igloos emptied in the process of demilitarization have also been categorized into one of three groups, depending on the monitoring status of the igloos. In addition, a group exists to classify igloos that have been designated for consolidation and/or storage of agent-contaminated waste. Section IV:

- explains the criteria used to organize storage units in discrete groups,
- defines storage unit groups, and
- examines conditions that may result in changes to group inventories.

DEQ guidance also requires UMCD to provide a complete inventory of storage units. To maintain chemical surety principles and site security, UMCD has provided a complete munitions inventory to DEQ under separate cover. Even though the information contained in the inventory is not classified, it contains information defined within DoD Directive (DoDD) 5200.1-R (DoD Information Security Program), Army Regulation (AR) 380-5 (Department of the Army Information Security Program), AR 380-86 (Classification of Former Chemical Warfare; Chemical and Biological Defense; and Nuclear, Biological, Chemical, and Biological Contamination Survivability Information), and AR 2555 (Army Freedom of Information Act [FOIA] Program) and "Controlled Unclassified Information (CUI)" and must be controlled and protected from unauthorized release.

B. Grouping Determination Criteria

Three basic principles were used as criteria for making storage unit grouping decisions for igloos containing chemical agent munitions or bulk items. The principles provide a solid foundation for evaluating and grouping the UMCD K-Block storage units and their contents. The three principles were as follows:

1. Each storage unit group was ultimately defined by the surveillance and containment features applied to it.

   The contents of the storage units within a group may vary; however, the surveillance and containment features applied to each storage unit in that group are consistent. Groupings must be accomplished to ensure protection of the community, workers, and the environment. Because of this, a balance must be struck between too few groups and too many. If the storage units are divided into too few groups, then UMCD will be applying unnecessarily stringent surveillance to certain igloos. This results in excessive costs and burdens to UMCD operations. On the other hand, if storage units are divided into too many groups, the result is an unnecessarily complex set of operations and management regimes at UMCD, also resulting in excessive costs and operational burdens. The Army believes it has optimized the number of groups to suit the array of storage units at UMCD while minimizing the impacts to pre-existing Depot operations.

2. An individual storage unit (igloo) is the smallest allowable group element.

   The DEQ requested that the Army not create any additional risks during the implementation of the SUOMP. Although inter-unit rearrangement of munitions or bulk containers between storage units might allow for additional operation and maintenance optimization, it would also increase risk without justification; therefore, no transfer between storage units will occur as a direct result of SUOMP implementation.

Under certain circumstances, munitions or containers must be removed from storage units (e.g., leak development, or transfer to UMCDF for destruction). In these instances, UMCD will apply preexisting stringent chemical surety and safety protocols during transfer operations. When an inventory is altered within a storage unit, UMCD will re-evaluate the highest order risk within that unit and, if necessary, shift the unit to a more applicable storage unit group. Refer to "Conditions Resulting in Changes to Group Inventory" in Section IV, Subsection D below for more information.

3. The munition or bulk container type posing the highest order of risk in a storage unit determines the group in which that storage unit belongs.

   The contents of most storage units at the UMCD were segregated by agent, munition, and bulk container type. Several storage units, however, contained multiple types of munitions and/or bulk containers. For these igloos, the munition or container posing the highest order risk for vapor or liquid release (refer to Section II) in an igloo determined the group to which that igloo was assigned. See also criterion #2 above.

   Currently, only one agent bulk container group remains for HD ton containers. There is also a group for HD secondary waste and three groups for empty igloos (see paragraph IV.C below for description of the groups).

C. Storage Unit Groups

Specific operation and management regimes in K-Block are defined by munitions containment mechanisms and storage unit surveillance procedures. Containment mechanisms include storage unit design features, construction, and engineering controls applied to the structure (Section III). Surveillance includes monitoring procedures and visual inspection procedures (Section V). Refer to Table IV-1for a summary of UMCD storage unit groups.

All permitted K-Block igloo storage units actively storing HD ton containers are similarly designed, constructed, and fitted with the same engineering controls. All igloos containing agent ton containers are subjected to quarterly visual monitoring. The Army has tailored air monitoring procedures and frequencies to reflect risks associated with the inventories of specific igloo storage unit groups. The igloos are air monitored for leaking agent using the Real-Time Analytical Platform (RTAP) equipment described in paragraphV.A.1.a. Table IV-1 lists the frequency of RTAP air monitoring. There is one igloo storage unit group for HD ton containers, one for agent-contaminated wastes, and three for empty, inactive igloos.

The empty igloos are assigned their groups based on monitoring criteria. When an igloo is first emptied, it still requires headwall monitoring. As soon as it is possible, the empty igloos are air monitored for three eight-hour periods with no

detection above the reportable limit (RL – the RL is defined in paragraph V.A.1.a). The sample periods do not have to be consecutive, but the ambient air temperature must be at least 60°F. This is to demonstrate that there is no agent detected at or above the RL in the igloo. After 24 hours of monitoring with no detection above the RL, the igloos will continue to be monitored quarterly for one year.

The igloo groups are described in the text below and in Table IV-1, "Summary of UMCD Storage Unit Groups." The empty igloos, Groups C, D, and E, will be locked and sealed. Each igloo is a HWMU. Once the RCRA closure plan for K-Block is approved, the empty igloos will be managed in accordance with the closure plan. The Chemical Operations Division will have control and inventory of quality assurance (QA) seals.

Table IV-1 Summary of UMCD Storage Unit Groups

Storage Unit Group	Munitions Defining Group	RTAP Air Monitoring Frequency
Group A	Mustard Ton Containers	Weekly (Summer), Monthly (Winter) Headwall
Group B	Agent-Contaminated Wastes	Weekly (while in use)
Group C	Empty Igloos – not monitored 24 hours to the RL	Monthly Headwall
Group D	Empty Igloos – monitored for 24 hours to the RL	Quarterly Headwall (for 1 year)
Group E	Empty Igloos – monitored for 24 hours to the RL and RTAP monitored quarterly for 1 year	None

Group A – Mustard Ton Containers: HD stored in K-Block igloos is expected to remain near or below the HD freezing point of 58° (14.5°C) most of the year. Based on historical data, monthly HD monitoring during the winter months is adequate and reasonable due to the freezing temperatures. Monitoring during the summer months has been conservatively set to occur on a weekly basis when temperatures are above freezing. While the MITECS is operational in an igloo, it will monitor that igloo 24 hours a day.

Group B – High-Level Agent-Contaminated Waste or Reusable Equipment Igloos: As needed, empty igloos may be temporarily used to consolidate or store high-level agent-contaminated waste generated from storage operations or equipment used during storage operations that has a potential of being agent contaminated. The appropriate chemical agent signs will be reposted or retained. The hazardous waste signs and PCB signs will not be removed. While serving this purpose, these igloos will be monitored weekly for the appropriate agent. After the waste has been decontaminated to less than the RL, the waste is transported to the J-Block. When a Group B igloo is no longer needed for storage of agent-contamined waste, it will be redesignated as a Group C empty igloo and progress through the stages until it reaches the Group E designation.

Group C – Empty Igloos: Upon removal of the last munitions, this group will receive monthly headwall air monitoring. The hazardous waste signs and PCB signs will not be removed. The igloo door will be locked and the hasp sealed with a controlled QA seal. As soon as possible, the igloo will be air monitored for 24 hours. Once it completes monitoring for 24 hours with no agent detected at or above the RL, the igloo will move to Group D.

Group D – Empty Igloos: This group includes empty igloos that have been monitored for 24 hours to the RL. All chemical agent signs will be removed. The hazardous waste signs and PCB signs will not be removed. The passive filtering equipment may be removed and transported to a Group B igloo for monitoring. Prior to off-site disposal, recycling, or reuse, additional sampling is required for filter housings removed from igloos in which agent leaks (liquid or vapor) occurred following installation of the filter units. For these housings, sampling shall be conducted in a manner consistent with Section 3.2.3 of Attachment 5 to this permit. Group D igloos will remain locked and sealed. Group D igloos will be headwall monitored quarterly for one year. After one year of quarterly monitoring without agent detection at or above the RL, the igloo will move to Group E.

Group E – Empty Igloos: This group includes igloos that have been monitored 24 hours with no detection at or above the RL and monitored for one year without agent detection at or above the RL (while in Group D status). The hazardous waste signs and PCB signs will not be removed. The passive filtering equipment may be removed and transported to a Group B igloo for monitoring. Prior to off-site disposal, recycling, or reuse, additional sampling is required for filter housings removed from igloos in which agent leaks (liquid or vapor) occurred following installation of the filter units. For these housings, sampling shall be conducted in a manner consistent with Section 3.2.3 of Attachment 5 to this permit. Group E igloos will remain locked and sealed. Group E igloos have no monitoring requirements.

D. Conditions Resulting in Changes to Group Inventories

1. Leak Development

   When a ton container leak occurs, the hardware causing the leak is either repaired or replaced. Though leaks are infrequent, UMCD Chemical Operations follows strict, time-tested procedures to safely manage the ones that do occur. These procedures are performed in accordance with the Chemical Operations SOPs and the Site-Specific Monitoring Plan (SSMP). It is unlikely that leaking HD ton containers will drive a change in storage unit groupings.

2. Demilitarization

The UMCD transferred munitions in a predetermined order from storage to the incinerator facility. Significant reductions in storage unit group inventories has occurred, and the risk associated with various storage units has declined. Empty igloos are placed in an inactive status in preparation for closure.

Some agent-filled ton containers may be returned from the UMCDF as rejects or by necessity due to UMCDF operational constraints. Returned ton containers will not require a change in storage unit grouping status.

V. STORAGE UNIT SURVEILLANCE

Storage units within K-Block are inspected and monitored according to a program designed to promptly detect deterioration, tampering, malfunctions, and discharges that could cause a release of contaminants to the environment or pose a threat to human health. Surveillance of waste munitions and their storage units is required by 40 CFR 264.1201(a)(5) and (f) and OAR 340-104-1201. The UMCD surveillance program includes both visual inspections and air monitoring of the storage units.

A. Monitoring Program Description

1. Equipment Descriptions

a. Real-Time Analytical Platform

The RTAP is a mobile vehicle used for all continuous, real-time air monitoring processes at the UMCD. Each RTAP contains an automated continuous sample collection device that collects an air sample and passes it through a gas chromatograph (GC) instrument. The RTAPs at the UMCD may be equipped with two gas chromatographs, the HP 5890/6890 GC, and the mini continuous air monitor (MINICAM). The HP5890/6890 is fitted with a capillary column and a phosphorous/sulfur dual-headed flame photometric detector (FPD). MINICAM units consist of an air sampler with a pre-concentrator tube (PCT) and dust filter, a GC with capillary column, and a FPD. A high-volume sampler and a V-to-G conversion pad enable the unit to detect VX. If agent is detected with one GC, then another GC with a different stationary phase (column) is run. If agent is detected by both GC's, agent detection is confirmed. Detailed specifications and operational procedures for the RTAP equipment are provided in the "Operations Manual for the Real Time Analytical Platform" (Edgewood Chemical Biological Center, 1994). RTAP analytical equipment can quantify airborne GB, VX, and HD agents down to their RL concentrations (based on current precision and accuracy

studies, 0.25 of the VSL; RL values are listed in Table V-1). There are approximately nine RTAP vehicles available for deployment at UMCD. Extra inventories of other critical equipment are kept ready for immediate use should an equipment failure occur.

b. Depot Area Air Monitoring System tubes

Depot Area Air Monitoring System (DAAMS) tubes are used to collect vapor-phase agent. The DAAMS tube consists of a hollow glass vessel filled with sorbent material to which agent contamination adsorbs. DAAMS tubes are used for mass sampling and must be analyzed in a laboratory after sampling to determine agent concentration.

2. Reportable and Exposure Limits

Table V-1 presents the RL, VSL, and Immediately Dangerous to Life and Health (IDLH) values for the three chemical agents.

Table V-1 Reportable Limit (RL), Vapor Screening Level (VSL), and Immediately Dangerous to Life and Health (IDLH) Limits for Chemical Agents

Chemical Agent	RL (mg/m^3)	VSL (mg/m^3)	IDLH (mg/m^3)
GB	0.000025	0.0001	0.1
VX	0.0000025	0.00001	0.003
HD	0.00075	0.003	0.7[1]

[1] Chemical agent workers are required to wear supplied air and self-contained breathing apparatus at the VSL concentration for HD, which is much lower than IDLH levels.

3. Three-Tier Approach to Monitoring

The UMCD monitoring program is designed to optimize agent detection by monitoring at critical control points.

a. Tier 1 Monitoring

Tier 1 monitoring involves systematic storage unit interior space air monitoring. Air monitoring frequencies vary by storage unit grouping and are outlined in Table IV-1 and Table V-2 below. Storage unit grouping justifications are described in detail in Section IV of this plan.

Air monitoring frequencies are designed to promptly detect an agent leak. Interior space air monitoring is performed with RTAP equipment and is monitored down to the RL.

b. Tier 2 Monitoring

If agent is detected and confirmed in storage unit interior during Tier 1 monitoring, Tier 2 monitoring is conducted.

Tier 2 Monitoring involves sampling the air between the two serial carbon filters in the exhaust filtration unit. The purpose of Tier 2 monitoring is to determine if agent breakthrough has occurred in the **first** filter bed. Tier 2 monitoring is performed to the RL using the RTAP equipment. If agent is not detected, breakthrough of the first filter has not occurred.

c. Tier 3 Monitoring

If agent is detected and confirmed during Tier 2 monitoring, Tier 3 monitoring is implemented.

Tier 3 monitoring involves sampling at the stack filtration emission point downstream of the **second** filter to determine if agent has breached the entire exhaust filter unit. Tier 3 monitoring is performed down to the RL using the RTAP. If no agent is detected, breakthrough of the filter unit has not occurred, no migration of agent outside the igloo has taken place, and therefore no reportable quantity release has occurred. If agent is detected, breakthrough of the filter unit has taken place and migration of agent of a reportable quantity (OAR 340-108-0010) to the exterior of the igloo has taken place.

Compliance monitoring at UMCD is performed to the RL for several reasons. First, monitoring to the more stringent General Population Limit (GPL) with either an RTAP or DAAMS tube requires a significantly longer sampling cycle time. An RTAP would theoretically need to cycle for 1 to 2 hours and the DAAMS tube would require 8 to 10 hours. Because compliance monitoring must be performed before “hot” igloo procedures are initiated, the extended cycle time required to reach the GPL level would delay agent detection response and corrective action procedures, which in turn would increase the risk of worker exposure or prolonged release to the environment. Delaying connection of the 1,000-cfm filter to evacuate the igloo interior for 1 to 10 hours will increase the risks associated with a “hot” igloo rather than decrease them. In contrast, the sampling cycle for the RL is approximately 8 minutes, sufficiently short for RL compliance monitoring to be performed immediately after Tier 1 agent detection without delaying execution of “hot” igloo procedures. Compliance monitoring at the RL using an RTAP will also provide immediate air concentration data for the igloo exterior, providing another level of safety for workers involved in detection response.

There are other problems related to monitoring to the GPL level. Due to the extreme sensitivity of the sampling methodology, background interference from trace concentrations of organophosphate pesticides, hydrocarbons, and other airborne chemicals in the ambient air has been common during past GPL monitoring events at UMCD and UMCDF. This background interference adds significant uncertainty to the accuracy of GPL monitoring data.

From a risk-based standpoint, compliance monitoring to the RL is highly conservative in protecting the general public as well. Air modeling performed by the Army indicates that an RL agent vapor concentration emitted from one of the igloos closest to the K-Block fence line would result in air concentrations lower than the GPL at the fence line of K-block area. Therefore, compliance monitoring at the RL is also protective of non-chemical workers and the general population beyond the K-Block boundary.

d. Filter Changeout

Confirmed agent detection during Tier 2 monitoring and negative agent detection during Tier 3 monitoring triggers a filter change-out event, when the inner filter replaced by the outer filter, and a new filter is installed in the outer filter mount. Confirmed agent detection during both Tier 2 and Tier 3 monitoring triggers a filter change-out event, wherein both inner and outer filters are replaced.

The three-tiered monitoring program is outlined in the flow chart in Figure V-1.

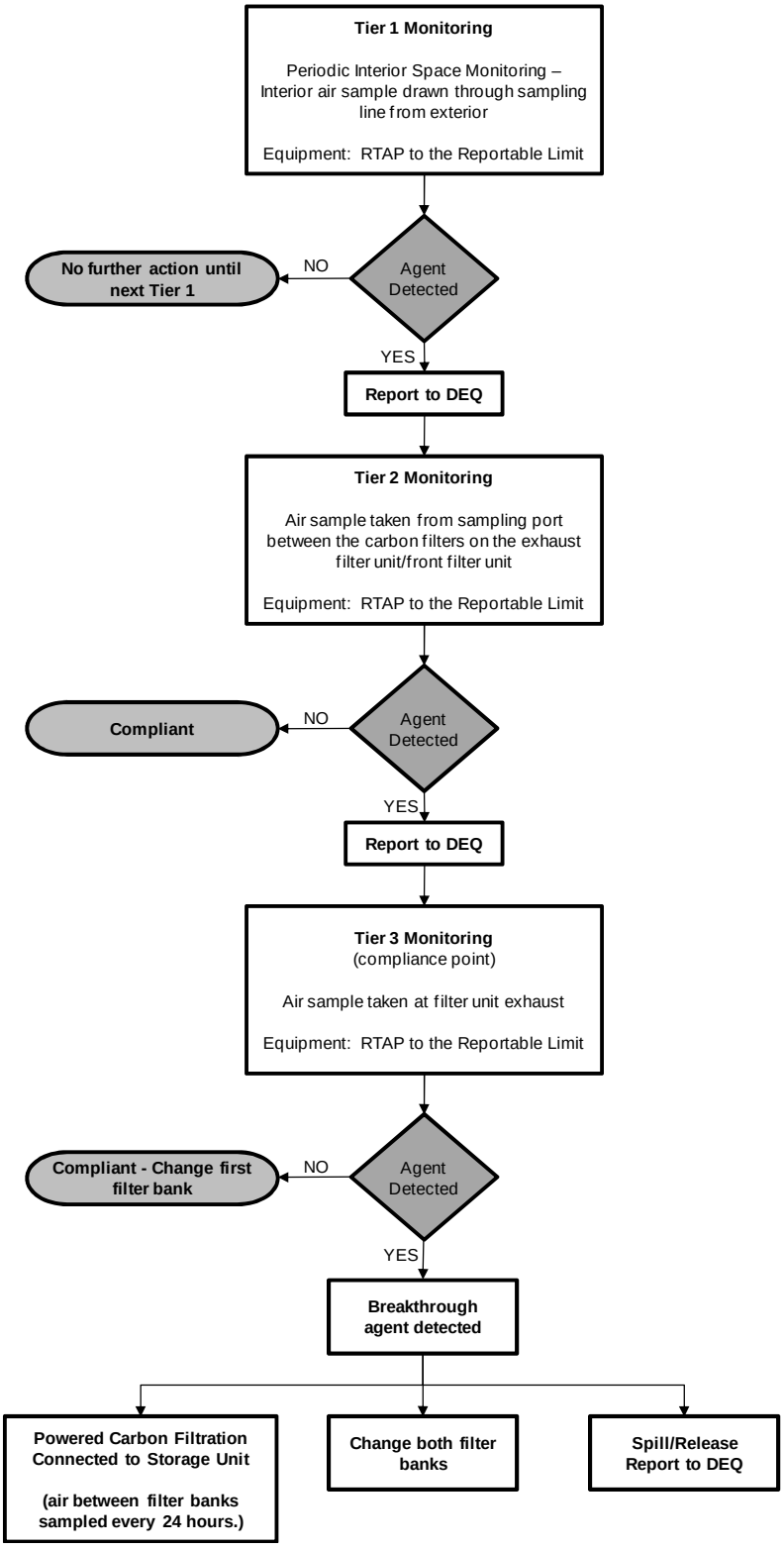

Figure V-1 Three-Tier Monitoring Flow Chart

4. Monitoring Locations

a. GB and HD Igloos

GB- and HD-designated K-Block igloos have two monitoring points, one in the front and one in the rear of each structure. The points consist of ¼-inch-diameter Teflon® sampling lines permanently marked "F" or "R" (for Front and Rear) and positioned 6 to 18 in. (15.2 to 45.7 cm) above the igloo floor near the center of the igloo. The monitoring points are placed near the floor because all of the chemical agent vapors are denser than air and will collect near the igloo floor in the event of a spill or leak. Each monitoring point attaches to Teflon lines that run from about 6in. (15.2 cm) outside the structure through the left drain into the igloo. Each line is equipped with a standard connector to which lines can be attached to collect air samples that are representative of a general area worker exposure profile. The outside ends of the lines are capped to prevent clogging or damage. All GB and HD igloo lines will be purged with compressed air at 30 pounds per square inch (psi) (2.1 kilograms per square centimeter) for one minute at least monthly, but no monitoring will occur within ten minutes of any purging.

b. VX Igloos

Igloos that contained VX munitions have three monitoring points. Two of the points are in the same locations and configuration as in the GB igloos, and are fitted with standard connectors. VX sampling lines inside igloos are equipped with a conversion pad to facilitate sampling. The conversion of VX into G analog is necessary because VX molecules often decompose at the high temperatures necessary to move them through sampling lines to detection equipment. G analog is much more volatile than VX, more mobile in air, and can easily be detected by GC with a FPD, (found on the RTAP). The third sampling line, marked "Impinger," is located near the interior side of the headwall near the center of the igloo. Impinger lines are no longer used at UMCD; the associated monitoring equipment is obsolete.

5. Communications Protocols

a. Internal Communications

Three methods are available for providing immediate emergency notification and instructions to UMCD Storage Area and contractor personnel: siren systems, a ring-down phone system originating in the Operations Center (OC), and portable radios and telephones for use in the storage areas. The siren network consists of seven sirens and is used to communicate to personnel working outside. The siren system has the

capability of broadcasting alarms and live or recorded messages. Internal communication between the OC and dedicated phones located in key personnel offices are available through a ring-down phone system. Emergency information, originating from a single ring-down phone in the OC, can be transmitted simultaneously to critical personnel. Communication in the K-Block storage area is accomplished using portable telephones and radios. Each K-Block igloo is equipped with a telephone jack, but no telephones are kept in the igloos except when MITECS is in use (see paragraph V.A.7, MITECS).

b. External Communications

The first method of contacting offsite emergency assistance operations centers is by computer through a wide-area network. The second method of contacting offsite emergency assistance is an "all-call" line, using microwave transmissions. Offsite agencies with access to this line include the local 911 responder and Operations Centers in Salem, Pendleton, Heppner, Richland, Prosser, and Olympia. A conference call, using a conference bridge (a special telephone line), can also be established with local agencies.

6. Agent Detection Responses/Corrective Actions

When chemical agent is detected in a storage unit during routine air monitoring, special requirements apply. Powered filter units are immediately placed on the igloo's rear stack vent or front vent. The leaker is located by sampling the storage unit ambient air, followed by air sampling of isolated pallets under plastic sheets, and then isolation and air sampling around individual munitions in plastic sheets. While the leaker is being isolated and repaired, agent-contaminated air is removed at an air vent through granular activated carbon filters. DEQ is notified upon initial agent detection, with follow-up notifications made periodically. Agent spill responses will be performed in accordance with the UMCD CAIRA Plan, which is the spill contingency plan for chemical agents.

7. Mustard Igloo Temperature Conditioning System (MITECS)

a. MITECS Monitoring System

The MITECS monitoring system will collect and analyze ambient air from within the igloo for the presence of Mustard (HD). The MITECS monitoring system will be operating 24 hours a day when the MITECS is operational. The monitoring system shall consist of MINICAMS, sample pumps, heat-traced sample line, exhaust line, and monitoring house. The basic design principle allows the MITECS monitoring system to integrate with existing igloo sample line configuration, transport a representative air

sample from the igloo interior back to the monitoring house, and analyze the sample for the presence of chemical agent using a MINICAMS. The MITECS monitoring system is compatible with RTAP sample lines. In the event of two consecutive MINICAMS agent alarms, the MITECS programmable logic controller will notify the UMCD OC, stop the flow of hydronic fluid through the heat exchanger, start the 1,000 CFM ventilation-filter system, illuminate the local panel-mounted strobe alarm, and initiate sounding of a local audible alarm. Initial confirmation efforts shall be performed the next day by UMCD RTAP personnel. Integration with the RTAP sample lines shall be effected via a Tee on the igloo sample line. The monitoring system will be challenged daily by UMCD RTAP personnel.

b. MITECS Ventilation-Filter System

Igloo passive filter systems, including both front and rear filters, will remain in place during the normal heating process of the ton containers. The rear filter will be capped. A 1,000 CFM ventilation-filter system using pre-filter, HEPA filter, and two carbon beds will be connected via flexible hose to the 12" by 8" steel access opening on the rear chimney and the passive filter on the chimney will be sealed. During normal heating this trailer mounted ventilation-filter system will be on standby. In the event of two consecutive MINICAMS alarms, the heating process will stop, (a three-way valve will bypass all hydronic fluid around the heat exchanger coil) and the ventilation-filter system will automatically start, bringing outside ventilation air through the front passive filter.

B. Inspection Program Description

All HD ton containers are subject to a quarterly visual inspection (see Table V-2 below). During these inspections, the exterior surface of each ton container is inspected for evidence of leakage (indicated by peeling, blistered, or discolored paint, or the presence of liquid). Only readily observable surfaces are examined, ton containers are not rewarehoused when performing the inspections (i.e., munitions are not removed from their storage configurations), and containers are not opened. Any other conditions affecting suitability for continued safe storage (e.g., deterioration of pallets) are recorded.

Table V-2 Visual Inspection and Air Monitoring Frequencies

Storage Unit Group	Visual Inspection	Air Monitoring
A-Mustard Ton Container	Quarterly visual inspection	Weekly (Summer), Monthly (Winter) Headwall
B-Agent-Contaminated Waste	Weekly visual inspection (while in use)	Weekly (while in use)
C-Empty Igloos – not monitored 24 hours to RL	None – igloos sealed	Monthly Headwall
D-Empty Igloos – monitored for 24 hours to RL		Quarterly Headwall for one year
E-Empty Igloos – monitored for 24 hours to RL and RTAP monitored quarterly for 1 year		None

The inspection process occurs until 100% of accessible containers have been inspected for that quarter. Storage configurations will not be disrupted in conjunction with visual inspections unless, on a case-by-case basis, an inspector deems movement of a ton container is necessary to detect or confirm leakage.

C. Documentation and Tracking of Monitoring and Inspections

Log sheets are kept to record inspection results. These log sheets serve as the written record of the items contained in the inspection. Calibration logs are also maintained. As required, the inspection sheets contain the date and time of inspection, inspector's name, a notation of the observations made, and the date and nature of any repairs or other remedial actions. The inspection logs and inspection schedule are kept for a minimum of three years from the date of inspection in accordance with federal and state regulations.

Appendix A. Additional Figures and Tables

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Table A.1: English-to-Metric Unit Conversion Factors[1]

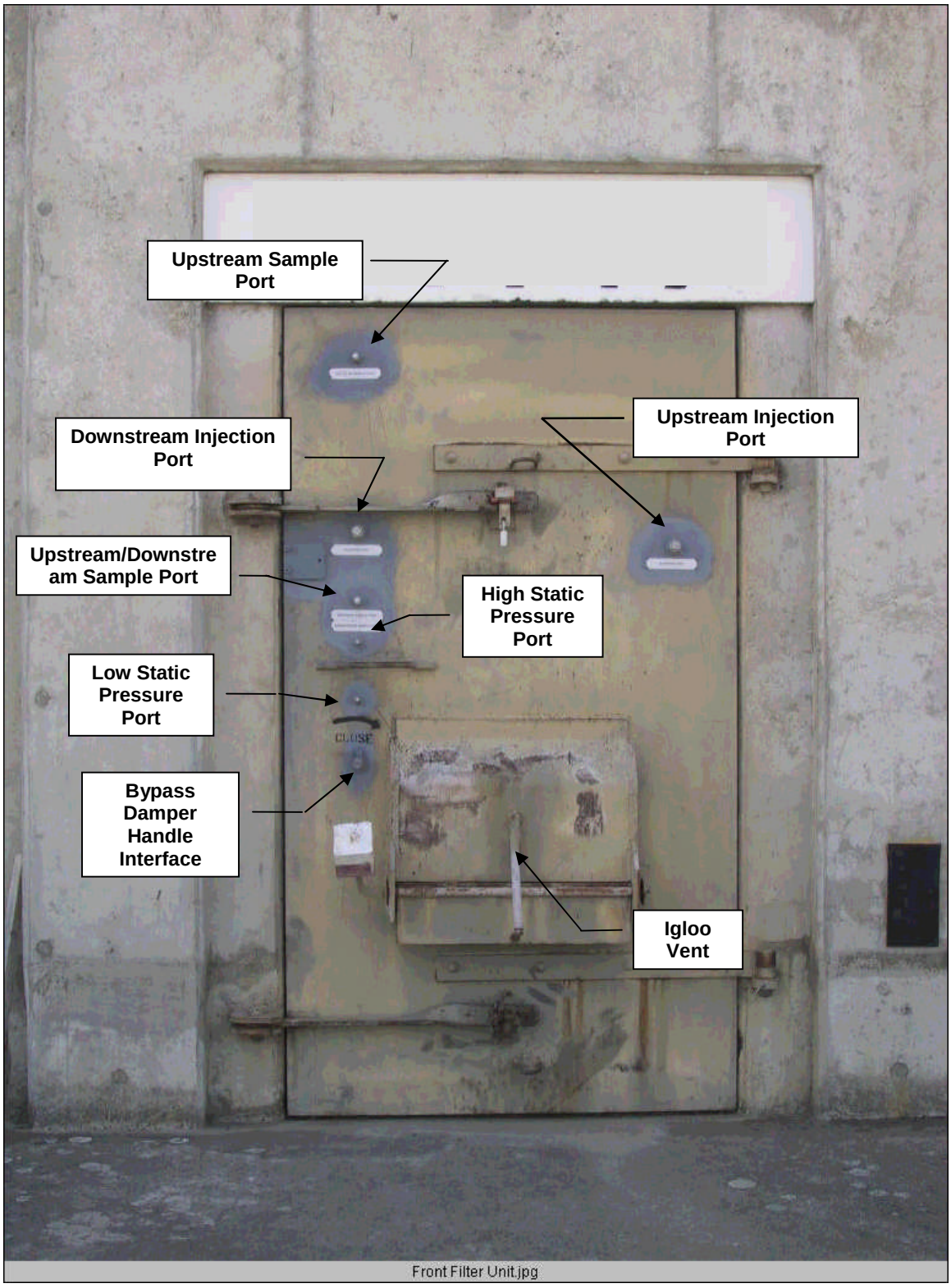
Units	Conversion Factor
Feet to meters	3.281 feet per meter
Inches to centimeters	2.54 centimeters per inch
Pounds to kilograms	0.454 pounds per kilogram
Fahrenheit to Celsius	°C = 5/9(°F – 32)
Celsius to Fahrenheit	°F = 9/5(°C) + 32
Pounds per square inch to kilograms per square centimeter	0.0703 pounds per square inch per kilogram per square centimeter
Gallons to liters	0.264 gallon per liter
Cubic feet to cubic meters	0.0283 cubic meters per cubic foot

[1]Handbook of Chemistry and Physics, 51st edition, 1970-1971, Robert C. Weast, ed., The Chemical Rubber Company, Cleveland, OH

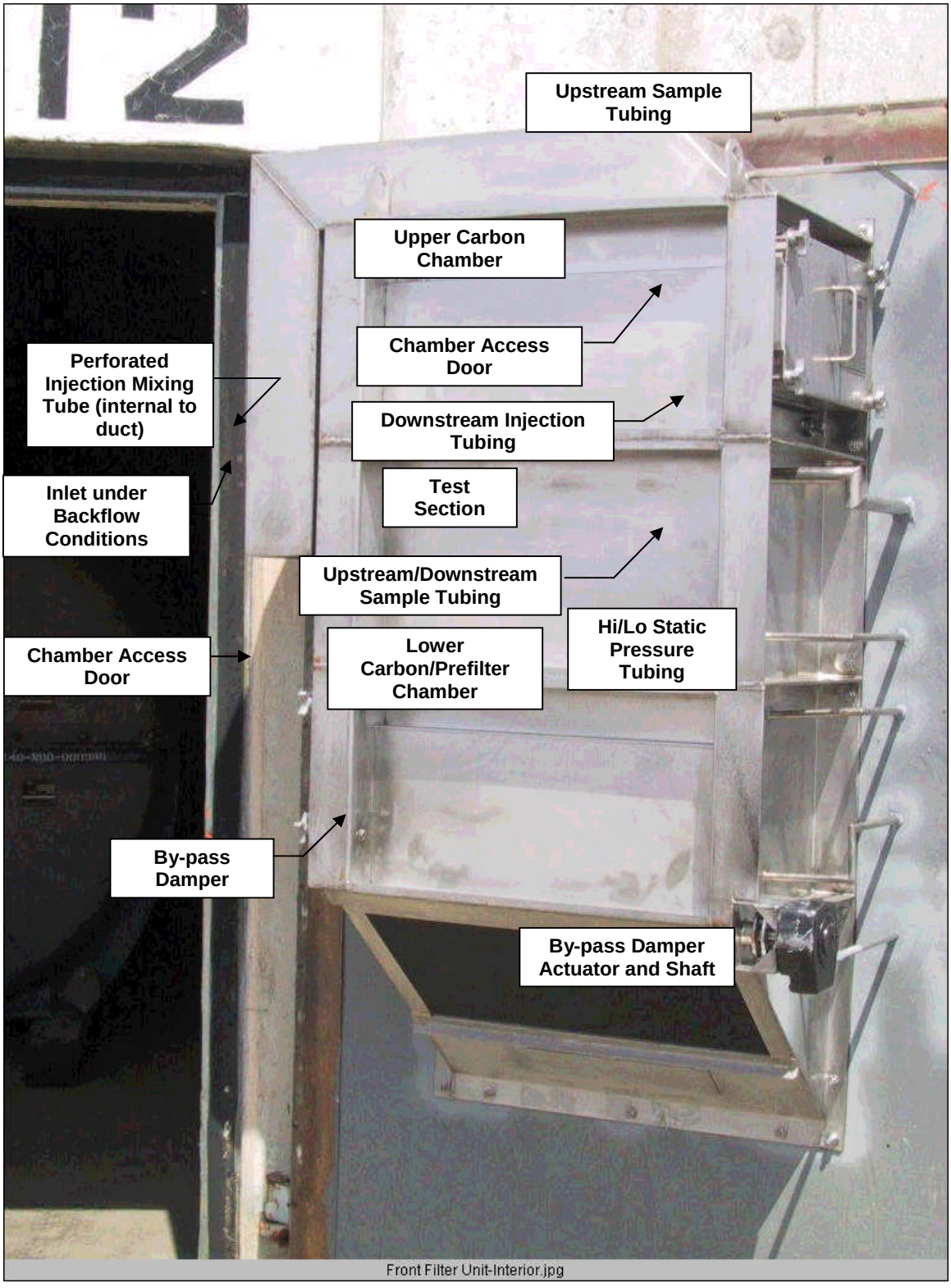
Igloo Drain Plug and Monitoring Port Assemblies

Floor Drain Monitoring Port Assembly

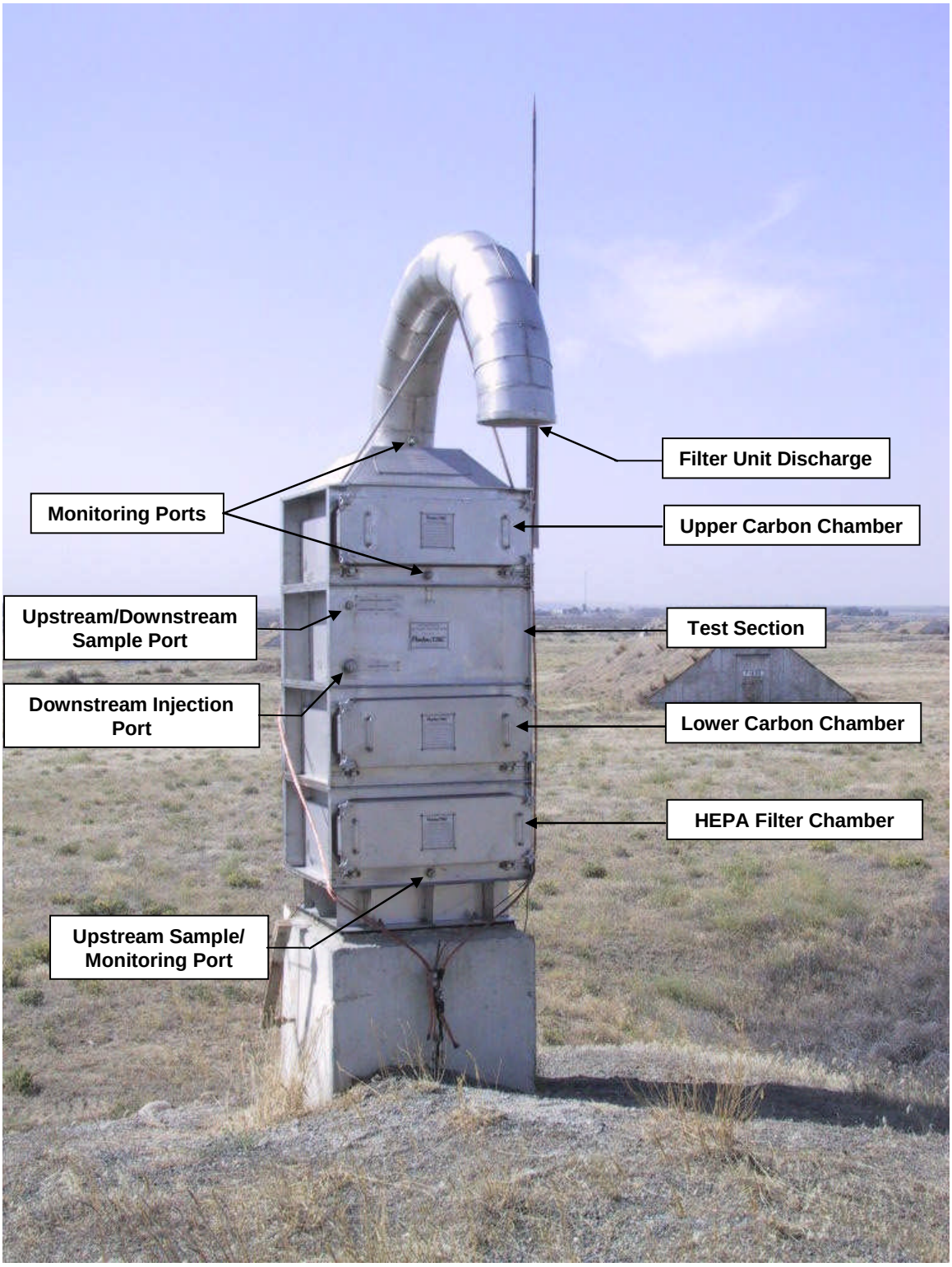
Floor Drain Plug Hex Nut Assembly



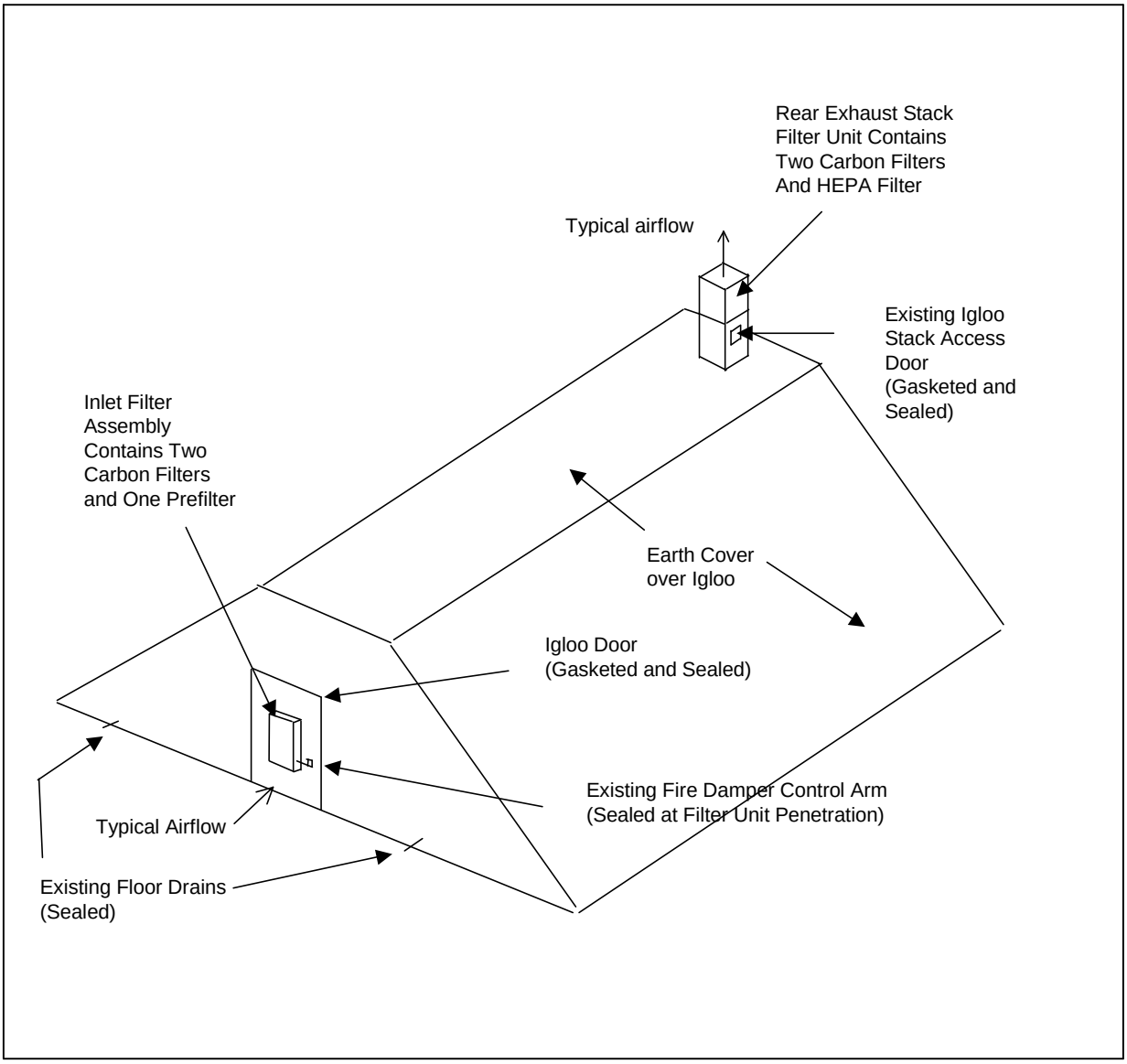
Front Filter Unit (Exterior)



Front Filter Unit (Interior)



Rear Filter Unit



Igloo Filter Unit Locator

Appendix B. Chemical Agent Munitions Properties, Descriptions and Configuration (FOUO)

(***The information in this appendix is FOUO and has been removed from the redacted document***)

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