SECTION C
CHEMICAL AND PHYSICAL ANALYSES

C-1 CHEMICAL AND PHYSICAL ANALYSES [6 CCR 1007-3 § 100.41(a)(2)]

Two Explosive Destruction System (EDS) units will be located at the Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP) EDS site that will be used to treat/destroy overpacked munitions, Department of Transportation (DOT) cylinders, and other miscellaneous items (ignition cartridges, propellant) currently stored at Pueblo Chemical Depot (PCD) that contain mustard agent (distilled sulfur mustard [HD]/mustard-T mixture [HT]) as well as to treat/destroy any reject chemical agent munitions or contaminated bursters generated from PCAPP operations. **Table C-1-1**[1] presents the physical and chemical properties of the mustard agents.

Treatment in an EDS unit will begin by placing the item(s) to be treated in the Containment Vessel. Once the item(s) are enclosed in the Containment Vessel, shaped charges that have been applied to the item(s) are then detonated to access chemical fill and deactivate the explosive components (if present). Liquid reagent is then added to treat the chemical fill and further deactivate explosives. When treatment is complete, the liquid effluent is drained and solid material is removed manually from the Containment Vessel. The liquid and solid wastes are containerized and stored pending shipment to a permitted treatment, storage, and disposal facility (TSDF). The EDS unit is then prepared for the next set of items for processing. A detailed description of the EDS treatment process is provided in Section D-11 of this permit modification.

A Container Storage Unit (CSU) will be located at the PCAPP EDS site for storing items pending treatment in the EDS units.

C-1a Containerized Wastes [6 CCR 1007-3 § 100.41(b)(1)(ii)(A) and (b)(1)(iv)]

One permitted hazardous waste storage unit (CSU) will be located at the PCAPP EDS site. The CSU is an existing concrete storage igloo comprising four walls, floor, and ceiling that will be used to store items pending treatment in an EDS unit. The CSU will be used to store overpacked munitions, DOT cylinders,[2] and other miscellaneous items (ignition cartridges, propellant, contaminated bursters) that contain or are

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[1] All tables are located at the end of this section.
[2] DOT cylinders may or may not be placed in overpacks.

contaminated with mustard chemical agents (HD/HT) pending treatment in the EDS units. For overpacked munitions, the overpack (such as the universal munition storage container [UMSC]) is considered the primary container for the munition contained within and provides containment protection. The overpack is compatible with the material contained within. For the DOT cylinders, the cylinder is the primary container (if overpack not used) and is compatible with the material contained within. For miscellaneous items in waste containers (such as M2A1 ammunition box), the waste container is the primary container and is compatible with the waste within. See Section C-1c of the PCD RCRA Permit Renewal Application, June 2013, for additional information on containers used for storage.

The overpacked munitions, miscellaneous items, and DOT cylinders will be stored atop secondary containment pallets inside the CSU. Items will be brought to the CSU from the PCD permitted storage igloos; then from the CSU to an EDS unit just prior to treatment. Wastes to be processed in the EDS units are discussed in Section C-1g, Wastes in Miscellaneous Treatment Units.

Wastes generated from EDS treatment operations will include, but are not limited to, the following:

- Neutralent and rinsates
- Used decontamination solution and containment pan liquids
- Decontaminated metal parts, fragments, and UMSC debris
- Spent carbon from the Environmental Enclosure Air Filtration System (AFS) and the CSU Igloo Containment System
- Spent prefilters and high efficiency particulate air (HEPA) filters from the Environmental Enclosure AFS
- Used personal protective equipment (PPE)
- Miscellaneous solid and liquid wastes as a result of support, maintenance, and cleanup activities
- Laboratory solid waste

- Laboratory liquid waste
- Grayloc® Seal and O-rings
- Unexploded or untreated energetics or propellant material (unlikely to occur but could be generated).

These wastes will be stored in United Nations (UN)-rated containers compatible with the wastes contained as determined by references such as DOT requirements, container compatibility charts provided by container manufacturers, and information presented in 6 CCR 1007-3 § 264 Appendix V regarding incompatible materials. The wastes will be stored in a less than 90-day hazardous waste storage area at the PCAPP EDS site, pending shipment to a permitted TSDF for further treatment and/or ultimate disposal.

Attachment C-1 contains general data sheets and diagrams of the munitions and DOT cylinders that will be stored and treated at the PCAPP EDS site. **Attachment C-3** contains EDS waste characterization data and waste profiles from the most recent EDS mustard agent operations that were used as a basis for information in **Table C-1-1**.

C-1b Wastes in Tanks [6 CCR 1007-3 § 100.41(a)(2)]

There will be no permitted hazardous waste treatment or storage tanks located at the PCAPP EDS site. Therefore, the requirements of this section are not applicable.

C-1c Waste in Piles [6 CCR 1007-3 § 264.250]

The hazardous waste management units addressed in permit modification are not waste piles. Therefore, the requirements for wastes in piles are not applicable.

C-1d Landfilled Wastes [6 CCR 1007-3 § 264.300]

The hazardous waste management units addressed in this permit modification are not landfills. Therefore, the requirements for landfilled wastes are not applicable.

C-1e Wastes in Incinerators, Boilers, and Industrial Furnaces [6 CCR 1007-3 § 264.340]

The hazardous waste management units addressed in this permit modification are not incinerators, boilers, or industrial furnaces. Therefore, the requirements of this section are not applicable.

C-1f Wastes to Be Land Treated [6 CCR 1007-3 § 264.270]

The hazardous waste management units addressed in this permit modification are not land treatment units. Therefore, the requirements of this section are not applicable.

C-1g Wastes in Miscellaneous Treatment Units [6 CCR 1007-3 § 100.41(b)(10)]

The wastes that will be processed in the EDS units contain or are contaminated with chemical agent mustard (HD/HT). The munitions and other miscellaneous items may contain energetics. The EDS units will process overpacked munitions of various sizes, DOT cylinders, and other miscellaneous items whereby the total net explosive weight (NEW) does not exceed 9.0 pounds per batch (detonation)/EDS unit.

Table C-1-2 identifies the wastes to be processed and the potential resulting treatment residues and other process wastes, along with origin, the appropriate U.S. Environmental Protection Agency (USEPA) waste code number, basis for hazardous waste designation, and disposition.

Table C-1-3 presents a general description of the chemical agent munitions that will be processed in an EDS unit.

C-1g(1) Chemical Fill

Chemical and physical characteristic information on the mustard agent contained in munitions, DOT cylinders, and other miscellaneous items to be treated are presented in **Table C-1-1**. Toxicity characteristic organics are associated with the chemical agents and toxicity characteristic metals may be present in some chemical fills due to leaching of metals from munition casings or as contaminants. Waste codes associated with these constituents are detailed in **Table C-1-2**. Decomposition products resulting from chemical agent mustard decontamination, age, and manufacturing impurities are shown in **Table C-1-4**.

Chemical agents HD and HT are liquid at room temperature and exhibit the characteristic of reactivity. HD and HT may exhibit the characteristic of corrosivity but analytical sampling and testing of the agents, including tests to determine whether or not the agents are a free liquid, have not been completed. The State of Colorado specifically lists mustard HD and HT as acutely hazardous and has added the chemical agents to the P-list as P909 and P910, respectively. The State of Colorado also specifically lists waste chemical weapons and the treatment residues of waste chemical weapons as K901 and any soil, water, debris, or containers contaminated through contact with waste chemical weapons or chemical agent as K902.

C-1g(2) Energetics

Energetic components of a munition are comprised of fuzes, bursters, ignition cartridges, and propellant that contain explosives and other components. Fuzes are composed of boosters, detonators, and other components. All energetic wastes (fuzes, bursters, ignition cartridges, and propellant) are classified as reactive hazardous wastes and carry the hazardous waste code D003. The energetic wastes are explosive, or they contain Class 1.1 explosives. Examples of explosives (found in bursters and supplementary charges) are tetryl and tetrytol, both Class 1.1 explosives (49 CFR 173.53). Tetrytol contains tetryl and trinitrotoluene (TNT). They are also classified as characteristic waste because they may contain lead from lead azide. A Safety Data Sheet (SDS) for tetryl is provided in **Attachment C-2**. There is no SDS for tetrytol, as it is a mixture of tetryl and TNT. **Table C-1-5** presents physical and chemical characteristics of explosives and **Table C-1-6** presents the composition of reactive material in HD and HT munitions.

The M6 propellant is a double base propellant containing nitrocellulose and nitroglycerin, which are classified as reactive hazardous wastes because they are explosive or contain Class 1.1 explosives. Per 6 CCR 1007-3 § 261.23(a)(8), the propellant wastes are explosive, or they contain Class 1.1 explosives, and therefore, carry the RCRA reactive hazardous waste code D003. The propelling charge M67 also contains dinitrotoluene and would, therefore, carry the waste code of D030.

Since the ignition cartridges have a primer that contains barium nitrate and lead styphnate, the ignition cartridges will also carry the waste code for barium (D005) and lead (D008).

C-1g(3) Characterization Prior to Treatment

Prior to storage at the CSU and treatment in the EDS units, overpacked munitions in storage at the PCD RCRA-permitted hazardous waste management units will have been repacked into universal munition storage containers, thus, munition type, condition, and presence or absence of liquids and energetics will have been verified at that time. The DOT cylinders and miscellaneous items do not require any further assessment prior to treatment since these items have already been assessed prior to storage in PCD RCRA-permitted hazardous waste management units. Likewise, reject munitions and contaminated bursters from PCAPP operations will be known and condition assessed. Thus, at the time of treatment/destruction, sufficient information will be known about an item to treat/destroy it in the EDS. No further characterization is necessary to conduct treatment.

C-1g(4) Treatment Effectiveness

The primary objective of "treatment" is to convert the chemical fill to less toxic products to minimize health and safety hazards associated with the handling and transportation of chemical materiel destined for further treatment and ultimate disposal.

The liquid waste product of treatment is termed "neutralent" and the term "treatment reagent" is applied to the treatment reagent liquids that react with the chemical-fill for detoxification. A treatment reagent reacts with a chemical agent to convert the chemical fill to less toxic products that are not classified as chemical warfare materiel (CWM). However, these products may still present certain hazards to personnel or the environment.

Laboratory studies were conducted to develop treatment chemistry with the objectives to eliminate/minimize chemical agent characteristics and minimize any health hazards associated with handling and transportation for further waste treatment or disposal. Treatment reagents were evaluated and selected based on effectiveness at moderate temperatures, equipment compatibility, and safety. Mustard agent will be treated using monoethanolamine (MEA) as a treatment reagent.

Data results from full-scale tests and previous EDS operations indicate that a treatment level for mustard agent of less than or equal to 50 milligrams per liter (mg/L) is reached after treatment using MEA reagent. Favorable results of the Russian-American Joint Evaluation Support studies provided a basis for developing the MEA reagent mixture for EDS operations. Moreover, MEA exhibits low toxicity, is not

corrosive to stainless steel at the temperatures used, is inexpensive, and exhibits advantageous solvent properties.

Treatment effectiveness of any energetic components will be determined by visual observation for unexploded components. Although unlikely, any observed unexploded components will be removed, placed in appropriate container(s), and transferred to explosive ordnance disposal (EOD) personnel for disposition. For the liquid neutralent and rinsewaters, treatment effectiveness will be determined by chemical analysis to the treatment level identified in **Table C-1-7**.

Treatment effectiveness of the decontaminated metal parts, fragments, and plastic shards will be determined by headspace monitoring. The required screening level identified in **Table C-1-7** must be met before the solid wastes can be shipped to a permitted TSDF for further management.

Table C-1-1. Physical and Chemical Properties of Mustard Agents HD/HT

Chemical Name	Mustard Agent HD Diethyl, 2,2-dichloride sulfide [bis (2-Chloroethyl) sulfide]	Mustard Agent HT Bis-(2-chloroethyl) sulfide; T: Bis {2(2-chloroethylthio)ethyl} ether
Source(s)	FM 3-11.9 and HD SDS	FM 3-11.9 and HT SDS
Short Name	Distilled Mustard (HD)	Distilled mustard and T mixture (HT)
Chemical Formula	$C_4H_8Cl_2S$	(H): $C_4H_8Cl_2S$; (T): $C_8H_{16}Cl_2OS_2$
Molecular Weight	159.07	188.96
Physical State	Pale yellow to dark brown oily liquid	Pale yellow to brown liquid
Liquid Density	1.27 g/mL at 25°C	1.263 g/mL at 20°C
Solid Density	1.372 g/cm^3 at 0°C 1.333 g/cm^3 at 10°C	None listed
Normal Freezing Point or Melting Point	14.45°C	1.3°C (Melting Point)
Boiling Point	218°C extrapolated (decomposes at 180°C)	No constant boiling point
Vapor Density (Relative to Air)	5.5	6.5
Vapor Pressure	0.106 mm Hg at 25°C	7.7×10^{-2} mm Hg at 25°C
Volatility	906 mg/m^3 at 25°C	7.83×10^2 mg/m^3 at 25°C
Viscosity	3.95 cP at 25°C	7.62 at 20°C
Solubility	0.092 g/100 g H_2O at 22°C. Freely soluble in fats and oils, gasoline, kerosene, most organic solvents, and CW agents.	Slightly soluble in water; soluble in most organic solvents
Latent Heat of Vaporization	15 kcal/mol at 25°C	Data not available
Special Properties	Permeates ordinary rubber	Permeates ordinary rubber
Flash Point	105°C	Flash point range 109° to 115°C
Corrosivity	0.0001 inch/month at 65°C on steel	0.00007 inch/month at 65°C on steel

Notes:

cP	=	centipoise	kcal/mol	=	kilocalorie per mole
CW	=	chemical warfare	mg/m^3	=	milligram per cubic meter
g	=	gram	mm Hg	=	millimeters of mercury
g/cm^3	=	gram per cubic centimeter	SDS	=	Safety Data Sheet
g/mL	=	gram per milliliter			

<u>Sources</u>:

U.S. Army, Marine Corps, Navy, Air Force, FM 3-11.9, *Potential Military Chemical/Biological Agents and Compounds*, January 2005.

U.S. Army Edgewood Chemical Biological Center (ECBC), Safety Data Sheet (HD), 14 February 2013.

U.S. Army Edgewood Chemical Biological Center (ECBC), Safety Data Sheet (HT), 14 February 2013.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Overpacked Munitions Containing Mustard Agent (HD, HT)	Overpacked munitions stored at PCD	D001, D002, D003, D004-D011, D022, D028, D029, D030, D034, D039, D040, D043 K901, K902	D001and D002 are listed because the waste codes are listed for mustard agent in the PCD Permit Renewal Application, dated June 2013. Munitions to be processed in the EDS may or may not contain energetic components (fuzes, bursters) and may or may not contain chemical agent mustard fill. Energetics are Class 1.1 explosives per 49 CFR 173.53; thus, are reactive (D003). Several TC organics have been identified as degradation compounds of mustard agents. These analytes and corresponding regulatory levels are: • chloroform (D022) 6.0 ppm • 1,2-dichloroethane (D028) 0.5 ppm • 1,1-dichloroethylene (D029) 0.7 ppm • 2,4-dinitrotoluene (D030) .13 ppm • hexachloroethane (D034) 3.0 ppm • tetrachloroethylene (D039) 0.7 ppm • trichloroethylene (D040) 0.5 ppm • vinyl chloride (D043) 0.2 ppm The State of Colorado lists waste chemical weapons as K901. The State of Colorado lists containers (such as overpacks) contaminated through contact with waste chemical weapons as K902.	Overpacked munitions will be detonated in the EDS, accessing the chemical fill. The chemical fill then will be chemically treated. Resulting neutralent, rinsewater, used decontamination solutions, and solid wastes will be placed in containers and stored in a less than 90-day hazardous waste storage area, pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Overpacked Munitions Containing Mustard Agent (HD, HT) (Continued)			The chemical agent may also contain TC metals since some munitions are constructed of specialty alloys containing heavy metals and the chemical agent over time may leach metals from munition casings. Also, explosive components may contain lead (D008) from lead azide. Mercury (D009) may also be present in the mustard agents.	
DOT Cylinders Containing Mustard Agent (HD, HT)	DOT cylinders stored at PCD generated from drill and transfer operations	D001, D002, D004-D011, D028, D029, D030, D034, D039, D040, D043 K901, K902	D001and D002 are listed because the waste codes are listed for mustard agent in the PCD Permit Renewal Application, dated June 2013. Several TC organics have been identified as degradation compounds of mustard agents. These analytes and corresponding regulatory levels are: • chloroform (D022) 6.0 ppm • 1,2-dichloroethane (D028) 0.5 ppm • 1,1-dichloroethylene (D029) 0.7 ppm • 2,4-dinitrotoluene (D030) 0.13 ppm • hexachloroethane (D034) 3.0 ppm • tetrachloroethylene (D039) 0.7 ppm • trichloroethylene (D040) 0.5 ppm • vinyl chloride (D043) 0.2 ppm Waste Code K901 is applied because the DOT cylinders do not contain standard mustard agent. The State of Colorado lists containers (such as overpacks) contaminated through contact with waste chemical agent as K902.	DOT cylinders will be detonated in the EDS, accessing the chemical fill. The chemical fill then will be chemically treated. Resulting neutralent, rinsewater, used decontamination solutions, and solid wastes will be placed in containers and stored in a less than 90-day hazardous waste storage area, pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
DOT Cylinders Containing Mustard Agent (HD, HT) (Continued)			The State of Colorado lists containers contaminated through contact with waste chemical weapons as K902. The chemical agent may also contain TC metals since some munitions are constructed of specialty alloys containing heavy metals and the chemical agent over time may leach metals from munition casings.	
Agent-Contaminated Propellant	Miscellaneous items stored at PCD	D001, D003-D011, D022, D028, D029, D030, D034, D039, D040, D043 K901, K902	Propellant is a Class 1.1 explosive per 49 CFR 173.53; thus, is reactive (D003). The State of Colorado lists containers contaminated through contact with waste chemical weapons as K902. Waste contaminated with chemical agent HD/HT may contain TC metals and TC organics associated with chemical agent HD/HT.	Propellant will be placed into the EDS and detonated. Resulting neutralent, rinsewater, and solid wastes will be placed in containers and stored in a less than 90-day hazardous waste storage area, pending shipment to a permitted TSDF.
Agent-Contaminated Ignition Cartridges	Miscellaneous items stored at PCD	D001, D003-D011, D022, D028, D029, D030, D034, D039, D040, D043 K901, K902	Ignition cartridges to be processed in the EDS carry the characteristics of ignitability (D001) and may also contain energetic components (fuzes and bursters); energetics are Class 1.1 explosives per 49 CFR 173.53; thus, are reactive (D003). The primer in the ignition cartridge may contain barium nitrate (D005) and lead styphnate (D008).	Ignition cartridges will be placed in the EDS and detonated. Resulting neutralent, rinsewater, and solid wastes will be placed in containers and stored in a less than 90-day hazardous waste storage area, pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Agent-Contaminated Ignition Cartridges (Continued)			The State of Colorado lists containers contaminated through contact with waste chemical weapons as K902. Waste contaminated with chemical agent HD/HT may contain TC metals and TC organics associated with chemical agent HD/HT.	
Potentially Agent-Contaminated Empty M2A1 Cans	Used to store waste propellant and ignition cartridges at PCD	D001, D003-D011, D022, D028, D029, D030, D034, D039, D040 K902	The State of Colorado lists containers (such as M2A1 cans) contaminated through contact with waste chemical weapons as K902. Waste contaminated with chemical agent HD/HT may contain TC metals and TC organics associated with chemical agent HD/HT.	Solid wastes will be placed in containers and stored in a less than 90-day hazardous waste storage area, pending shipment to a permitted TSDF.
Potentially Agent-Contaminated Empty Metal Overpacks	Used to store leaking munitions	D001, D002, D003, D004-D011, D022, D028, D029, D030, D034, D039, D040, D043 K902	The State of Colorado lists containers contaminated through contact with waste chemical weapons as K902. Waste contaminated with chemical agent HD/HT may contain TC metals and TC organics associated with chemical agent HD/HT.	Solid wastes will be placed in containers and stored in a less than 90-day hazardous waste storage area, pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Mustard Agent/MEA Neutralent	Generated from detonation of munition/DOT cylinders and chemical neutralization of chemical fill	D002, D004-D011, D018, D019, D022, D028, D029, D030, D034, D039, D040, D043 K902	Liquid neutralent waste may be corrosive (D002) and have a pH ≥12.5; may contain heavy metals from the munition casings and container components, thus, may contain TC metals; may contain TC organics known to be degradation and decomposition products of mustard agent. Lead may be present from lead azide. Based on data from previous EDS operations, other TC organics that may be present in the neutralent waste are benzene (D018) and carbon tetrachloride (D019). The State of Colorado lists K902 as any water contaminated through contact with K901-listed waste chemical weapons or hazardous waste listed as P909 (H, HD) or P910 (HT).	Liquid waste will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Rinsewater	Generated from rinsing the EDS Containment Vessel following treatment	D004-D011, D018, D019, D022, D028, D029, D030, D034, D039, D040, D043 K902	May contain TC organics and TC metals from residues in the EDS Containment Vessel following treatment. The State of Colorado lists K902 as any water contaminated through contact with K901-listed waste chemical weapons or hazardous waste listed as P909 (H, HD) or P910 (HT).	Liquid waste will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Used Decontamination Solutions and Containment Pan Liquids	Generated from the decontamination of the EDS Containment Vessel and/or components with a bleach/water solution	D004-D011, D018, D019, D022, D028, D029, D030, D034, D039, D040, D043 K902	May contain TC organics from residues in the EDS Containment Vessel following treatment. The State of Colorado lists K902 as any water contaminated through contact with K901-listed waste chemical weapons or hazardous waste listed as P909 (H, HD) or P910 (HT).	Liquid waste will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Decontaminated Metal Parts, Fragments, and Plastic Shards	Generated from treatment of munitions/DOT cylinders in the EDS	D004-D011 K902	Munition casings, metal parts, and fragments are composed of metal alloys and may contain TC metals. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Miscellaneous Solid Waste (Hoses, Valves, Absorbent Rags and Wipes)	Generated during EDS operations	D018, D019, D022, D028, D030, D034, D039, D040, D043 K902	TC organics may be present as a result of chemical agent mustard contamination. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers, decontaminated if necessary, and stored appropriately in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Potentially Agent-Contaminated Dunnage/Packing Material	Generated from munition unpacking inside Environmental Enclosure for EDS Treatment	D001, D002, D003, D004-D011, D022, D028, D029, D030, D034, D039, D040, D043 K902	Waste contaminated with chemical agent HD/HT may contain TC metals and TC organics associated with chemical agent HD/HT. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers, decontaminated if necessary, and stored appropriately in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Unexploded or Untreated Energetic Components or Propellant Material	Generated from detonation of munitions	D003, D004-D011 K902	Waste stream may be generated if incomplete detonation of munition energetics, propellant material, or donor charges occurs. Components may still be reactive and may contain heavy metals. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT). Energetic components and propellant are components of a chemical munition.	Components will either be retreated in the EDS or transferred to EOD personnel for disposition.
Miscellaneous Liquid Wastes	Liquids such as chemical or supply spill, or other fluids, including waste oil and solvents from routine maintenance operations	D001, D002, D004-D011, D018-D043, F001-F005	Liquids may contain TC metals and/or TC organics. Routine maintenance operations may generate waste oils and solvents. Liquids may be ignitable and/or corrosive.	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Spent Carbon (from Environmental Enclosure Air Filtration System [AFS] and CSU Igloo Containment System	Generated from changeout activities	D004-D011, D018, D019, D022, D028, D030, D034, D039, D040, D043 K902	May be contaminated with chemical agent; thus, may contain TC metals and TC organics associated with chemical agent mustard. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Spent Prefilters and HEPA Filters from the Environmental Enclosure (AFS)	Generated from changeout activities	D004-D011, D018, D019, D022, D028, D030, D034, D039, D040, D043 K902	May contain TC metals and TC organics associated with chemical agent mustard. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Used PPE (Includes Gloves, Masks, and Other Protective Gear)	Generated from personnel use in providing worker protection from chemical agent	D018, D019, D022, D028, D030, D039, D040, D043 K902	The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Grayloc® Seal and O-Rings	Generated from the EDS Metal Grayloc Door Rings	K902	The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.
Solid Laboratory Waste	Generated from Mobile Analytical Platform operations	D018, D019, D022, D028, D030, D034, D039, D040, D043 K902	Solids such as decontaminated labware, vials, broken glassware, wipes, lab trash, and sampling equipment, may contain TC organics associated with mustard agent. The State of Colorado lists K902 as any debris or containers contaminated through contact with K901-listed waste chemical weapons or hazardous wastes listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.

Table C-1-2. RCRA Hazardous Waste Designation, Rationale, and Disposition (Continued)

Waste Material	Source	EPA Waste Codes[a,b]	Basis for Designation	Disposition of Waste Material
Liquid Laboratory Waste	Generated from Mobile Analytical Platform operations	D018, D019, D022, D028, D030, D034, D039, D040, D043, F001-F005 K902	Liquids may consist of decontaminated mustard agent working standards in bleach (sodium hypochlorite; spent solvents [for example, 2-propanol and acetone may contain TC organics associated with mustard agent]) The State of Colorado lists K902 as any water contaminated through contact with K901-listed waste chemical weapons or hazardous waste listed as P909 (H, HD) or P910 (HT).	Will be placed in containers and stored in a less than 90-day hazardous waste storage area pending shipment to a permitted TSDF.

Notes:

[a] Waste codes may change based on sampling and analysis results.

[b] State waste codes K901 and K902 are based on CDPHE-approved Pueblo Chemical Depot Waste Analysis Plan, April 28, 2011.

CFR = Code of Federal Regulations
CSU = Container Storage Unit
DOT = Department of Transportation
EDS = Explosive Destruction System
EPA = U.S. Environmental Protection Agency
HD = distilled sulfur mustard
HEPA = high efficiency particulate air
HT = mustard-T mixture
MEA = monoethanolamine
PCD = Pueblo Chemical Depot
PPE = personal protective equipment
ppm = parts per million
TC = Toxicity Characteristic
TSDF = treatment, storage, and disposal facility
UMSC = universal munition storage container

Table C-1-3. General Description of Chemical Fill Munitions

			Dimensions			Fill		Burster			Propellant		Other Components	
Munition	Model	Materials of Construction	Munition Diameter	Munition Length (in.)	Total Mass of Munition (lb)	Chemical Agent	Mass of Agent (lb)	Model	Explosive	Mass of Explosive (lb)	Model	Mass of Propellant (lb)	Fuze Model	Other Energetic Components
105mm Cartridge	M60	Steel	105mm	31.1[a]	42.92	HD	2.97	M5	Tetrytol	0.26	M67	2.825	M57	M125A1
			105mm	31.1	42.92	HD	2.97	M5	Tetrytol	0.26	M67	2.825	M51A5	M21A4
4.2-inch Mortar	M2	Steel	4.2-inch	21.0	24.67	HT	5.8	M14	Tetryl	0.14	M6	0.6	M8	See **Table C-1-6**.
	M2A1		4.2-inch	21.0	24.67	HD	6.0	M14	Tetryl	0.14	M6	0.6	M8	See **Table C-1-6**.
155mm Projectile	M110	Steel	155mm	26.8	94.59	HD	11.7	M6	Tetrytol	0.41	--	--	--	--
	M104		155mm	26.8	98.9	HD	11.7	M6	Tetrytol	0.41	--	--	--	--

Notes:

[a] This amount includes the munition shell case and projectile.

HD = distilled sulfur mustard
HT = 60:40 mix of HD and T. T = bis(2-chloroethylthio)ethyl ether
in. = inches
lb = pound

Source: Technical Manual, *Army Ammunition Data Sheets, Artillery, Ammunition, Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers, and Artillery Fuzes* (FSC 1310, 1315, 1320, 1390) TM 43-0001-28, April 1994.

Table C-1-4. Mustard Agent Decomposition Products from Decontamination, Age, and Impurities from Manufacturing

Process Reaction	Decomposition Products and Manufacturing Impurities
Reaction of Decontamination Solution (NaOCl) and Mustard	Na_2SO_4, NaCl, CO_2, and H_2O
Degradation of Mustard from Age	HCl ethylene ethylene dichloride 2,2′-dichlorodiethyl disulfide vinyl chloride hydrogen sulfide oxathiane dithiane Bis(2-chloroethoxy)-2(2-chloroethylthio)ethane 1,2-dichloroethane ethyl 2-chloroethyl sulfide diethyl disulfide 1,2-Bis(2-chloroethylthio)ethane and oligomers Bis-2[bis(2-hydroxy ethyl-sulfonium ethyl)] sulfide dichloride thiodiglycol 2-chloroethyl vinyl sulfide divinyl sulfide 2-hydroxy ethyl vinyl chloride 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,1,2-tetrachloroethane 1,1,2,2-tetrachloroethane

Table C-1-4. Mustard Agent Decomposition Products from Decontamination, Age, and Impurities from Manufacturing (Continued)

Process Reaction	Decomposition Products and Manufacturing Impurities
Impurities from Manufacturing	2-methyl 1-propene
	thiirane
	2-chlorobutane
	trichloroethylene
	tetrachloroethylene
	1,4-oxathiane
	1,4-dithiane
	hexachloroethane
	Bis (2-chloroethyl) sulfide (HD)
	2-chloroethyl 3-chloropropyl sulfide
	Bis (3-chloropropyl) sulfide
	HD isomer
	2-chloroethyl 4-chlorobutyl sulfide
	1,2,5-trithiepane
	Bis (2-chloroethyl) disulfide
	2-chloroethyl (2-chloroethoxyl) ethyl sulfide
	Bis (2-chloroethyl) trisulfide

Sources: Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement, January 1988.

Aberdeen Proving Ground HD Ton Container Survey, Aberdeen Proving Ground RCRA Permit Application, May 1997.

Table C-1-5. Physical and Chemical Characteristics of Explosives

Waste	Composition	Molecular Weight	Density	Explosion Temperature Test Value (°C)	Heat of Combustion (cal/g) at Constant Pressure
Explosives					
Tetryl	2,4,6-trinitrophenyl-methylnitramine	287.15	1.73 (crystal) 1.62 (cast)	257	2,914
Tetrytol	70% tetryl 30% TNT	266	1.60 (cast)	275	3,136

Notes:

cal/g = calorie per gram
TNT = trinitrotoluene

Table C-1-6. Composition of Reactive Material in HD and HT Munitions

Munition Type	Component[a]	Weight	Composition
M2/M2A1 (4.2-inch Mortar)	1. Fuze, M8 Burster Charge	65.2 g	Tetryl
	2. Detonator, M22		
	a. Upper Charge (Primer Mixture AN-6)	50.0 mg	Overall Mixture: 33.4% Potassium Chlorate 33.3% Antimony Sulfide 28.3% Lead Azide 5.0% Carborundum
	b. Intermediate Charge	150.0 mg	Lead Azide
	c. Lower Charge	70.0 mg	Tetryl
	3. Propellant, M6	272 g	Overall Mixture: 52.15% Nitrocellulose 43.0% Nitroglycerin 3.0% Diethylphthalate 1.25% Potassium Nitrate 0.6% Ethyl Centralite
	4. Cartridge, Ignition M2 Assy		
	a. Charge, Propelling M2	7.8 g	Overall Mixture: 77.33% Nitrocellulose 19.47% Nitroglycerin 1.4%Barium Nitrate 0.75% Potassium Nitrate 0.6% Ethyl Centralite 0.45% Graphite
	b. Primer	64.8 g	Overall Mixture: 42%Barium Nitrate 40% Lead Styphnate 11% Antimony Sulfide 6% Nitrocellulose 1% Tetracene
M60 (105mm Cartridge)	1. Percussion Primer M28A2 Assy – Charge Primer (Black Powder)	19.4 mg	Overall Mixture: 74% Potassium Nitrate 15.6% Charcoal 10.4% Sulfur
	2. Percussion Primer M61 Assy – Primer Mix #70	64.8 mg	Overall Mixture: 53% Potassium Chlorate 25% Lead Thiocyanate 15% Antimony Sulfide 5% Trinitrotoluene
	3. Charge, Propelling M67 Assy	1.28 kg	Overall Mixture: 85% Nitrocellulose 9% Dinitrotoluene 5% Dibutylphthalate 1% Diphenylamine

Table C-1-6. Composition of Reactive Material in HD and HT Munitions (Continued)

Munition Type	Component[a]	Weight	Composition
	4. Fuze, M51A5 (with NSN 1315-00-322-6365)		
	a. Booster, M21A4		
	(1) Booster Pellet	22.7g	Overall Mixture: 98% Tetryl 0.75% Calcium Stearate 0.75% Barium Stearate 0.5% Graphite
	(2) Booster Charge	0.25 g	Overall Mixture: 98%Tetryl 2% Graphite
	(3) Detonator, M17		
	a. Intermediate Charge	0.26 g	Lead Azide
	b. Lower Charge	79.7 g	Tetryl
	b. Fuze PD M48A3 Assy		
	(1) Detonator M24 Assy.		
	a. Primer Mix	55.7mg	Overall Mixture: 33.4% Potassium Chlorate 33.3% Antimony Sulfide 28.3% Lead Azide 5% Carborundum
	b. Lower Charge	179.5mg	Lead Azide
	(2) Delay Element M2		
	a. M54 Primer		
	(1) M54 Primer – Primer Mix #70	11.0 mg	Overall Mixture: 53% Potassium Chlorate 25% Lead Thiocyanate 17% Antimony Sulfide 5% Trinitrotoluene
	(2) Black Powder Delay Charge	2.1g	Overall Mixture: 74% Potassium Nitrate 15.6% Charcoal 10.4% Sulfur
	(3) Relay M7	92.7 mg	Lead Azide
	5. Fuze, M57 (with NSN 1315-00-028-4829)		
	a. Booster, M22		
	(1) Pellet Booster	22g	Tetryl

Table C-1-6. Composition of Reactive Material in HD and HT Munitions (Continued)

Munition Type	Component[a]	Weight	Composition
	(2) Detonator Assy		
	(a) Charge Detonator	0.65g	Lead Azide
	(b) Pellet Detonator	0.32g	Tetryl
	b. Detonator, M24		
	(1) Upper Charge	55.7mg	Overall Mixture: 33.4% Potassium Chlorate 33.3% Antimony Sulfide 28.3% Lead Azide 5% Carborundum
	(2) Lower Charge	179.5mg	Lead Azide

Notes:

[a] Other munition composition data are presented in **Table C-1-3**. Components such as the M5, M6, and M14 bursters each consist solely of the explosive listed in **Table C-1-5**.

g = gram
gr = grains
mg = milligrams
TNT = 2,4,6-trinitrotoluene

Source: PCD RCRA Renewal Application, June 2013, Final Rev. 1.

Table C-1-7. Chemical Fills, Treatment Reagents, Treatment, and Vapor Screening Levels

Chemical Fill	Treatment Reagent	Treatment Level[a]	Vapor Screening Level[b] (VSL)
Mustard Agent (HD/HT)[c]	90 vol.% MEA	≤ 50 mg/L mustard agent	< 0.003 mg/m^3

Notes:

[a] When treating chemical agent fills, any liquid waste stream that may have come in contact with chemical agent must meet the treatment level shown.
[b] VSL value is for solid wastes associated with chemical agent only.
[c] HD/HT will be measured as H.

MEA = monoethanolamine
mg/L = milligram per liter
mg/m^3 = milligram per cubic meter
vol.% = volume percent

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