APPENDIX 8-2
EDS PHASE 2 UNIT TRAILER CONTAINMENT PAN
SECONDARY CONTAINMENT CALCULATION

Note: The EDS P2A secondary containment sump has the same dimensions as the sump on the EDS P2R trailer. To eliminate redundancy, only the secondary containment calculation for the EDS P2R trailer is provided.

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CALCULATION COVER SHEET

Calculation Number: P-0167-001
Revision Number: 0
Page 1 of 3

Title: Explosive Destruction System Phase 2 Trailer Secondary Containment Pan Capacity

Project Identification Number: P-0167

Key Words:

Charge Number: 195656.00.001.0167.330 and 195656.00.001.0167.310

Purpose: The purpose of this calculation is to demonstrate that the secondary containment pan located on the Explosive Destruction System (EDS) Trailer contains sufficient capacity to collect all liquids resulting from a spill, leak or release from the EDS Phase 2 Containment Vessel.

Summary of Results:

The calculated secondary containment capacity is 169.64 gallons. The required containment capacity must be 100 percent of the volume of the largest container (EDS Containment Vessel, 160 gallons) or 10 percent of the total volume stored (16 gallons), whichever is greater. In this case, the required containment capacity is 160 gallons. Therefore the trailer secondary containment pan has adequate capacity to provide secondary containment for the EDS Containment Vessel in the event of a leak, spill or [redacted] release.

	Signature:	Date:	Name (print or type):
g	[signature]	1 September 2011	Originator(s): Andrew E. Kin
...ngs	[signature]	1 Sep 2011	Reviewed by: [signature]
...ger: ...t	[signature]	01 Sept 2011	DM/Responsible Manag Aaron Speigh

CALCULATION SHEET

Calculation Number: P-0167-001
Revision Number: 0
Page 2 of 3

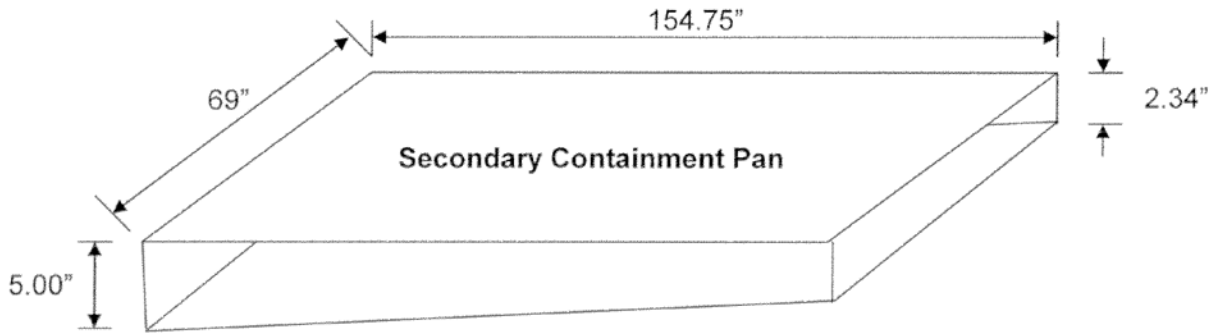
The EDS Trailer **Secondary Containment Pan** will provide secondary containment for the EDS Containment Vessel.

The containment pan will be used to collect any liquids that may result from a spill, leak or release from the EDS Phase 2 Containment Vessel.

Although the EDS is a miscellaneous treatment unit, it is container-like and therefore the secondary containment requirements for hazardous waste container storage areas is presented to show adequate containment capacity. For container storage areas, the required capacity of the secondary containment is 100 percent of the largest container or 10 percent of the total volume stored, whichever is greater.

Design volume of the EDS Containment Vessel is 160 gallons.

NOT TO SCALE



Inside Dimensions:

Length	154.75 inches
Width	69 inches
Depth	2.34 – 5.00 inches

SP 4-2, Rev. 2

The **secondary containment pan** capacity volume is calculated as follows:

Volume of pan	=	volume of rectangular portion of pan + volume of sloped portion of pan		
Volume of rectangle	=	154.75" x 69" x 2.34"	=	24,985.94 inches^3
			=	14.46 feet^3
			=	108.16 gallons
Volume of sloped	=	$\frac{154.75" \times 69" \times (5-2.34)"}{2}$	=	14,201.41 inches^3
			=	8.22 feet^3
			=	61.48 gallons
Volume of pan	=	108.16 + 61.48	=	**169.64 gallons**

The calculated secondary containment capacity is 169.64 gallons. The required containment capacity must be 100 percent of the volume of the largest container (EDS Containment Vessel, 160 gallons) or 10 percent of the total volume stored (16 gallons), whichever is greater. In this case, the required containment capacity is 160 gallons. Therefore the trailer secondary containment pan has adequate capacity to provide secondary containment for the EDS Containment Vessel.

SP 4-2, Rev. 2

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APPENDIX 8-3

SUBPARTS BB AND CC COMPLIANCE STRATEGY

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Table Appendix 8-3-1. EDS Phase 2R Unit Equipment Items

Equipment ID[a]	Location	Equipment Type	Liquid or Vapor	Percent by Weight Organics	Compliance Method
1	Vapor Sample Line/Vessel Door	Valve	V	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
2	Vapor Sample Line	Sample Connection System	V	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
3	Vessel Door	Valve	L/V	> 10%	Monitor per Subpart BB during operations
5	Vessel Door	Drain Valve	L/V	> 10%	Monitor per Subpart BB during operations
6	Vessel Door	Valve	L/V	> 10%	Monitor per Subpart BB during operations
8	Liquid Sample Line/Vessel Door	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
9	Liquid Sample Line/Vessel Door	Sample Connection System	L	> 10%	*In situ* sampling device, exempt [§ 264.1055(c)]
10	Vessel Door	Valve	L/V	> 10%	Monitor per Subpart BB during operations
57	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
58	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
80	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
81	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
83	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
84	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]

Table Appendix 8-3-1. EDS Phase 2R Unit Equipment Items (Continued)

Equipment ID[a]	Location	Equipment Type	Liquid or Vapor	Percent by Weight Organics	Compliance Method
85	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
86	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
87	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
90	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
91	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
92	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
93	Waste Transfer Subsystem	Valve	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
Tank 3 Pan Pump P-890	Waste Transfer Subsystem	Pump	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]
Tank 3 Effluent Pump P-830	Waste Transfer Subsystem	Pump	L	> 10%	Exempt, operates less than 300 hours per year [§ 264.1050(f)]

Notes:

[a] Pumps, Sample Connection System Valves, and ID numbers are identified in **Figure Appendix 8-3-1**.

All information to be retained in the Site Operating Record.

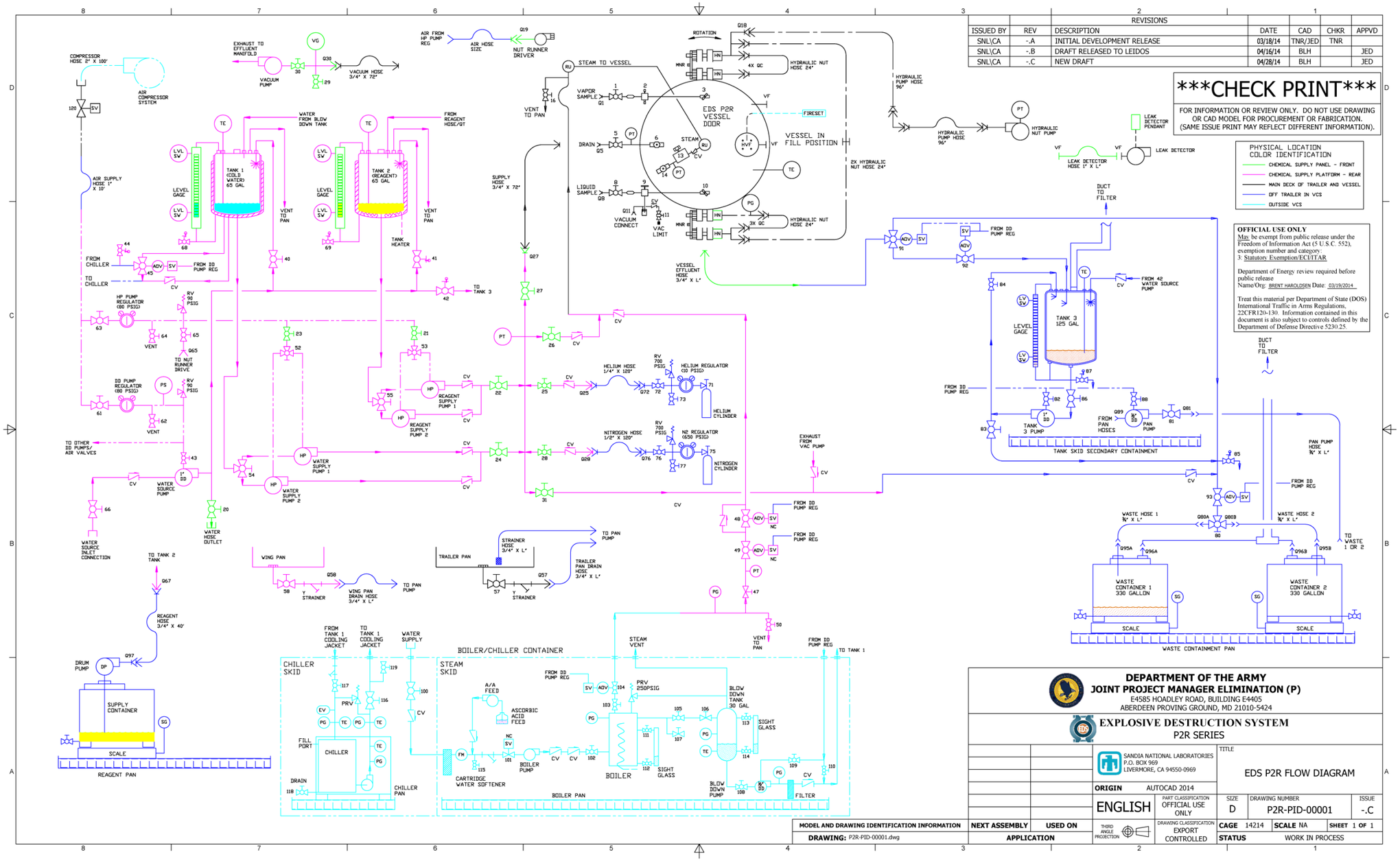

Figure Appendix 8-3-1. EDS P2R Flow Diagram

SUBPART BB HAZARDOUS WASTE TRANSFER TIME TRACKING SHEET													
If Accumulated Time Reaches 250 hours, contact the Command Post or Environmental Coordinator													
EDS Unit:													
EQUIPMENT ID[1]													
Date	Time (24hr)	Valve 1 Vapor Sample Line	Valve 2 Vapor Sample Line	Valve 3 Vapor Sample Line	Valve 5 Liquid Sample Line	Valve 6 Liquid Sample Line	Valve 8 Liquid Sample Line	Valve 9 Liquid Sample Line	Valve 10 Liquid Sample Line	Valve 57 Trailer Sump Y-Strainer	Valve 58 RSS Sump Y-Strainer	Valve 81 HW Tank 3 Sump	Valve 91 Vessel Effluent Hose
	Start: Stop:												
	Start: Stop:												
	Start: Stop:												
	Start: Stop:												
	Start: Stop:												
Accumulated Transfer Time (hh:mm)													

[1] "Equipment ID" means each valve, pump, compressor, pressure relief valve, sampling connection system open-ended valve or line, flange, or other connector, and any control devices or systems that contain or contact hazardous wastes with organic concentrations of at least 10 percent organic content by weight and are managed in a hazardous waste management unit.

Note: Time entered in columns divided by dotted lines are normally the same (i.e., waste flow between valves 83 and 86).

Figure Appendix 8-3-2. Example Subpart BB Hazardous Waste Transfer Time Tracking Sheet (Sheet 1 of 2)

EDS Unit:												
Date	Time (24hr)	Valve 92 Vessel Effluent Feed to Tank 3	Valve 84 Tank 3 Recycle Line	Valve 85 Tank 3 Effluent Sample Line	Valve 87 Tank 3 Effluent Sample Line	Valve 86 Tank 3 Effluent Line	Valve 83 Tank 3 Effluent Line	Valve 90 Tank 3 Effluent Line	Valve 93 Tank 3 Effluent Line	Valve 80 Tank 3 Effluent Hose Select	P-830 Tank 3 Effluent Pump	P-890 Tank 3 Pan Pump
	Start: Stop:											
	Start: Stop:											
	Start: Stop:											
	Start: Stop:											
	Start: Stop:											
	Start: Stop:											
Accumulated Transfer Time (hh:mm)												

[1] "Equipment ID" means each valve, pump, compressor, pressure relief valve, sampling connection system open-ended valve or line, flange, or other connector, and any control devices or systems that contain or contact hazardous wastes with organic concentrations of at least 10 percent organic content by weight and are managed in a hazardous waste management unit.

Note: Time entered in columns divided by dotted lines are normally the same (i.e., waste flow between valves 83 and 86).

Figure Appendix 8-3-2. Example Subpart BB Hazardous Waste Transfer Time Tracking Sheet (Sheet 2 of 2)

APPENDIX 8-4

EDS AIR FILTRATION SYSTEM CARBON FILTER PERFORMANCE

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APPENDIX 8-4
EDS AIR FILTRATION SYSTEM CARBON FILTER PERFORMANCE

1. INTRODUCTION

1.1 Purpose

Two Explosive Destruction System (EDS) units will be located at the Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP) EDS site, Pueblo Chemical Depot, Colorado. Each EDS unit will be located inside an Environmental Enclosure that provides weather protection and interior environmental control for worker comfort and safety. Each enclosure will have two co-located Air Filtration Systems (AFSs) operating in parallel. Each AFS includes prefilter, high efficiency particulate air (HEPA) filters (2), sulfur-impregnated carbon (SIC) high efficiency gas adsorber (HEGA) filters (2), and an induced draft fan to maintain a negative pressure within the structure relative to the outside air and to capture vapors that may result from handling and treatment operations. Air intake dampers will be manually adjusted to maintain negative air pressure in relation to atmospheric pressure. Negative pressure within the Environmental Enclosure is measured using a pressure sensor. The sensor provides a readout and alarms to alert operators in the event the negative pressure deviates from normal acceptable range. Monitoring and maintenance of the pressure sensor and alarm will be part of the Operating Record.

This appendix contains a description of an enclosure AFS and carbon filter unit components plus calculations on carbon filter performance. The purpose of the calculations is to predict how the carbon filter will perform during a catastrophic event.

- **Appendix Attachment 8-4-1** contains a list of acronyms and abbreviations.
- **Appendix Attachment 8-4-2** details the calculations for the catastrophic release scenario.
- **Appendix Attachment 8-4-3** is a list of references.

A description of the EDS and treatment operation is provided in Section D of the permit modification. Mustard chemical agents distilled sulfur mustard (HD)/mustard-T mixture (HT) will be treated at the PCAPP EDS site.

1.2 Background

An Environmental Enclosure surrounds the EDS. The AFS provides negative pressure ventilation for the enclosure and filters air from the enclosure before it is released to the environment. Gases from the EDS treatment process are vented via a duct to the AFS. The release of gases from the EDS to the AFS is a controlled process and is not performed until the treatment level has been reached. Therefore, the amount of chemical agent released from the EDS to the AFS is negligible. The greatest potential for agent challenge to the AFS would be if a munition were to leak while inside the Environmental Enclosure, but before it has been sealed inside the EDS Containment Vessel.

The AFS consists of a prefilter, a HEPA filter, two HEGA filter banks in series, another HEPA filter, and a motor-powered exhaust fan. The filter unit fan draws air from the Environmental Enclosure through the carbon filter unit components and subsequently discharges to the atmosphere.

The two HEGA filter banks in the enclosure AFS are composed of SIC beds.

1.3 Methodology for Evaluating Calculation Results

The evaluated scenario has been developed using an indoor spill scenario developed for the Federal Emergency Management Agency and U.S. Army Chemical Stockpile Emergency Preparedness Program (CSEPP) and presents conservative operating conditions and maximum anticipated operating parameters.

1.4 EDS Safeguards

Safeguards and procedures have been established to ensure that: (1) filter units are operating properly before treatment operations begin and (2) if breakthrough occurs, necessary actions are taken to restore filter performance. Additionally, all of the munitions to be treated will arrive at an EDS unit in either a universal munition storage container or other containers approved for use at PCD, and will be placed in its entirety into an EDS for treatment. The container will not be opened.

EDS safeguards include:

- Leak-testing of AFS carbon filter banks
- Midbed agent monitoring
- Carbon changeout.

Leak-Testing Carbon Banks

EDS carbon filters are tested before first use, after each changeout of carbon filters, and before restarting operations after a temporary closeout. Testing is in accordance with the American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) standard N511-2007, "Testing of Nuclear Air Cleaning System." Leak testing and leak-test results including comparison criteria will be part of the Operating Record.

Midbed Agent Monitoring

Operational safeguards present at the EDS provide for system reliability. As described in **Attachment 2** of this permit modification, MINICAMS® and Depot Area Air Monitoring System (DAAMS) confirmation monitoring will be used to monitor the enclosure AFS. The presence of chemical agent mustard at the midbed is monitored continuously; the filters are replaced should breakthrough be confirmed. Monitoring will be performed to provide sufficient warning so that corrective action can be taken before a release of chemical agent occurs.

Carbon Changeout Strategy

Mandatory criteria have been established for changing out banks of activated carbon in the enclosure AFS when chemical agent is positively detected in the midbed or exhaust monitoring locations. Carbon filters will be changed out when (1) midbed monitoring confirms breakthrough of chemical agent at a **concentration at the vapor screening level (0.7Z where Z is equivalent to 1 VSL) alarm level** and (2) after completing EDS treatment operations (Resource Conservation and Recovery Act [RCRA] closure). If a carbon midbed monitoring detection is confirmed, the operation will be brought to a safe shutdown state. The first carbon filter will be removed and disposed of, the second carbon filter will be moved to the first, and a new carbon filter will be added as the second filter. All filters will be leak checked in accordance with the ANSI N511-2007 standard before processing may resume. The in-place

leak tests ensure mechanical integrity of the filter units before bringing them back into service after the carbon changeout.

2. CALCULATION METHOD

Vapor emission rates are calculated based on physical properties and process parameters. The emission period for vapors will be scenario-specific, but a time sequence for operation, monitoring, and performance of corrective actions will be postulated. Termination of the emission event will be recognized when engineering containment of the release is re-established.

3. CALCULATION SCENARIO

The following scenario was considered:

- Catastrophic release of mustard agent (H)[1] within the EDS enclosure from the rupture of a munition outside the EDS Containment Vessel.

Calculations for this scenario are presented in **Appendix Attachment 8-4-2** of this attachment.

3.1 Catastrophic Scenario

The catastrophic scenario evaluated is the accidental release of H, the fill material present in all of the items to be treated in the EDS. The spill size was assumed to be the entire contents of the largest item expected to contain that fill and be brought into the EDS enclosure. It was assumed that the spilled liquid formed a pool 0.1 centimeter deep that was open to the room (as opposed to being contained in a sump).

The largest H-filled item is a 155mm projectile, which could contain up to 11.7 pounds (lbs) (0.148 cubic feet) of H (SciTech, 1998). This amount of H fill (11.7 lbs) equates to approximately 7.6 lbs (0.096 cubic feet) of liquid mustard agent, as the rest is solid heel. After being placed into a munition, H forms a heel of solid material, which no longer being liquid would not flow from the munitions. A study of 155mm H-filled munitions revealed that the average munition contained 39 percent heel while the median value was 32 percent. Therefore, a heel value of 35 percent was used for these calculations (PMCD, 2011). It

[1] HD/HT are measured as H.

is assumed that 1 hour is needed for the spilled material to be contained and that the temperature of the spilled material is 21.1°C (70°F). Based on these assumptions, the filter challenge is calculated to be the amount of agent that would be adsorbed by the carbon filter in 60 minutes at 21.1°C (70°F). The minute by minute iterative calculations showed that only 0.02273 lb of H was transferred to the carbon filter in 60 minutes and 0.02271 lb was adsorbed by the carbon filter with 99.9 percent mechanical efficiency.

3.2 Calculations

Catastrophic Scenario. The catastrophic emission scenario calculations are presented in **Appendix Attachment 8-4-2**.

4. RESULTS

4.1 Catastrophic Emission

4.1.1 H Scenario. The evaporation for H was calculated to be 68.6 milligrams per minute (mg/min) per square meter (m^2) (or 185 mg/min based on 2.699 m^2 pool area). A mass of 0.02273 lb of H was transferred to the carbon filter during the 60 minutes after the spill. The amount adsorbed by the carbon filter was 0.02271 lb during these 60 minutes. Thus, the emissions from the carbon filter would be 0.000023 lb in the first 60 minutes after the spill. The maximum concentration in the exhaust air was estimated to be 0.000982 milligram per cubic meter (mg/m^3) during this 60-minute period. Based on a carbon filter capacity for H of 0.2 gram (g) of H per g of carbon, the total filter capacity (assuming 4,000 pounds of carbon) is approximately 800 lbs of H. The filter is capable of handling more than 35,195 H maximum credible events (MCEs) without breakthrough. Therefore, the catastrophic event would not result in breakthrough of the carbon filter.

5. CONCLUSIONS

The carbon filter unit used in the enclosure AFS was specifically designed for chemical agent processing operations and is more than adequate to handle normal as well as catastrophic releases as shown by calculations. The use of this filtration system, in addition to EDS Standing Operating Procedures, will ensure that normal EDS operations with accidental spills pose little threat to human health and the environment.

The calculations for an unlikely catastrophic release of H within the EDS enclosure indicate that the enclosure AFS has sufficient capacity to contain H vapors without breakthrough of the AFS. The filter challenge from the H catastrophic scenario was determined to be 0.02273 lb of H and the filter capacity for H was calculated to be 800 lbs of H.

The maximum 1-minute emission rate for H leaving the AFS is 0.000982 mg/m^3, which is less than the source emission limit (SEL) of 0.03 mg/m^3 and below the VSL of 0.003 mg/m^3.

APPENDIX ATTACHMENT 8-4-1
ACRONYMS AND ABBREVIATIONS

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APPENDIX ATTACHMENT 8-4-1

ACRONYMS AND ABBREVIATIONS

AFS	Air Filtration System
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
cfm	cubic feet per minute
cm	centimeter
CSEPP	Chemical Stockpile Emergency Preparedness Program
DAAMS	Depot Area Air Monitoring System
EDS	Explosive Destruction System
ft^3	cubic feet
g	gram
g/g	gram per gram
H	sulfur mustard (bis(2-chloroethyl) sulfide)
HD	distilled sulfur mustard
HEGA	high efficiency gas adsorber
HEPA	high efficiency particulate air
HT	mustard-T mixture
kg	kilogram
lbs	pounds
m^2	square meter
m/min	meter per minute
MCE	maximum credible event

mg	milligram
mg/min	milligram per minute
mg/m^3	milligram per cubic meter
$mg/min/m^2$	milligram per minute per square meter
mm	millimeter
PCAPP	Pueblo Chemical Agent-Destruction Pilot Plant
psia	pounds per square inch absolute
RCRA	Resource Conservation and Recovery Act
SEL	source emission limit
SIC	sulfur-impregnated carbon
VSL	vapor screening level

APPENDIX ATTACHMENT 8-4-2

CATASTROPHIC RELEASE

MUSTARD AGENT (H)

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APPENDIX ATTACHMENT 8-4-2

CATASTROPHIC RELEASE

MUSTARD AGENT (H)

1. PURPOSE

Determine the capacity of the enclosure Air Filtration System (AFS) to contain chemical agent during a catastrophic release within the Explosive Destruction System (EDS) enclosure.

Calculations were performed for the following catastrophic release scenario: a spill of sulfur mustard (H). H was selected because the items with the largest catastrophic potential to be brought into the EDS enclosure are mustard-filled munitions. Therefore, assuming all the munitions are equally corroded, it is most likely that if there is a leak, it will be from an H-filled munition.

The catastrophic release scenario for H assumes spillage of the liquid portion of a 155mm projectile (the largest recovered munition likely to contain H) contents inside the EDS enclosure.

2. ANALYTICAL METHOD

- Calculate H challenge to the AFS.
- Calculate H evaporation rate.
- Calculate mass of H evaporated.
- Calculate enclosure AFS capacity for H.
- Calculate AFS carbon capacity safety factor and H emission rate.

3. H SCENARIO INPUTS

EDS Enclosure Volume (assumes Sprung Structure with 60' L x 40' W x 25' H)

35,100 cubic feet (ft^3)

Munitions (SciTech, 1998)

Type	155mm projectile, M110
Fill	11.7 pounds (lbs) H
Heel	35%
Liquid H	7.6 lbs
Density of H	79.28 lbs/cubic foot
Volume of Liquid H	0.096 ft^3

AFS Specifications

Flow rate	3,325 ft^3 per minute (cfm per AFS; two AFS units operate in parallel during operations)
Mass of carbon	4,000 lbs (2,000 lbs per AFS)
Filter mech. efficiency (H) (per ASME N-510-1)	99.9%
Carbon capacity H	0.2 gram of H per gram (g/g) of carbon (based on Mahle, 2008)

4. ASSUMPTIONS

1. The EDS enclosure has no interior rooms or false ceilings.
2. Airflow through the room is constant and uniform.
3. The spilled material forms a pool 0.1 centimeter (cm) deep.
4. Evaporation rate is constant over the duration of the calculation.
5. The spilled liquid is at the same temperature as the enclosure air (21.1°C [70°F] is assumed).
6. Ambient pressure is 14.7 pounds per square inch absolute (psia).
7. The entire mass of evaporated chemical enters the AFS; none is lost due to condensation on equipment or structural surfaces.
8. It is further assumed that 1 hour elapses before spill response actions are able to contain the spilled chemical agent.

5. H CALCULATIONS

5.1 Calculate H Challenge to Enclosure AFS

5.1.1 Calculate Evaporation Rate of H. This calculation used the evaporation model for indoor spill scenarios developed for the Chemical Stockpile Emergency Preparedness Program (CSEPP) (Fedele, 2003). This model is considered conservative, as it provides the highest value for evaporation flux.

$$E = C_{vol} \text{ x } V_{evap}$$

Where:

E	=	evaporation flux in milligrams per minute per square meter ($mg/min/m^2$)
C_{vol}	=	volatility of the liquid in milligrams per cubic meter (mg/m^3) = 686 mg/m^3 at 21.1°C (70°F) for H
V_{evap}	=	evaporation transfer rate in meters per minute (m/min) = 0.1 m/min (Fedele, 2003)
E	=	686 $mg/m^3 \times 0.1$ m/min = 68.6 mg/min per m^2

Because mustard agent has about 35% heel, the liquid portion is calculated to be:

Liquid Portion	=	Total Content (1 - % Heel/100)
	=	$11.7 \times (1 - 35/100)$
	=	7.6 lbs

Because the spill amount is 7.6 lbs (3.45 kilograms [kg]), the pool area (A) is evaluated to be 29.04 sq. ft. (2.699 m^2) for H agent with density of 79.28 lbs/cubic foot and 0.039 inch (0.1 cm) pool thickness. The evaporation rate (R) for the entire spill is calculated as follows:

$$ER = E \times A$$
$$= 68.6 \times 2.699$$
$$= 185 \text{ mg/min}$$

5.1.2 Calculate Mass of H Evaporated in 60 Minutes.

Mass of H evaporated in 60 minutes = 60 min × (Evaporation Rate)

Mass = 60 min × 185 mg/min = 11,100 mg (or 0.0111 kg)
= 11,100 mg × 0.001 g/mg / 454 g/lb
= 0.02445 lbs

5.1.3 Calculate Filter Capacity for H.

Filter Capacity = (Carbon Capacity) × (Mass of Carbon)
Capacity = 0.2 lb/lb × 4,000 lb = 800 lbs

5.1.4 Calculate AFS Carbon Capacity Safety Factor and Emission Rate.

Amount transferred to filter in one hour = 0.02273 lbs
(By iterative calculations)

Amount adsorbed in AFS carbon filters = (Mass Rate of H Entering Filter in 1 hour) × (% Filter Efficiency/100)
= 0.02273 lbs/hr × 0.999
= 0.02271 lbs/hr

Emission Rate = (Mass Rate of H Entering Filter in 1 hour) × (1 - % Filter Efficiency/100)
Emission Rate = 0.02273 lbs/hr × (1-0.999)
= 0.000023 lbs/hr

Note: Mass rate entering the filter is calculated by evaluating the gas concentration in the room as a function of time. This concentration changes as long as there is a difference between the amount evaporated in a minute and the amount transferred to the carbon filter.

The filter capacity (800 lbs) is greater (by a factor of about 35,195) than the size of the H challenge (0.02273 lb/hr). Therefore, the filter is able to contain the challenge without reaching breakthrough for H.

6. CONCLUSION

As shown by calculation, the enclosure AFS has sufficient capacity that the H released from the catastrophic spill scenarios will not exceed the capacity of the AFS.

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APPENDIX ATTACHMENT 8-4-3

REFERENCES

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APPENDIX ATTACHMENT 8-4-3

REFERENCES

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Fedele, P., P. Georgopoulos, P. Shade, P. Lioy, M. Hodgson, and M. Brown, *In-hospital Response to External Chemical Emergencies: Personal Protective Equipment, Training, Site Operations Planning, and Medical Programs*, para. 3.5, pg. 11, 15 April 2003.

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APPENDIX 8-5

800 kW GENERATOR SET PMCS CHECKLIST

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800 kW Generator Set
(QST30 Series Diesel Engine)

Preventive Maintenance, Checks and Services (PMCS) Checklist

Recovered Chemical Materiel Directorate

August 2014

GENERAL INFORMATION

Purpose

The purpose of this checklist is to provide users of the 800 kW Generator Set (Part Number 800DQFAB) with a quick reference of preventive maintenance, checks and services (PMCS) that are recommended by the manufacturer. Scheduled maintenance tasks listed in the checklist are based on information available in the generator set operations and maintenance manuals provided by Cummins Power Generation Inc. The checklist is intended to be used as a guide in correlation with the product manuals. Personnel performing maintenance on the generator set must be familiar with the equipment and its operation including Safety Precautions listed in the product manuals.

How to Use the Checklist

The checklist provides a list of maintenance tasks in the left-hand column that should be performed on a scheduled basis. The columns that are to the right of the maintenance task column list the frequency of when each task should be completed. Hours listed with calendar time periods (I.e., daily, weekly) represent operating hours of the equipment. Maintenance should be performed at the earliest specified frequency. In other words, if the frequency is listed as *Weekly or 50 hours*, and 50 hours operating time is reached before the week has ended, that particular maintenance should be done at the 50 hour interval. Notes at the end of the table provide additional information regarding the task or frequency as needed.

References

Cummins Power Generation, Inc., *Health and Safety Manual,* 0908-0110, Issue 5, November 2009.
Cummins Power Generation, Inc., *Generator Set Operator Manual,* 961-0115, Issue 3, November 2012.
Cummins Power Generation, Inc., *Owner's Manual, QST30 Series Engine,* November 2005

800 kW Generator Set PMCS Checklist

Maintenance Tasks	Frequency						
	Daily or 8 Hours	Weekly or 50 Hours	Monthly or 100 Hours	Semi-Annual or 250 Hours	Yearly or 500 Hours	2 Years or 6000 Hours	Operating Hours Only
General inspection of generator condition	X						
Check battery condition, terminals	X						
Check coolant heater	X						
Check engine oil level	X						
Check for engine oil leaks	X						
Check coolant level	X						
Check for coolant leaks	X						
Check fuel level	X						
Check for fuel leaks	X						
Drain fuel/water separator	X						
Check for exhaust system leaks (Check audibly and visually)	X						
Check charge air cooler, piping and hoses	X						
Check air cleaner ducts and hoses	X						
Check air intake piping	X						
Check air cleaner precleaner	X						
Check Centinel™ oil level	X						
Check and record AC voltage, AC ammeter, frequency	X						
Check “switch in auto” functionality	X						

800 kW Generator Set PMCS Checklist (Continued)

Maintenance Tasks	Frequency						
	Daily	Weekly or 50 Hours	Monthly or 100 Hours	Semi-Annual or 250 Hours	Yearly or 500 Hours	2 Years or 6000 Hours	Operating Hours Only
Check air cleaner (Replace filter element if required)		X (1)					
Drain water/sediment from fuel filter and tank		X					
Check battery charging system		X					
Drain exhaust condensate trap			X				
Check starting batteries (8D Lead/Acid type)			X				
Operate the generator (if idle for long periods)			X				
Change air cleaner element				X (1)			
Check condition of radiator hoses				X			
Change engine oil and filter				X (2) (3)			
Change fuel filters				X			
Check crankcase oil, filter, and clean breather tube				X			
Check anti-freeze concentration and supplement if needed				X			
Change coolant filter				X			
Check engine drive belt(s) condition and tension				X			
Check cooling fan and clean system				X			
Charge air cooler				X			
Clean fuel lift pump inlet screen				X			
Test generator insulation resistance					X		
Test rupture basin leak detect switch					X		
Steam clean engine					X (4)		
Check radiator hoses					X (4)		

800 kW Generator Set PMCS Checklist (Continued)

Maintenance Tasks	Frequency						
	Daily	Weekly or 50 Hours	Monthly or 100 Hours	Semi-Annual or 250 Hours	Yearly or 500 Hours	2 Years or 6000 Hours	Operating Hours Only
Check air compressor discharge lines					X (4)		
Check engine mounts					X (4)		
Check crankshaft					X (4)		
Adjust overhead set					X (4)		
Check engine oil heater					X (4)		
Check coolant heater					X (4)		
Check fan drive idler pivot arm assembly					X (4)		
Adjust cooling fan drive belt					X (4)		
Check heat exchanger plugs for corrosion					X (4)		
Flush coolant system						X	
Check fan hub belt						X	
Check water pump						X	
Check turbocharger						X	
Check viscous vibration damper						X	
Check air compressor unloader valve assembly						X	
Check battery charge, specific gravity and electrolyte level							200
Grease generator bearing							4000-4500

(1) Perform more often in high dust/dirty environmental conditions, or when service indicator button pops.
(2) If generator is used for standby applications, change oil every 12 months or 250 hours.
(3) If desired, the oil change frequency can be based on fixed hours or chart method for fuel consumption by following the manufacturer's maintenance manual.
(4) Perform at 2000 hours or 1 year, whichever is reached first.

APPENDIX A

PREVENTIVE MAINTENANCE
CHECKS AND SERVICES (PMCS) FORMS

800 KW GENERATOR SET / QST30 SERIES DIESEL ENGINE
COMPLETED PMCS VERIFICATION FORM

Instructions: The individual who performed PMCS must fill out this form and sign it, then obtain the maintenance supervisor's signature. This form should be stapled to the completed PMCS Task Sign-off Form (provided in this appendix) and filed for a record of completed PMCS actions. Items 1 and 2 are self-explanatory. For item 3, the maintainer circles the frequency performed in columns (a) or (b) of the table, then initials column (c) appropriately. If a PMCS frequency is performed, but not listed in the table, it should be identified in the "Other" block depending whether the frequency was calendar or operating hours. The Remarks column (d) provides space for additional detail.

1. Date PMCS Performed (MM/DD/YYYY): _____

2. Generator Serial Number: _____

3. PMCS Frequency Performed (Circle and initial):

(a)	(b)	(c)	(d)
Calendar	Operating Hours	Initials of Maintainer	Remarks
Daily	8 Hours		
Weekly	50 Hours		
Monthly	100 Hours		
Semi-Annual	250 Hours		
Yearly	500 Hours		
2 Years	6,000 Hours		
Other _____	Other _____		

4. Individual Who Performed PMCS: _____

5. Maintenance Supervisor: _____

800 KW GENERATOR SET / QST30 SERIES DIESEL ENGINE
COMPLETED PMCS TASK SIGN-OFF FORM

Instructions: This form is provided to assist individuals performing PMCS by ensuring that all tasks are completed when required. Any discrepancies found during PMCS should be listed in the Remarks column, however, the purpose of this form is not to capture repair maintenance actions. Tasks that could not be completed in whole or part should also be explained in the Remarks column. When the individual performing PMCS has completed a task, the individual initials next to that task to signify completion. All PMCS must be performed in accordance with manufacturer/vendor instructions. Additional details about performing this PMCS can be provided at the end of the table.

Frequency	Maintenance Task	Initials	Remarks
Daily or 8 hours	General inspection of generator condition		
Daily or 8 hours	Check battery condition, terminals		
Daily or 8 hours	Check coolant heater		
Daily or 8 hours	Check engine oil level		
Daily or 8 hours	Check for engine oil leaks		
Daily or 8 hours	Check coolant level		
Daily or 8 hours	Check for coolant leaks		
Daily or 8 hours	Check fuel level		
Daily or 8 hours	Check for fuel leaks		
Daily or 8 hours	Drain fuel/water separator		

Frequency	Maintenance Task	Initials	Remarks
Daily or 8 hours	Check for exhaust system leaks (Check audibly and visually)		
Daily or 8 hours	Check charge air cooler, piping and hoses		
Daily or 8 hours	Check air cleaner ducts and hoses		
Daily or 8 hours	Check air intake piping		
Daily or 8 hours	Check air cleaner precleaner		
Daily or 8 hours	Check Centinel™ oil level		
Daily or 8 hours	Check and record AC voltage, AC ammeter, frequency		
Daily or 8 hours	Check “switch in auto” functionality		
Weekly or 50 hours	Check air cleaner (Replace filter element if required)		
Weekly or 50 hours	Drain water/sediment from fuel filter and tank		
Weekly or 50 hours	Check battery charging system		
Monthly or 100 hours	Drain exhaust condensate trap		
Monthly or 100 hours	Check starting batteries (8D Lead/Acid type)		
Monthly or 100 hours	Operate the generator (if idle for long periods)		
Semi-Annual or 250 hours	Change air cleaner element		
Semi-Annual or 250 hours	Check condition of radiator hoses		

Frequency	Maintenance Task	Initials	Remarks
Semi-Annual or 250 hours	Change engine oil and filter		
Semi-Annual or 250 hours	Change fuel filters		
Semi-Annual or 250 hours	Check crankcase oil, filter, and clean breather tube		
Semi-Annual or 250 hours	Check anti-freeze concentration and supplement if needed		
Semi-Annual or 250 hours	Change coolant filter		
Semi-Annual or 250 hours	Check engine drive belt(s) condition and tension		
Semi-Annual or 250 hours	Check cooling fan and clean system		
Semi-Annual or 250 hours	Charge air cooler		
Semi-Annual or 250 hours	Clean fuel lift pump inlet screen		
Yearly or 500 hours	Test generator insulation resistance		
Yearly or 500 hours	Test rupture basin leak detect switch		
Yearly or 500 hours	Steam clean engine		
Yearly or 500 hours	Check radiator hoses		
Yearly or 500 hours	Check air compressor discharge lines		
Yearly or 500 hours	Check engine mounts		
Yearly or 500 hours	Check crankshaft		

Frequency	Maintenance Task	Initials	Remarks
Yearly or 500 hours	Adjust overhead set		
Yearly or 500 hours	Check engine oil heater		
Yearly or 500 hours	Check coolant heater		
Yearly or 500 hours	Check fan drive idler pivot arm assembly		
Yearly or 500 hours	Adjust cooling fan drive belt		
Yearly or 500 hours	Check heat exchanger plugs for corrosion		
2 Years or 6,000 hours	Flush coolant system		
2 Years or 6,000 hours	Check fan hub belt		
2 Years or 6,000 hours	Check water pump		
2 Years or 6,000 hours	Check turbocharger		
2 Years or 6,000 hours	Check viscous vibration damper		
2 Years or 6,000 hours	Check air compressor unloader valve assembly		
200 hours	Check battery charge, specific gravity and electrolyte level		
4,000-4,500 hours	Grease generator bearing		

During PMCS, the following additional equipment, special tools, parts, or personnel were required (Explain):

During PMCS, the following non-mission capable discrepancies were discovered and reported:

Additional Comments: