Resource Conservation and Recovery Act (RCRA)

Hazardous Waste Storage and Treatment Permit Application

MODULE IX

Transportation and Storage of Nerve Agent-Related Items from Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP)

Blue Grass Army Depot, Richmond, Kentucky
EPA ID# KY8-231-820-105

Submitted to:
Energy and Environment Cabinet
Kentucky Department for Environmental Protection
Division of Waste Management
300 Sower Boulevard
Frankfort, Kentucky 40601

Submitted by:
Blue Grass Army Depot
431 Battlefield Memorial Highway, Richmond, Kentucky 40475

and

Assembled Chemical Weapons Alternatives
Blue Grass Chemical Agent-Destruction Pilot Plant
830 Eastern Bypass, Suite 106, Richmond, Kentucky 40475

March 2021

Revision 3

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LIST OF ABBREVIATIONS

ACWA	Assembled Chemical Weapons Alternatives
AEGL	Acute Exposure Guideline Level
ATNAA	Antidote Treatment Nerve Agent Autoinjector
BGAD	Blue Grass Army Depot
BGCA	Blue Grass Chemical Activity
BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
CAIRA	Chemical Accident or Incident Response and Assistance
CFM	cubic feet per meter
CFR	Code of Federal Regulations
CLA	Chemical Limited Area
CPC	chemical protective clothing
CSEPP	Chemical Stockpile Emergency Preparedness Program
DAAMS	Depot Area Air Monitoring System
DoD	Department of Defense
DOT	Department of Transportation
EHS	extremely hazardous substance
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ft^2	square feet
gal	gallon
GB	Sarin nerve agent
H	mustard agent
HAZMART	hazardous materials pharmacy
HAZMAT	hazardous material
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high efficiency particulate air
HWMTP	Hazardous Waste Management Training Program
HWSU	hazardous waste storage unit
IC	Incident Commander
KAR	Kentucky Administrative Regulations
KDEP	Kentucky Department for Environmental Protection
L	liter

MCE	Maximum Credible Event
mg/m^3	milligram(s) per cubic meter
MHE	material handling equipment
min	minute
NIOSH	National Institute of Occupational Safety and Health
NRC	National Response Center
NRHP	National Register of Historic Places
OD	outside diameter
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyls
PE	Professional Engineer
PEO	Program Executive Office
POC	point of contact
PPE	personal protective equipment
QRA	quantitative risk assessment
RCRA	Resource Conservation and Recovery Act
RM	rocket motor (M67 rocket motor assembly)
SDC	Static Detonation Chamber
SDS	Safety Data Sheet
SFT	shipping and firing tube
SOP	Standing Operating Procedure
SRC	single round container
SWMU	solid waste management unit
TAP	Toxicological Agent Protective
USEPA	U.S. Environmental Protection Agency
VSL	vapor screening level
VX	V-series nerve agent
WH	warhead (M56 warhead assembly)
WPL	worker population limit

United States Environmental Protection Agency
RCRA SUBTITLE C SITE IDENTIFICATION FORM

1. Reason for Submittal (Select only one.)

☐	Obtaining or updating an EPA ID number for an on-going regulated activity that will continue for a period of time. (Includes HSM activity)
☐	Submitting as a component of the Hazardous Waste Report for___________(Reporting Year)
	☐ Site was a TSD facility and/or generator of > 1,000 kg of hazardous waste, > 1 kg of acute hazardous waste, or > 100 kg of acute hazardous waste spill cleanup in **one or more months of the reporting year** (or State equivalent LQG regulations)
☐	Notifying that regulated activity is no longer occurring at this Site
☐	Obtaining or updating an EPA ID number for conducting Electronic Manifest Broker activities
☑	Submitting a new or revised Part A Form

2. Site EPA ID Number

K	Y	8	2	1	3	8	2	0	1	0	5

3. Site Name

Blue Grass Army Depot (BGAD)

4. Site Location Address

Street Address **431 Battlefield Memorial Highway**		
City, Town, or Village **Richmond**		County **Madison**
State **KY**	Country **United States**	Zip Code **40475**

5. Site Mailing Address ☑ Same as Location Address

Street Address		
City, Town, or Village		
State	Country	Zip Code

6. Site Land Type

☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

7. North American Industry Classification System (NAICS) Code(s) for the Site (at least 5-digit codes)

A. (Primary) **928110**	C. **NA**
B. **NA**	D. **NA**

8. Site Contact Information

☑ Same as Location Address

First Name James	MI L	Last Name Hawkins
Title BGAD, Director of Public Wroks		
Street Address 431 Battlefield Memorial Highway		
City, Town, or Village Richmond		
State KY	Country United States	Zip Code 40475
Email james.l.hawkins18.civ@mail.mil		
Phone 859-779-6374	Ext NA	Fax 859-779-6465

9. Legal Owner and Operator of the Site

A. Name of Site's Legal Owner

☑ Same as Location Address

Full Name U.S. Department of the Army	Date Became Owner (mm/dd/yyyy) 4/1/1942
Owner Type ☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other	
Street Address 431 Battlefield Memorial Highway	
City, Town, or Village Richmond	
State KY	Country United States · Zip Code 40475
Email stephen.d.dorris.mil@mail.mil	
Phone 859-779-6246	Ext NA · Fax
Comments NA	

B. Name of Site's Legal Operator

☑ Same as Location Address

Full Name Assembled Chemical Weapons Alternatives - BGCAPP	Date Became Operator (mm/dd/yyyy) 7/11/2016
Operator Type ☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other	
Street Address 830 Eastern Bypass, Suite 106	
City, Town, or Village Richmond	
State KY	Country USA · Zip Code 40475
Email candace.m.coyle.civ@mail.mil	
Phone 859-779-7450	Ext NA · Fax
Comments: Assembled Chemical Weapons Alternatives (ACWA) - Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP): ACWA's mission is chemical weapons destruction.	

10. Type of Regulated Waste Activity (at your site)

Mark "Yes" or "No" for all current activities (as of the date submitting the form); complete any additional boxes as instructed.

A. Hazardous Waste Activities

✔Y N	1. Generator of Hazardous Waste—If "Yes", mark only one of the following—a, b, c		
	☑	a. LQG	-Generates, in any calendar month (includes quantities imported by importer site) 1,000 kg/mo (2,200 lb/mo) or more of non-acute hazardous waste; or - Generates, in any calendar month, or accumulates at any time, more than 1 kg/mo (2.2 lb/mo) of acute hazardous waste; or - Generates, in any calendar month or accumulates at any time, more than 100 kg/mo (220 lb/mo) of acute hazardous spill cleanup material.
	☐	b. SQG	100 to 1,000 kg/mo (220-2,200 lb/mo) of non-acute hazardous waste and no more than 1 kg (2.2 lb) of acute hazardous waste and no more than 100 kg (220 lb) of any acute hazardous spill cleanup material.
	☐	c. VSQG	Less than or equal to 100 kg/mo (220 lb/mo) of non-acute hazardous waste.
If "Yes" above, indicate other generator activities in 2 and 3, as applicable.			
Y ✔N	2. Short-Term Generator (generates from a short-term or one-time event and not from on-going processes). If "Yes", provide an explanation in the Comments section.		
Y ✔N	3. Mixed Waste (hazardous and radioactive) Generator		
✔Y N	4. Treater, Storer or Disposer of Hazardous Waste—Note: A hazardous waste Part B permit is required for these activities.		
✓Y N	5. Receives Hazardous Waste from Off-site		
Y ✔N	6. Recycler of Hazardous Waste		
	☐	a. Recycler who stores prior to recycling	
	☐	b. Recycler who does not store prior to recycling	
Y ✔N	7. Exempt Boiler and/or Industrial Furnace—If "Yes", mark all that apply.		
	☐	a. Small Quantity On-site Burner Exemption	
	☐	b. Smelting, Melting, and Refining Furnace Exemption	

B. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g. D001, D003, F007, U112). Use an additional page if more spaces are needed.

D001	D006	D011	D026	D035	F001	U002
D002	D007	D018	D027	D037	F002	U003
D003	D008	D019	D028	D038	F003	U044
D004	D009	D022	D029	D039	F004	U080
D005	D010	D024	D030	D040	F005	U103

C. Waste Codes for State Regulated (non-Federal) Hazardous Wastes. Please list the waste codes of the State hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed.

N001	N003	N702	N901			
N002	N701	N703	N902			

11. Additional Regulated Waste Activities (NOTE: Refer to your State regulations to determine if a separate permit is required.)

A. Other Waste Activities

☐ Y ☑ N		1. Transporter of Hazardous Waste—If "Yes", mark all that apply.
	☐	a. Transporter
	☐	b. Transfer Facility (at your site)
☐ Y ☑ N		2. Underground Injection Control
☐ Y ☑ N		3. United States Importer of Hazardous Waste
☐ Y ☑ N		4. Recognized Trader—If "Yes", mark all that apply.
	☐	a. Importer
	☐	b. Exporter
☐ Y ☑ N		5. Importer/Exporter of Spent Lead-Acid Batteries (SLABs) under 40 CFR 266 Subpart G—If "Yes", mark all that apply.
	☐	a. Importer
	☐	b. Exporter

B. Universal Waste Activities

☐ Y ☑ N		1. Large Quantity Handler of Universal Waste (you accumulate 5,000 kg or more) - If "Yes" mark all that apply. Note: Refer to your State regulations to determine what is regulated.
	☐	a. Batteries
	☐	b. Pesticides
	☐	c. Mercury containing equipment
	☐	d. Lamps
	☐	e. Other (specify) ________________
	☐	f. Other (specify) ________________
	☐	g. Other (specify) ________________
☐ Y ☑ N		2. Destination Facility for Universal Waste Note: A hazardous waste permit may be required for this activity.

C. Used Oil Activities

☐ Y ☑ N		1. Used Oil Transporter—If "Yes", mark all that apply.
	☐	a. Transporter
	☐	b. Transfer Facility (at your site)
☐ Y ☑ N		2. Used Oil Processor and/or Re-refiner—If "Yes", mark all that apply.
	☐	a. Processor
	☐	b. Re-refiner
☐ Y ☑ N		3. Off-Specification Used Oil Burner
☐ Y ☑ N		4. Used Oil Fuel Marketer—If "Yes", mark all that apply.
	☐	a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner
	☐	b. Marketer Who First Claims the Used Oil Meets the Specifications

12. Eligible Academic Entitieth Laboratories—Notification for opting into or withdrawing from managing laboratory hazardous wastes pursuant to 40 CFR 262 Subpart K.

☐ Y ☑ N		A. Opting into or currently operating under 40 CFR 262 Subpart K for the management of hazardous wastes in laboratories—If "Yes", mark all that apply. Note: See the item-by-item instructions for definitions of types of eligible academic entities.
	☐	1. College or University
	☐	2. Teaching Hospital that is owned by or has a formal written affiliation with a college or university
	☐	3. Non-profit Institute that is owned by or has a formal written affiliation with a college or univer-
☐ Y ☑ N		B. Withdrawing from 40 CFR 262 Subpart K for the management of hazardous wastes in laboratories.

13. Episodic Generation

☐ Y ☑ N	Are you an SQG or VSQG generating hazardous waste from a planned or unplanned episodic event, lasting no more than 60 days, that moves you to a higher generator category. If "Yes", you must fill out the Addendum for Episodic Generator.

14. LQG Consolidation of VSQG Hazardous Waste

☐ Y ☑ N	Are you an LQG notifying of consolidating VSQG Hazardous Waste Under the Control of the Same Person pursuant to 40 CFR 262.17(f)? If "Yes", you must fill out the Addendum for LQG Consolidation of VSQGs hazardous waste.

15. Notification of LQG Site Closure for a Central Accumulation Area (CAA) (optional) OR Entire Facility (required)

☐ Y ☑ N	LQG Site Closure of a Central Accumulation Area (CAA) or Entire Facility.
	A. ☐ Central Accumulation Area (CAA) or ☐ Entire Facility
	B. Expected closure date:_____________mm/dd/yyyy
	C. Requesting new closure date:_____________mm/dd/yyyy
	D. Date closed :_____________mm/dd/yyyy ☐ 1. In compliance with the closure performance standards 40 CFR 262.17(a)(8) ☐ 2. Not in compliance with the closure performance standards 40 CFR 262.17(a)(8)

16. Notification of Hazardous Secondary Material (HSM) Activity

☐ Y ☑ N	A. Are you notifying under 40 CFR 260.42 that you will begin managing, are managing, or will stop managing hazardous secondary material under 40 CFR 260.30, 40 CFR 261.4(a)(23), (24), or (27)? If "Yes", you must fill out the Addendum to the Site Identification Form for Managing Hazardous Secondary Material.
☐ Y ☑ N	B. Are you notifying under 40 CFR 260.43(a)(4)(iii) that the product of your recycling process has levels of hazardous constituents that are not comparable to or unable to be compared to a legitimate product or intermediate but that the recycling is still legitimate? If "Yes", you may provide explanation in Comments section. You must also document that your recycling is still legitimate and maintain that documentation on site.

17. Electronic Manifest Broker

☐ Y ☑ N	Are you notifying as a person, as defined in 40 CFR 260.10, electing to use the EPA electronic manifest system to obtain, complete, and transmit an electronic manifest under a contractual relationship with a hazardous waste generator?

18. Comments (include item number for each comment)

Item 10.b, continued: U127, U131, U154, U188, U196, U210, and/or U213

19. Certification I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. **Note: For the RCRA Hazardous Waste Part A permit Application, all owners and operators must sign (see 40 CFR 270.10(b) and 270.11)**.

Signature of legal owner, operator or authorized representative	Date (mm/dd/yyyy)
DORRIS.STEPHEN.DON.1102327272 Digitally signed by DORRIS.STEPHEN.DON.1102327272 Date: 2021.03.08 14:00:20 -05'00'	
Printed Name (First, Middle Initial Last) **Stephen D. Dorris**	Title **Colonel, U.S. Army, Commanding**
Email **stephen.d.dorris.mil@mail.mil**	

Signature of legal owner, operator or authorized representative	Date (mm/dd/yyyy) 02/25/2021
Printed Name (First, Middle Initial Last) **Candace M. Coyle, Ph.D.**	Title **ACWA-BGCAPP Site Project Manager**
Email **candace.m.coyle.civ@mail.mil**	

United States Environmental Protection Agency

HAZARDOUS WASTE PERMIT PART A FORM

1. Facility Permit Contact

First Name	**James**	MI	**L**	Last Name	**Hawkins**
Title	**BGAD Director of Public Works**				
Email	**james.l.hawkins18.civ@mail.mil**				
Phone	**859-779-6374**	Ext	**NA**	Fax	**859-779-6465**

2. Facility Permit Contact Mailing Address

Street Address	**431 Battlefield Memorial Highway**				
City, Town, or Village	**Richmond**				
State	**KY**	Country	United States	Zip Code	40475

3. Facility Existence Date (mm/dd/yyyy)

4/1/1942

4. Other Environmental Permits

A. Permit Type	B. Permit Number													C. Description
N	K	Y	0	0	2	0	7	3	7					KPDES Permit
P	V	-	1	6	-	0	1	9						Air Quality Permit - BGCAPP (KY)
P	V	-	1	8	-	0	4	0						Air Quality Permit - BGAD (KY)
R	K	Y	8	2	1	3	8	2	0	1	0	5		BGAD RCRA Permit (KY)
R	K	Y	8	2	1	3	8	2	0	1	0	5		BGCAPP RCRA/HSWA Permit (KY)
R	K	Y	8	2	1	3	8	2	0	1	0	5		EPA RCRA HSWA Permit
E	K	Y	8	2	1	3	8	2	0	1	0	5		EPA TSCA Approval
E	1	0	1	3										KY Water Withdrawal Permit

5. Nature of Business

National Security; this Part A addresses: 1) Mustard (H) sampling operations, 2) GB sample extraction operation, 3) Proposed change to the operator of the HWSUs in the storage area of the CLA to permitted the storage of munitions and munition components associated with GB/VX agent from BGCAPP, management of agent or associated items, and/or transportation of agent or associated items.

6. Process Codes and Design Capacities

Line Number		A. Process Code			B. Process Design Capacity (1) Amount	B. (2) Unit of Measure	C. Process Total Number of Units	D. Unit Name
0	1	T	0	4	4.4	U	1	H Sampling
0	2	T	0	4	318.4	U	1	Movement of H filled items
0	3	T	0	4	12	V	1	GB Sampling
0	4	T	0	4	12	V	1	Movement of GB filled item
								See Pages 9-14

7. Description of Hazardous Wastes (Enter codes for Items 7.A, 7.C and 7.D(1))

Line No.		A. EPA Hazardous Waste No.				B. Estimated Annual Qty of Waste	C. Unit of Measure	D. Processes (1) Process Codes									D. (2) Process Description (if code is not entered in 7.D1))
0	1	N	0	0	3	0.25	T	S	0	1	/	T	0	4			see comments
0	2	D	0	0	1	0.25	T	S	0	1	/	T	0	4			see comments
0	3	D	0	0	2												included with above
0	4	D	0	0	3												included with above
0	5	D	0	0	4												included with above
0	6	D	0	1	1												included with above
0	7	D	0	1	8												included with above
0	8	D	0	2	2												included with above
0	9	D	0	3	5												included with above
1	0	D	0	3	6												included with above
1	1	D	0	3	7												included with above

8. Map

Attach to this application a topographical map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all spring, rivers, and other surface water bodies in this map area. See instructions for precise requirements.

9. Facility Drawing

All existing facilities must include a scale drawing of the facility. See instructions for more detail.

10. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, and disposal areas; and sites of future storage, treatment, or disposal areas. See instructions for more detail.

11. Comments

Comments are on page 14

6. Process Codes and Design Capacities (continued)

Line Number		A. Process Code			B. Process Design Capacity (1) Amount	B. Process Design Capacity (2) Unit of Measure	C. Process Total Number of Units	D. Unit Name
0	5	S	0	1	3831	G	1 to 46[1]	M56 Warhead Assembly
0	6	S	0	1	3831	G	1 to 46[1]	Chemicl Rocket Assembly, Projectiles, DOT Bottles, and/or miscellaneous compounds
0	7	S	0	1	3831	G	1 to 46[1]	M67 Rocket Motor Assembly, Propellant Component of the Rocket Motor, Shipping Firing Tubes, End-Caps, and/or overpack/SRCs associated with GB/VX munitions (agent and/or ≥1 VSL)
0	8	S	0	1	3831	G	1 to 46[1]	M67 Rocket Motor Assembly, Propellant Component of the Rocket Motor, Shipping Firing Tubes, and/or End-Caps associated with GB/VX munitions (<1 VSL)
0	9	S	0	1	3831	G	1 to 46[1]	Lab Wastes associated with management or treated GB/VX wastes, or Lab Waste associated with destroying agent (GB/VX) wastes with caustic
1	0	S	0	1	3831	G	1 to 46[1]	M55 Rocket including Warhead Assembly (GB or VX Agent and Explosives) and/or Rocket Motor Assembly (Propellant Component of the Rocket) in a Shipping Firing Tube (including End-Caps) in overpack/SRC
1	1	S	0	1	3831	G	1 to 46[1]	VX 155mm Projectile in overpack/SRC
1	2	S	0	1	3831	G	1 to 46[1]	Filters contaminated with agent, associated with management or treatment of GB/VX wastes

Line Number		A. Process Code			B. Process Design Capacity		C. Process Total Number of Units	D. Unit Name
					(1) Amount	(2) Unit of Measure		
1	3	S	0	1	3831	G	1 to 46[1]	Spent Decontamination, Solution and/or Debris/PPE associated with management or treatment of GB or VX
1	4	T	0	4	N/A	N/A	N/A	Movement of agent (GB/VX) or agent related Items

[1] The first hazardous waste storage units (HWSUs) to transfer operator control will be HWSUs PK, OL, N, and O. As permitted HWSUs/igloos in the storage area of the Chemical Limited Area (CLA) under the operational control of the Blue Grass Chemical Activity (BGCA) are emptied of their chemical munitions, operational control may be transferred to the Program Executive Office (PEO) Assembled Chemical Weapons Alternatives (ACWA), as needed, for storage of chemical agent munitions and components of chemical agent munitions (items). Potential HWSUs in the storage area of the CLA to be transferred include the following: I, J, K, L, M, P, Q, R, S, T, U, V, W, X, Y, Z, AB, CD, EF, GH, IJ, KL, MN, OP, QR, ST, UV, WX, YZ, ZA, YB, XC, WD, VE, UF, TG, SH, RI, QJ, NM, MN(H), and KP. When the operational control of designated HWSUs are to be transferred to ACWA (operator), a revised Table B-1 will be submitted to KDEP as a Class 1 permit modification requiring approval, along with an amended Part A.

7. Description of Hazardous Wastes (Enter codes for Items 7.A, 7.C and 7.D(1)) (continued)

Line No.		A. EPA Hazardous Waste No.				B. Estimated Annual Qty of Waste	C. Unit of Measure	D. Processes									
								(1) Process Codes									(2) Process Description (if code is not entered in 7.D1))
1	2	D	0	3	9												Included with above
1	3	D	0	4	0												Included with above
1	4	D	0	4	3												Included with above
1	5	F	0	0	1												Included with above
1	6	F	0	0	2												Included with above
1	7	F	0	0	3												Included with above
1	8	F	0	0	4												Included with above
1	9	U	0	0	2												Included with above
2	0	U	0	4	4												Included with above
2	1	U	1	0	3												Included with above
2	2	U	1	2	7												Included with above
2	3	U	1	5	4												Included with above

Line No.		A. EPA Hazardous Waste No.				B. Estimated Annual Qty of Waste	C. Unit of Measure	D. Processes									
								(1) Process Codes									(2) Process Description (if code is not entered in 7.D1))
2	4	U	1	3	1												Included with above
2	5	U	2	1	0												Included with above
2	6	N	7	0	3												Included with above, Waste No. are “and/or”
2	7	D	0	0	2	0.25	T	S	0	1	/	T	0	4			SEE COMMENT
2	8	N	0	0	3												Included with above, Waste No. are “and/or”
2	9	N	0	0	3	0.25	T	S	0	1	/	T	0	4			SEE COMMENT
3	0	D	0	0	7												Included with above, Waste No. are “and/or”
3	1	N	0	0	1	0.25	T	S	0	1	/	T	0	4			SEE COMMENT
3	2	D	0	0	1	0.25	T	S	0	1	/	T	0	4			SEE COMMENT
3	3	D	0	0	2												Included with above
3	4	D	0	0	3												Included with above
3	5	D	0	0	4												Included with above
3	6	D	0	1	1												Included with above
3	7	D	0	1	8												Included with above
3	8	D	0	2	2												Included with above
3	9	D	0	3	5												Included with above
4	0	D	0	3	6												Included with above
4	1	D	0	3	7												Included with above
4	2	D	0	3	9												Included with above
4	3	D	0	4	0												Included with above
4	4	D	0	4	3												Included with above
4	5	F	0	0	1												Included with above
4	6	F	0	0	2												Included with above
4	7	F	0	0	3												Included with above
4	8	F	0	0	4												Included with above
4	9	U	0	0	2												Included with above
5	0	U	0	4	4												Included with above
5	1	U	1	0	3												Included with above
5	2	U	1	2	7												Included with above
5	3	U	1	3	1												Included with above
5	4	U	1	5	4												Included with above
5	5	U	2	1	0												Included with above

Line No.		A. EPA Hazardous Waste No.				B. Estimated Annual Qty of Waste	C. Unit of Measure	D. Processes									
								(1) Process Codes									(2) Process Description (if code is not entered in 7.D1))
5	6	N	7	0	1												Included with above, Waste No. are “and/or”
5	7	D	0	0	2	0.25	T	S	O	1	/	T	0	4			SEE COMMENT
5	8	N	0	0	1												Included with above, Waste No. are “and/or”
5	9	N	0	0	1	0.25	T	S	O	1	/	T	0	4			SEE COMMENT
6	0	D	0	0	1	110	T	S	O	1	/	T	0	4			SEE COMMENT
6	1	D	0	0	3												Included with above
6	2	D	0	0	5												Included with above
6	3	D	0	0	8												Included with above
6	4	D	0	3	0												Included with above
6	5	N	0	0	1												Included with above
6	6	N	7	0	1												Included with above
6	7	N	9	0	1												Included with above, Waste No. are “and/or”
6	8	D	0	0	1	110	T	S	O	1	/	T	0	4			SEE COMMENT
6	9	D	0	0	3												Included with above
7	0	D	0	0	5												Included with above
7	1	D	0	0	8												Included with above
7	2	D	0	3	0												Included with above
7	3	N	0	0	2												Included with above
7	4	N	7	0	2												Included with above
7	5	N	9	0	2												Included with above, Waste No. are “and/or”
7	6	D	0	0	1	110	T										SEE COMMENT
7	7	D	0	0	3												Included with above
7	8	D	0	0	8												Included with above
7	9	N	0	0	1												Included with above
8	0	N	0	0	2												Included with above
8	1	N	1	0	1												Included with above
8	2	N	1	0	2												Included with above, Waste No. are “and/or”
8	3	D	0	0	1	0.25	T										SEE COMMENT
8	4	D	0	0	2												Included with above
8	5	D	0	0	3												Included with above
8	6	D	0	0	4												Included with above

Line No.		A. EPA Hazardous Waste No.				B. Estimated Annual Qty of Waste	C. Unit of Measure	D. Processes (1) Process Codes	D. Processes (2) Process Description (if code is not entered in 7.D1))
8	7	D	0	0	5				Included with above
8	8	D	0	0	6				Included with above
8	9	D	0	0	7				Included with above
9	0	D	0	0	8				Included with above
9	1	D	0	0	9				Included with above
9	2	D	0	1	0				Included with above
9	3	D	0	1	1				Included with above
9	4	D	0	1	8				Included with above
9	5	D	0	2	2				Included with above
9	6	D	0	3	5				Included with above
9	7	D	0	3	6				Included with above
9	8	D	0	3	7				Included with above
9	9	D	0	3	9				Included with above
10	1	D	0	4	0				Included with above
10	2	D	0	4	3				Included with above
10	3	F	0	0	1				Included with above
10	4	F	0	0	2				Included with above
10	5	F	0	0	3				Included with above
10	6	F	0	0	4				Included with above
10	7	U	0	0	2				Included with above
10	8	U	0	4	4				Included with above
10	9	U	1	0	3				Included with above
11	0	U	1	2	7				Included with above
11	1	U	1	3	1				Included with above
11	2	U	1	5	4				Included with above
11	3	U	2	1	0				Included with above
11	4	N	7	0	1				Included with above
11	5	N	7	0	2				Included with above Waste No. are “and/or”
11	6	N	0	0	1				SEE COMMENT
11	7	N	0	0	2				Included with above

11. Comments (continued)

Waste streams listed in Item 7. are further described below. The streams include those wastes that will be transported between HWSUs/Igloos and disposal facility.

Item 7. Line 1: Agent contaminated debris/PPE from sampling/analyzing mustard agent (H).

Item 7. Lines 2-26: Laboratory wastes associated with sampling/analyzing H. [listed waste codes are "and/or"].

Item 7. Lines 27-28: Spent decontamination waste associated with H. [listed waste codes are "and/or"].

Item 7. Lines 29-30: Agent contaminated carbon filters associated with H. [listed waste codes are "and/or"].

Item 7. Line 31: Agent contaminated debris/PPE from GB sampling.

tem 7. Lines 32-56: Laboratory wastes associated with sampling/analyzing GB. [listed waste codes are "and/or"].

Item 7. Lines 57-58: Spent decontamination wastes associated with GB sampling operatoins. [listed waste codes are "and/or"].

Item 7. Line 59: Agent contaminated carbon filters; associated with GB sampling operartions.

Item 7. Lines 60-67: M56 warhead assembly associated with GB[2]. [listed waste codes are "and/or"].

Item 7. Lines 68-75: M56 warhead assembly associated with VX[2]. [listed waste codes are "and/or"].

Item 7. Lines 76-82: M67 rocket motor assembly, propellant component of the rocket motor, shipping firing tubes, end-caps, containerized/overpack rockets assembly or assembly parts associated with GB or VX[2], and overpack VX projectiles. [listed waste codes are "and/or"].

Item 7. Line 83-115: Lab wastes and/or spent decontamination solution and/or debris/PPE associated with the management and/or treated GB or VX.[2] [listed waste codes are "and/or"].

Item 7. Line 116-117: Agent contaminated carbond filter associated with the management and/or treatment of GB or VX.[2] [listed waste codes are "and/or"].

[2] The first hazardous waste storage units (HWSUs) to transfer operator control will be HWSUs PK, OL, N, and O. As permitted HWSUs/igloos in the storage area of the Chemical Limited Area (CLA) under the operational control of the Blue Grass Chemical Activity (BGCA) are emptied of their chemical munitions, operational control may be transferred to the Program Executive Office (PEO) Assembled Chemical Weapons Alternatives (ACWA), as needed, for storage of chemical agent munitions and components of chemical agent munitions (items). Potential HWSUs in the storage area of the CLA to be transferred include the following: I, J, K, L, M, P, Q, R, S, T, U, V, W, X, Y, Z, AB, CD, EF, GH, IJ, KL, MN, OP, QR, ST, UV, WX, YZ, ZA, YB, XC, WD, VE, UF, TG, SH, RI, QJ, NM, MN(H), and KP. When the operational control of designated HWSUs are to be transferred to ACWA (operator), a revised Table B-1 will be submitted to KDEP as a Class 1 permit modification requiring approval, along with an amended Part A.

Kentucky Department for Environmental Protection
Division of Waste Management
Hazardous Waste Branch
300 Sower Blvd, Frankfort, KY 40601
(502) 564-6716

Part A Application Addendum

(EPA Form 8700-23)

FOR OFFICIAL USE ONLY. DO NOT WRITE IN THIS SPACE.

	FEE SUBMITTED: $___ *(See instructions to determine your fee)*
I. Reason for Submittal *(see instructions)*	**Reason for Submittal:** ☐ **FIRST SUBMITTAL –** Must be accompanied by the completed forms EPA 8700-12 and Addendum DWM-7037A. ■ **REVISION – Identify the classification of the revision.** See instructions for when a revised application should be submitted. ☐ **Class 1 not requiring approval** ☐ **Class 1 requiring approval** ☐ **Class 2** ■ **Class 3** ☐ **RENEWAL –** See instructions for when a renewal application should be submitted. ☐ **STANDARDIZED PERMIT –** See instructions for the eligibility of a standardized permit.
II. ID Numbers	**A. EPA ID Number:** KY 8-213-820-105 — **B. AGENCY INTEREST Number:** 2805
III. Existing and New Facilities	**Existing Facilities, the date operation began or construction commenced: (mm/dd/yyyy)** 04 / 01 / 1942 **New Facilities, the date operation is expected to begin: (mm/dd/yyyy)** __/__/____
IV. Contact Email Address	**Facility Contact** **Email address:** james.l.hawkins18.civ@mail.mil
V. Facility Operator (2)	**Name of Facility Operator 2** (see Instructions): ACWA-BGCAPP
VI. Type of Operator (2)	**Type of Operator 2:** ■ Federal (F) ☐ State (S) ☐ County (C) ☐ Indian (I) ☐ Municipal (M) ☐ District (D) ☐ Private (P) ☐ Other (O) Specify:
VII. Operator Mailing Address (2)	**Operator 2 Street Address or P.O. Box:** 830 Eastern Bypass, Suite106 **City:** Richmond **State:** KY **County:** Madison **Zip Code:** 40475 **Facility Operator 2 Telephone Number:** 859-779-7450 **Phone Number Extension:** NA **New Operator Assumed Responsibility for Facility on this Date: (mm/dd/yyyy)** 07 / 11/ 2016
VIII. Facility Operator (3)	**Name of Facility Operator 3** (see Instructions):
IX. Type of Operator (3)	**Type of Operator 3:** ☐ Federal (F) ☐ State (S) ☐ County (C) ☐ Indian (I) ☐ Municipal (M) ☐ District (D) ☐ Private (P) ☐ Other (O) Specify:
X. Operator Mailing Address (3)	**Operator 3 Street Address or P.O. Box:** **City:** **State:** **County:** **Zip Code:** **Facility Operator 3 Telephone Number:** **Phone Number Extension:** **New Operator Assumed Responsibility for Facility on this Date: (mm/dd/yyyy)** __/__/____

EPA ID Number: KY8 – 213 – 820 – 105 **Agency Interest Number:** 2805

XI. PROCESS DESCRIPTION: (See Instructions)

a. Commercial Indicator	b. Unique Unit or Group Name	c. Legal Status Code	d. Operating Status Code(s)	e. Description of Process
4	H Sampling	PI (permitted)	OP	Sampling and analysis of chemical agent H
4	GB Sampling	PI	OP	Sampling and analysis of nerve agent GB
4	HWSU/Igloo: PK	PR (Proposed)	OP	Storage of Warhead Assembly, Rocket Assembly, Projectiles, DOT Bottles, and/or miscellaneous compounds associated with the management and/or treatment of items containing GB or VX
4	Continue: from above	PR	OP	M67 Rocket Motor Assembly, Propellant Component of the Rocket Motor, Shipping Firing Tubes, End-Caps associated with the management and/or treatment of items containing GB or VX
4	Continue: from above)	PR	OP	Lab Wastes and/or Spent Decontamination Solution associated with the management and/or treatment of items containing GB or VX, and Contaminated carbon filters associated with the management and/ treatment of GB or VX.
4	HWSU/Igloo: OL	PR	OP	See description under HWSU/Igloo PK
4	HWSU/Igloo: N	PR	OP	See description under HWSU/Igloo PK
4	HWSU/Igloo: O	PR	OP	See description under HWSU/Igloo PK
4	(Other HWSUs/igloos within the storage area of the CLA will be added lated as they become available.)	PR	OP	See description under HWSU/Igloo PK

EPA ID Number: KY 8–213–820–105 **Agency Interest Number:** 2805

XII. WASTE STREAM DESCRIPTION (See Instructions)

a. Line Number	b. Waste Stream Number	c. Waste Description
1	1	Agent contaminated debris/PPE from sampling chemical agent H
2-26	2	Laboratory wastes associated with analyzing chemical agent H
27-28	3	Spent decontamination waste associated with chemical agent H
29-30	4	Contaminated carbon filters associated with chemical agent H
31	5	Agent contaminated debris/PPE associated with GB sampling operations
32-56	6	Laboratory wastes associated with analyzing nerve agent GB associated with GB sampling operations
57-58	7	Spent decontamination waste associated with nerve agent GB associated with GB sampling operations
59 and 116	8	Contaminated carbon filters associated with nerve agent GB associated with GB sampling operations
60-67	9	Warhead Assembly associated with GB
68-75	10	Warhead Assembly associated with VX
76-82	11	M67 Rocket Motor Assembly, Propellant Component of the Rocket Motor, Shipping Firing Tubes, End-Caps associated with GB or VX
83-115	12	Lab Wastes and/or Spent Decontamination Solution associated with the management and/or treatment of GB or VX.
116-117	13	Agent contaminated carbon filters associated with the management and/or treatment of GB or VX.

EPA ID Number: KY 8– 213 – 820 – 105 **Agency Interest Number:** 2805

XIII. Facility Status	☐ Waste is NOT received from off-site ☐ Accepts waste from any off-site source(s) [A] ■ Accepts waste from only a restricted group of off-site sources [R]: Specify: Other Federal/DOD Agencies
XIV. Facility Owner Certification	If the facility owner is also the facility operator, please skip this section and complete item XV below. I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. Stephen D. Dorris Colonel, U.S. Army, Commanding — DORRIS.STEPHEN.DON.1102327272 — Digitally signed by DORRIS.STEPHEN.DON.1102327272 Date: 2021.03.08 13:59:26 -05'00' NAME (PRINT OR TYPE) SIGNATURE DATE
XV. Operator Certification	I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. Candace M. Coyle, PH.D. ACWA-BGCAPP, Site Project Manager — [signature] — 25 Feb 2021 NAME (PRINT OR TYPE) SIGNATURE DATE
XVI. Land Owner Certification	I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. Stephen D. Dorris, Colonel, U.S. Army, Commanding — DORRIS.STEPHEN.DON.1102327272 — Digitally signed by DORRIS.STEPHEN.DON.1102327272 Date: 2021.03.08 13:59:43 -05'00' NAME (PRINT OR TYPE) SIGNATURE DATE

PART B FACILITY DESCRIPTION [401 KAR 39:050, Section 5; 40 CFR 270.14]

B-1 GENERAL DESCRIPTION

Blue Grass Chemical Activity (BGCA), a tenant of Blue Grass Army Depot (BGAD) in Richmond, Kentucky, is responsible for the chemical munitions storage mission inside the storage area of the Chemical Limited Area (CLA). The Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA) is the BGAD tenant responsible for the safe destruction of chemical weapons and is the operator and a co-permittee with BGAD. PEO ACWA may use BGCA or contractor personnel for completion of the work associated with this application.

This module addresses the transport and subsequent storage of chemical munitions and/or components (hereinafter items) from the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) (Main Plant or Static Detonation Chambers [SDCs]) to the storage area of the CLA and subsequent transfer from the storage area of the CLA for destruction. Items to be transported/stored include the following:

- Overpacked leaking or reject nerve agent (sarin [GB] and VX) munitions:
  - M55 115mm chemical rocket assemblies (hereinafter rockets)
  - M121A1 155mm projectiles (hereinafter 155mm projectiles) (VX only)
- Rocket components (GB and VX):
  - Containerized punched and drained M56 warhead assemblies (hereinafter warheads [WHs])
  - Containerized undrained WHs
  - M67 rocket motor assemblies (hereinafter rocket motors [RMs]) (≥1 vapor screening level [VSL])
  - RMs (<1 VSL)
- Laboratory wastes, spent decontamination solution, and/or debris/personal protective equipment associated with the management and/or treatment of GB or VX.
- Agent-contaminated carbon filters

Waste associated with monitoring requirements, filtration, decontamination, leaker isolation, re-warehousing, re-palletization, routine maintenance, munitions sampling, etc., is stored and disposed of by BGCA, BGAD, or other government or contractor organization.

Miscellaneous materials in support of chemical agent operations, such as spill response items, may also be stored in CLA hazardous waste storage units (HWSUs)/igloos.

Items that contain liquid agent or that monitor to ≥1 VSL at the BGCAPP Main Plant are held in the storage area of the CLA before they are transferred for destruction. As permitted HWSUs/igloos under BGCA (permit operator) operational control are emptied of their chemical munitions, operational control transfers to PEO ACWA. RMs/items that monitor to <1 VSL at the BGCAPP Main Plant may be held in permitted HWSUs/igloos inside or outside the CLA. This application only addresses HWSUs inside the CLA. PEO ACWA is responsible for transport and storage but other government or contractor organizations may provide the following support under PEO ACWA direction:

- Transport items to the storage area of the CLA and from the storage area of the CLA for destruction
- Perform monitoring of HWSUs/igloos
- Perform leaker management activities
- Respond to contingencies
- Conduct Resource Conservation and Recovery Act (RCRA) inspections of HWSUs/igloos
- Perform partial and final closure activities

BGAD does not routinely accept hazardous waste from off-site sources. However, to provide continued support to the nationwide demilitarization missions, BGAD retains the capability of accepting off-site hazardous waste from other defense installation sources only. Likewise, RMs may be shipped to Anniston Army Depot for temporary storage prior to being demilitarized in an SDC at Anniston. Subject to the process rates through the SDC at Anniston and the availability of the SDCs at BGCAPP, RMs may be returned to BGCAPP for destruction. RMs returned to Kentucky from Alabama will be manifested as hazardous waste and shipped in accordance with Department of Transportation (DOT) and Kentucky regulations.

B-1a Description of Blue Grass Army Depot

A general description for BGAD is located in the Permit Renewal Application for Conventional Munition Related Items (hereinafter referred to as the BGAD Permit Application), Part B-1 (General Description of the Blue Grass Army Depot).

B-1b Description of Chemical Limited Area

Up to 46 permitted HWSUs/ammunition storage units in the storage area of the CLA are available for storage of items that contain agent or monitor to ≥1 VSL at the BGCAPP Main Plant, as well as storage of RMs/items that monitor to <1 VSL at the BGCAPP

Main Plant. Table B-1[1] lists HWSUs/igloos permitted under this application. Items stored in these permitted HWSUs/igloos are described in Section A of the RCRA Part A Permit Application. BGCA uses two storage units (Igloos KP and LO) to store wastes generated during storage operations.

Table B-1 will be updated as operational control of the permitted HWSUs/igloos within the CLA transfers from BGCA to PEO ACWA. PEO ACWA will submit to the Kentucky Department for Environmental Protection a Class 1 (requiring approval) permit modification along with an updated Part A upon transfer.

B-2 TOPOGRAPHIC MAP OF FACILITY

The BGAD Permit Application, Part B-2 (Topographic Map of Facility), describes the topography of BGAD and provides a topographic map in Figure B-2 (BGAD Terrain Map). The BGAD Permit Application also supplies a land use and land cover map in Figure B-3 (BGAD Land Cover Map).

The topographic map indicates gentle sloping in the storage areas, which generally allows water to drain away from the HWSUs/igloos. There are drainage provisions within the CLA, and flooding is not a problem. The BGAD Permit Application contains Figure B-5 (BGAD Flood Plains), the Federal Emergency Management Agency (FEMA) floodplain map showing that the HWSUs/igloos are not situated in a 100-year flood zone.

The BGAD Permit Application, Figure B-6 (BGAD Wind Rose Map), shows a BGCA Tower 1 wind rose from 1 January 2009 to 30 September 2013 at a height of 60 meters.

B-3 FACILITY LOCATION INFORMATION

B-3a Geological Information

Geological information for the BGAD is located in the BGAD Permit Application, Part B-3a (Geological Information).

B-3a (1) Seismic Consideration

Madison County is not listed in Appendix VI of 40 Code of Federal Regulations (CFR) Part 264 (Political Jurisdictions in Which Compliance with 264.18(a) Must be Demonstrated). The HWSUs/igloos are greater than 200 feet from any fault listed in the Kentucky area.

The BGAD Permit Application describes the seismic faults at BGAD and provides geologic quadrangle maps of the area.

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[1] Tables are located at the end of this Part.

B-3a (2) Evaluation of Subsurface Geologic Formations and Surface Topography for Solution or Karst Features

The storage area of the CLA is located on karst topography, and the magazines were built in the early 1940s. Routine annual inspections of the HWSUs/igloos consider each unit's structural integrity. Review of the inspection records indicates that subsidence historically has not been a problem. Minor settling has been observed within some of the units, but is not caused by a karst feature.

B-3b Climate and Floodplain Requirements

The climate in Richmond, Kentucky, is generally temperate. Average annual rainfall is 41 inches, and average annual snowfall is 13 inches.

As a federal Department of Defense facility, the BGAD site does not come under the National Flood Insurance Program. As shown in the FEMA flood map for the site (BGAD Permit Application, Figure B-5 [BGAD Flood Plains]), the HWSUs/igloos listed in this permit application are not in a flood zone area.

B-4 TRAFFIC INFORMATION

Traffic information for BGAD is located in the BGAD Permit Application, Part B-4 (Traffic Information).

Table B-2 describes roads in the storage area of the CLA. The CLA is enclosed by fence and locked gate.

All traffic into the CLA must have specific business in the area and have special clearance. Vehicles include security vehicles, ammunition vehicles, automobiles, crew trailers, crew vans, decontamination units, pick-up trucks, and forklifts. Given the small amount of traffic, there are no traffic signals; however, control is maintained by extensive ingress and egress security procedures.

B-5 REQUIREMENTS FOR APPLICANTS FOR CONSTRUCTION PERMITS

This section is not applicable.

B-6 PAST COMPLIANCE RECORD

This section is not applicable.

B-7 FINANCIAL RESPONSIBILITY TO CONSTRUCT AND OPERATE

This section is not applicable.

B-8 PUBLIC PARTICIPATION

This is a new permit application. A public notice requesting public comments was issued with the submittal of this application.

B-9 FEES

This application is being submitted to support the PEO ACWA chemical demilitarization mission. An existing grant from PEO ACWA to the Kentucky Department for Environmental Protection Division of Waste Management includes monies to pay the fee for filing and review of this RCRA Permit application. No additional monies are required.

Table B-1. HWSUs/Igloos Permitted Under this Application

HWSUs/Igloos	Notes
PK	VX (≥1 VSL waste)
OL	VX (≥1 VSL waste)
N	VX (≥1 VSL waste)
O	VX (≥1 VSL waste)
**	**See note below

Note:

** As permitted HWSUs/igloos in the storage area of the Chemical Limited Area (CLA) under the operational control of the Blue Grass Chemical Activity (BGCA) are emptied of their chemical munitions, operational control may be transferred to the Program Executive Office (PEO) Assembled Chemical Weapons Alternatives (ACWA), as needed, for storage of chemical agent munitions and components of chemical agent munitions (items). Potential HWSUs in the storage area of the CLA to be transferred include the following: I, J, K, L, M, P, Q, R, S , T, U, V, W, X, Y, Z, AB, CD, EF, GH, IJ, KL, MN, OP, QR, ST, UV, WX, YZ, ZA, YB, XC, WD, VE, UF, TG, SH, RI, QJ, NM, MN(H), and KP. When the operational control of designated HWSUs are to be transferred to ACWA (operator), a revised Table B-1 will be submitted to KDEP as a Class 1 permit modification requiring approval, along with an amended Part A.

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Table B-2. Description of Roads Associated with the Storage Area of the Chemical Limited Area

Route [a]	Class	Width	Surface	Condition
6-1 through 6-7 [b]	Secondary	12 feet	Asphalt	Good
6-12 [c]	Secondary	12 feet	Asphalt	Good
6-12 [d]	Secondary	12 feet	Asphalt	Good
2 [e]	Secondary	12 feet	Asphalt	Good

Notes:

a Traffic control is provided by guard located at intersection of Route 6-1 and Route 6-7.
b Service roads to individual hazardous waste storage units/igloos
c Vertical road connecting service roads
d Perimeter road
e Outside road connecting to other parts of Blue Grass Army Depot

PART C WASTE ANALYSIS PLAN [401 KAR 39:060, Section 5; 40 CFR 270.14(b)(3); 264.13]

C-1 INTRODUCTION

The hazardous wastes applicable to this permit application include chemical munitions and components of chemical munitions (hereinafter items) managed and stored in the storage area of the Chemical Limited Area at Blue Grass Army Depot (BGAD) in Richmond, Kentucky. Existing published and documented data on the hazardous wastes stored are used for characterization. Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) wastes that are stored as part of this application are:

- Overpacked leaking or reject nerve agent (sarin [GB] and VX) munitions:
  - M55 115mm chemical rocket assemblies (hereinafter rockets)
  - M121A1 155mm projectiles (hereinafter 155mm projectiles) (VX only)
- Rocket components (GB and VX):
  - Containerized punched and drained M56 warhead assemblies (hereinafter warheads [WHs])
  - Containerized undrained WHs
  - M67 rocket motor assemblies (hereinafter rocket motors [RMs]) (≥1 vapor screening level [VSL])
  - RMs (<1 VSL)
- Laboratory wastes, spent decontamination solution, and/or debris/personal protective equipment associated with the management and/or treatment of GB or VX
- Agent-contaminated carbon filters

Waste associated with monitoring requirements, filtration, decontamination, leaker isolation, re-warehousing, re-palletization, routine maintenance, munitions sampling, etc., is stored and disposed of by Blue Grass Chemical Activity (BGCA) or other government or contractor organization.

Table C-1[1] contains a listing of possible wastes stored as part of this permit application.

[1] Tables are located at the end of this Part.

All munitions were manufactured to strict military standards. Chemical and physical characteristics are known and do not need to be determined through analyses. Explosive content is documented, and munitions were produced to military specification.

Table C-2 is a listing of the specific characteristics of the chemical agents GB and VX. Table C-3 lists the component parts of the chemical agent waste munitions to be stored as part of this application. Table C-4 provides detailed component composition of the rockets.

The bursters, propellant, fuzes, and miscellaneous explosive components contained in the chemical munitions listed in Table C-1 are classified as explosives. Therefore, the munitions are classified as reactive wastes.

The estimated quantity (in tons) of each waste stored as part of this permit application is provided in Part A of this application.

C-2 WASTE CHARACTERIZATION

The GB- and VX-containing munitions were produced according to fixed known specifications. The shipping and firing tubes, in which the rockets are stored, are marked with color-coded banding and decals displaying the chemical contents of the rocket. Items stored as part of this application are labeled (using a hazardous waste label or marking) and, if placed in an overpack, the overpack is labeled to indicate the contents and date of overpacking. For skids/pallets containing multiple packaged rocket components, the hazardous waste label or marking will be placed on the outside of the skid/pallet instead of on individual items. If containerized rocket components are removed from a skid/box, either the individual item(s) or the skid/box the item(s) are placed in will be labeled with the same information that was on the original skid/box.

Each storage unit for items containing or contaminated with chemical agent contains only a single agent type—the GB items are stored in separate storage units from those containing VX.

Items are stored in an area under constant security, and unauthorized access is prohibited. Detailed records are kept on the quantity, identity, and storage location of all items.

No off-site generated wastes are stored in the storage area of the Chemical Limited Area.

C-2a Pre-Acceptance Phase

This section is not applicable.

C-2b Acceptance Phase

This section is not applicable.

C-2c Waste Generated On-Site

The chemical agents were manufactured to exact specifications. The manufactured agent chemicals were then loaded into various munition configurations, some of which contained explosives. The current Safety Data Sheets (SDSs) fully disclose the characteristics of these products. Subsequent to their production, these agent-filled munitions have been declared waste (they became a declared generated waste). Since the products (agents and explosives) have not been further processed, their characteristics are basically identical to that represented in the SDS. Further, additional analytical testing is performed periodically on the national stockpile of chemical weapons (not specifically BGAD's local stockpile) to verify the adequacy of the SDS information and characteristics of each agent (waste).

C-2d Additional Requirements for Facilities Handling Ignitable, Reactive, or Incompatible Wastes

The Army is committed to managing hazardous waste in a safe and efficient manner. Appropriate personnel are aware of and familiar with the additional requirements for handling ignitable, reactive, or incompatible wastes. Additionally, they are fully aware of the hazards associated with and the physical/chemical characteristics of the wastes. Chemical compositions of all wastes stored at the facility are documented and the storage locations are documented. Additional analyses are not required to meet the regulatory requirements.

The specific requirements address the following precautions and preventive measures:

- Precautions to prevent ignition or reaction of ignitable or reactive waste; general precautions for handling ignitable or reactive waste and mixing of incompatible waste

- Management of hazardous wastes in containers

All sources of ignitions or reactions are limited where hazardous waste storage facilities are located. Wastes are stored in containers in a configuration to prevent ignition and reaction under normal storage conditions. All storage is accomplished in hazardous waste storage units/igloos specifically designed to house energetic materials.

C-2e Additional Requirements Pertaining to Boiler/Industrial Furnace Facilities

This section is not applicable.

C-3 ADDITIONAL WASTE ANALYSIS REQUIREMENTS PERTAINING TO LAND DISPOSAL RESTRICTIONS

This section is not applicable.

Table C-1. Agent-Related Hazardous Waste Stored in Chemical Limited Area

Waste Material	Hazardous Waste Codes [a]	Basis for Designation
Chemical Agents		
GB or VX	N001 (GB) or N002 (VX)	Agents are designated as hazardous based on Kentucky Administrative Regulations and will be handled as such upon waste determination by designated Army officials
Munitions and Components		
M56 warhead assembly	N001 (GB) or N002 (VX)	Contains agent GB and/or VX
M67 rocket motor assembly and/or components (≥1 VSL)	N001 (GB) or N002 (VX)	Contaminated with agent GB or VX (Monitor to ≥1 VSL)
M67 rocket motor assembly (<1 VSL)	N101 (linked with GB) or N102 (linked VX)	Associated with agent GB/VX munitions (Monitor to <1 VSL)
Overpacked M55 (115mm) chemical rocket assembly (GB or VX)	N001 (GB) or N002 (VX)	Contains agent GB and/or VX
Overpacked 155mm VX projectile	N002	Contains agent VX
Propellants		
M28	TC Metals: D008	Contains Division 1.1 explosives, nitrocellulose, and nitroglycerin. The explosives contain lead (D008).
	Reactivity (D003)	
Fuzes		
M417	TC Metals: D008	Contains Division 1.1 explosive, RDX. The explosive contains lead (D008).
	Reactivity (D003)	
Miscellaneous Explosives Munitions Components		
M2 (Squib)	TC Metals: D008	Contains lead (D008) and contains a Division 1.1 explosive, nitrocellulose. Also contains magnesium/potassium perchlorate mixture, which may be ignitable.
	Ignitability (D001)	
	Reactivity (D003)	

Table C-1. Agent-Related Hazardous Waste Stored in Chemical Limited Area

Waste Material	Hazardous Waste Codes [a]	Basis for Designation
Miscellaneous Explosives Munitions Components (Continued)		
M62 (Igniter)	Reactivity (D003)	Contains magnesium, potassium perchlorate, and cellulose nitrate. Also contains magnesium/potassium perchlorate mixture which may be ignitable
	Ignitability (D001)	
M34 (Burster)	Reactivity (D003)	Contains Division 1.1 explosive, RDX and TNT; therefore, the waste code for 2,4-dinitrotoluene (D030) applies
	TC Organics: D030	
M36 (Burster)	Reactivity (D003)	Contains Division 1.1 explosive, RDX and TNT, as per 49 CFR 173.53 and 173.50; therefore, the waste code for 2,4-dinitrotoluene (D030) applies
	TC Organics: D030	
Miscellaneous Hazardous Waste		
Laboratory wastes, spent decontamination solution, and/or debris/PPE associated with management and/or treatment of GB or VX	See Part A (items 7, lines 83-115)	Contaminated with GB and/or VX
Agent-contaminated carbon filters associated with management and/or treatment of GB or VX	N001 (GB) or N002 (VX)	Contaminated with GB and/or VX

Notes:

a N001, N002, N101, and N102 are Kentucky hazardous waste codes.

CFR Code of Federal Regulations
PPE personal protective equipment
RDX cyclonite
TC toxicity characteristic
TNT trinitrotoluene
VSL vapor screening level

Table C-2. Characteristics of Chemical Agents

Agent Type	Sarin (GB)	VX
Characteristics	GB is a rapid-acting nerve agent causing the inactivation of cholinesterase within the body. The hazard from GB is that of vapor absorption through the respiratory tract, although it can be absorbed through any part of the skin, through the eyes, and through the gastrointestinal tract by ingestion. The absorption rate is accelerated through cuts and abrasions in the skin. When dispersed as large droplets, GB is moderately persistent; it is non-persistent when disseminated as a cloud of very fine particles.	VX is a rapid-acting nerve agent causing the inactivation of cholinesterase within the body. The hazard from VX is primarily that of liquid absorption through the skin, although it can be absorbed through the respiratory tract as a vapor or aerosol and through the gastrointestinal tract by ingestion. VX is slow to evaporate and may persist as a liquid for several days.
Chemical Name	isopropylmethyl phosphonofluoridate	O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothiolate
Chemical Formula	$C_4H_{10}FO_2P$	$C_{11}H_{26}NO_2PS$
Vapor Density (air = 1.00)	4.86	9.2
Liquid Density (g/cm^3)	1.0887 @ 25°C (77°F)	1.0883 @ 20°C (68°F)
Freezing Point	-56°C (-68.8°F)	Below -51°C (-59.8°F)
Boiling Point	158°C (316.4°F)	298°C (568.4°F)
Vapor Pressure (mmHg)	2.9 @ 25°C (77°F)	0.00007 @ 20°C (68°F)
Volatility (mg/m^3)	16,090 @ 20°C (68°F)	10.5 @ 20°C (68°F)
Flash Point	Did not flash @ 137.8°C (280°F)	70.6°C (159°F)
Color	Colorless	Colorless to straw-colored liquid similar in appearance to motor oil
Odor	Odorless	Odorless

Notes:

g/cm^3	grams per cubic centimeter
mg/m^3	milligrams per cubic meter
mmHg	millimeters of mercury

Table C-3. Description of Agent-Bearing Munitions

Munition	Fill Agent	Nominal Agent Fill Weight (lb) [a]	Burster Explosive	Nominal Burster Weight (lb)	Propellant	Nominal Propellant Weight (lb)	Fuze Type	Nominal Fuze Weight (lb)
M55 (115mm) Chemical Rocket Assembly [M56 and M67]	GB	10.7	Comp B	3.2	M28	19.3 (M28)	M417	0.6
	VX	10.0	Comp B	3.2	M28	19.3 (M28)	M417	0.6
M121A1 Projectile, 155mm	VX	6.0	None	N/A	None	N/A	None	N/A
M56 Warhead Assembly	GB	10.7	Comp B	3.2	None	N/A	M417	0.6
	VX	10.0	Comp B	3.2	None	N/A	M417	0.6
M67 Rocket Motor Assembly	GB	N/A	N/A	N/A	M28	19.3 (M28)	None	N/A
	VX	N/A	N/A	N/A	M28	19.3 (M28)	None	N/A

Notes:

a The declared weight to the Organisation for the Prohibition of Chemical Weapons (OPCW) [Treaty]. Note that the M56 warhead assemblies may be drained and only contain residual agent.

lb pound(s)
M28 propellant grain assembly
M417 point detonating fuze
M56 From an M55 (115mm) chemical rocket assembly containing agent fill GB or VX
M67 From an M55 (115mm) chemical rocket assembly containing agent fill GB or VX
N/A not applicable

Table C-4. Composition of Material in the M55 Rocket

Component	Weight (grains)	Composition
1. Fuze, M417		
a. Booster (C90-4-33)	1.12	RDX
b. Pellet Booster (B90-4-36)	183.5	RDX
c. Rotor, Lead (B90-4-85)	2.77	RDX
2. Detonator, M63 (8798730)		
a. Upper Charge Primer Mix (9297865) (NOL 130 Mix)	0.31	• 40% Lead Styphnate • 20% Lead Azide • 20% Barium Nitrate • 15% Antimony Sulfide • 5% Tetracene
b. Intermediate Charge	2.0	Lead Azide
c. Lower Charge	0.99	RDX
3. Squib, M2		
a. Flash Charge (8799892)	1.0 ea. (2 required)	• 32% Lead Thiocyanate • 40% Potassium Chlorate • 18% Charcoal • 10% Egyptian Lacquer
b. Booster Igniter (C90-3-62) (FILM 10021/1403)	46.2 ea. (2 required)	• 49% Magnesium • 49% Potassium Perchlorate • 2% Cellulose Nitrate-Camphor
4. Igniter, Rocket Motor, M62 (C-90-3-82) (FILM 10021/1403)	385	• 49% Magnesium • 49% Potassium Perchlorate
	3.1	2% Cellulose Nitrate-Camphor
5. Propellant Grain, M28 (FILM 10022/1166)	134,750	Overall Mixture • 60% Nitrocellulose • 23.8% Nitroglycerin • 9.9% Triacetin • 2.6% Di-Ethylphthalate • 2.0% Lead Stearate • 1.7% 2-Nitrodiphenylamine
6. Burster, Rocket, M34 (C90-8-6)	22,400	Comp B • 60% RDX • 39% TNT
7. Burster, Rocket, M36 (C90-8-9)	22,400	Comp B • 60% RDX • 39% TNT

Table C-4. Composition of Material in the M55 Rocket

Component	Weight (grains)	Composition
8. Pellet, Rocket Motor, M62 (A-90-3-69) (FILM 10021/1403)	3.1	Overall Mixture • 49% Magnesium • 49% Potassium Perchlorate • 2% Cellulose Nitrate-Camphor

Notes:

RDX cyclonite
TNT trinitrotoluene

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PART D PROCESS INFORMATION [401 KAR 39:090, Section 1; 40 CFR 264.170–179; 264.190–200; 264.600-603; 270.15]

D-1 CONTAINERS

D-1a Container Management

Munitions and munition components (hereinafter items) subject to this module of the permit application originate from the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) (Main Plant or Static Detonation Chambers [SDCs]). Items that contain chemical agent or monitor to ≥1 vapor screening level (VSL) at the BGCAPP Main Plant are moved[1] to the storage area of the Chemical Limited Area (CLA) and placed in permitted hazardous waste storage units (HWSUs)/igloos at Blue Grass Army Depot (BGAD). Items that monitor to <1 VSL at the BGCAPP Main Plant will only be stored in a permitted CLA HWSU/igloo if both pre (Blue Grass Chemical Activity [BGCA]) and post (Program Executive Office, Assembled Chemical Weapons Alternatives [PEO ACWA]) permit operators concur. The items to be stored consist of nerve agent (Sarin [GB] and VX) chemical munitions and components, as described in Sections D1a (1) through D1a (4). The items remain in HWSUs/igloos until they are transferred for destruction. *Under normal conditions, items that monitor to <1 VSL and that do not contain liquid agent will not be stored with items that monitor to ≥1 VSL or that contain liquid agent. Should items that monitor to <1 VSL be stored with items that monitor to ≥1 VSL or that contain liquid agent, the HWSU/igloo will be air monitored weekly.*

The materials of construction used in the manufacturing of the chemical munitions were selected based on their compatibility with the explosives and chemicals containerized. Each waste container (munition) is described in greater detail in the following paragraphs. The hazardous waste codes associated with each waste stream are provided in Part A of this permit application.

D-1a (1) Leaking or Reject M55 Chemical Rocket Assembly

The M55 115mm chemical rocket assemblies (hereinafter rockets) are disassembled in the BGCAPP Main Plant. Reject rockets that cannot be disassembled or that are found to be leaking at the BGCAPP Main Plant are overpacked and transported to an HWSU/igloo in the storage area of the CLA. The rocket consists of a chemical agent-filled M56 warhead assembly (hereinafter warhead [WH]) attached to a M67 rocket motor assembly (hereinafter rocket motor [RM]). The rocket is stored in a cylindrical M441 shipping and firing tube (SFT).

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[1] Kentucky Revised Statute 224.50-130(5) defines “treatment” to include the manual or mechanical handling of the chemical agent compounds (GB and VX) of any munitions containing the compounds during the processing of munitions to remove the compounds, to separate munitions components, and to otherwise prepare the components and compounds for destruction, neutralization, dismantling, or decommissioning.

The components of the rocket are depicted in Figure D-1.[2]

Leaking or reject rockets are overpacked in single round containers (SRCs). The steel SRC is large enough to hold the munition and is designed to prevent leakage. If an SRC leaks, it will be overpacked in a larger SRC. Overpacked munitions are stored on specialized pallets designed to secure the SRC. The SRCs conform to the minimum size necessary to house the munition and meet or exceed performance oriented packaging requirements.[3] Figure D-2 depicts a typical SRC.

D-1a (2) Containerized M56 WH Assembly

In the BGCAPP Main Plant, the SFT is cut and the top half removed to expose the WH before the WH is de-mated from the RM and potentially drained. In this application, undrained WHs are those that have not been punched in the Main Plant. Munitions that are punched in the Main Plant are considered both punched and drained. The WH is then containerized, placed in a skid with other WHs, and transported to an HWSU/igloo in the storage area of the CLA. The WH container is a 5-inch outside diameter (OD) steel tube with welded bottom (see Figure D-3) and is designed to contain the agent within it. An insert in the bottom of the container cushions the WH. The insert has a reservoir to catch any residual agent that may leak from the WH. Once the WH is placed into the container, a steel plug containing O-rings is fitted into the top of the container to seal it. A hydraulic tool crimps the container such that the plug locks in place and the indent from the crimp mates against the surface of the middle O-ring.

The skid (Figure D-4) holds up to 25 containerized WHs. The skid is an open design constructed from steel with approximate dimensions of 42x42x41 inches (WxDxH). The containerized WHs are stored vertically (nose up) in the skid. The bottom of the skid is a pan sufficient to comply with Resource Conservation and Recovery Act (RCRA) secondary containment regulations, as noted in Section D-1c (1). The skids containing containerized WHs are transported to an HWSU/igloo in the storage area of the CLA. Undrained WHs may also be placed in SRCs and secured on a pallet for transport. If the pallet is not necessary, the SRC will be secured directly to the flatbed truck.

D-1a (3) M67 RM Assembly

RMs are de-mated from the WHs in the BGCAPP Main Plant by first cutting and removing the top half of the SFT to expose the WH, then severing the rocket between the WH and the RM. The RM remains in the bottom half of the SFT. Up to 30 RMs are placed in a wooden box designed to safely store the motors (see Figures D-5 and D-6). The wooden boxes are monitored for agent in the BGCAPP Main Plant. RMs that

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2 Figures are located at the end of this Part.

3 Performance oriented packaging is a series of packaging design qualification tests developed by the UN Committee of Experts. The tests are used to ensure the safety of people, property, and environment during the transportation of regulated hazardous materials (HAZMATs) by all modes (air and surface). The tests include drop, hydrostatic pressure, leakage, stack, and vibration of the packages.

monitor to ≥1 VSL at the BGCAPP Main Plant are placed in SRCs and transported to an HWSU/igloo in the storage area of the CLA. The wooden boxes of RMs that monitor to <1 VSL at the BGCAPP Main Plant may be transported to an HWSU/igloo inside or outside the CLA.

D-1a (4) Leaking or Reject Projectiles

Projectiles that leak or are rejected in the BGCAPP Main Plant because they cannot be disassembled are overpacked in SRCs and transported to an HWSU/igloo in the storage area of the CLA. Overpacked munitions are stored on specialized pallets designed to secure the SRCs. These projectiles do not contain explosive material.

M121A1 155mm projectiles (hereinafter 155mm projectiles) contain 6 pounds of VX agent.

D-1a (5) Munitions Returned to Storage from BGCAPP SDCs

Items described in Sections D-1a (1) through D-1a (4) that are transported to the BGCAPP SDC service magazines awaiting destruction could be returned to storage.

D-1a (6) Miscellaneous Hazardous Wastes

Waste associated with monitoring requirements, filtration, decontamination, leaker isolation, re-warehousing, re-palletization, routine maintenance, munitions sampling, etc., is stored and disposed of by BGCA, BGAD, or other government or contractor organization. These miscellaneous hazardous wastes include:

- Laboratory wastes, spent decontamination solution, and/or debris/personal protective equipment associated with the management and/or treatment of GB or VX
- Agent-contaminated carbon filters

D-1b Container Handling

Items are moved from BGCAPP to an HWSU/igloo. The items remain in an HWSU/igloo until they are transferred for destruction. Transport will only occur when Acute Exposure Guideline Level (AEGL)-3 plumes based on the Maximum Credible Event (MCE) are within the boundary of BGAD. Monitoring discussed in this application will be conducted to 1 VSL with an action/alarm setpoint at 0.5 VSL. Normal handling of chemical agent items does not require any dismantling that would have the potential of releasing agent. Storage operations include the following steps:

- Movement of items from the BGCAPP Main Plant to an HWSU/igloo:
  - Items are monitored for agent at the BGCAPP Main Plant

  - Items are loaded on transport vehicle (typically a flatbed truck) and secured using a cradle, bracing blocks, ratchet strapping, and/or equivalent method to prevent movement of the skids during transport. (Figure D-7 shows the typical skid loading of a flatbed truck and Figure D-8 shows typical loading of RM boxes.)

Overpacked chemical munitions in SRCs or containers are transferred by hand or by forklift to a transport vehicle. The items (munitions, munition components, SRCs, container, skid, pallet, etc.) are secured in the transport vehicle by a cradle, straps, and/or bracing blocks. For chemical munitions in SRCs, if the bed of the transport vehicle does not have secondary containment, plastic is placed under the SRC. Overpacked munitions in SRCs will be not be stacked during transport. The transport vehicle moves the items to the designated HWSU/igloo in the CLA. The items are removed from the truck by hand or forklift and moved into the designated storage unit. Overpacked rockets in SRCs are stored on specially designed wooden cradles. Overpacked projectiles in SRCs are stored vertically in a nine-unit wooden crate.

Secondary waste is transported by flatbed truck.

  - Items that monitor to <1 VSL with an action/alarm setpoint at 0.5 VSL may be transported to designated permitted HWSUs/igloos

  - Items are unloaded from the vehicle and placed in the HWSU/igloo by a forklift

  - HWSUs/igloos that contain chemical agent or items that monitor to ≥1 VSL are monitored again for agent once the transport operation is completed

- Routine maintenance in the HWSU/igloo of items containing chemical agent or that monitor to ≥1 VSL:

  - Air monitoring is performed for first-entry monitoring and as part of the RCRA inspections for HWSUs/igloos containing agent-contaminated items

  - Items inside the HWSU/igloo are moved by forklift or material handling equipment (MHE) as necessary

  - Items are re-palletized as necessary

- Isolation, containerization, packaging, and movement of leaking chemical munitions/items for HWSUs/igloos that contain chemical agent or items that monitor to ≥1 VSL:

  - Air monitoring is performed for first-entry monitoring and as part of identifying and isolating leaking munitions

  - Munitions are moved within the HWSU/igloo by forklift or other MHE as part of the isolation process

    - Leaking munition or item is overpacked
    - Overpacked munitions or items are secured on a pallet
    - Pallets containing overpacked munitions/items are left within the current HWSU/igloo or loaded on a transport vehicle by a forklift and moved to an HWSU/igloo designated for storage of overpacked munitions
    - HWSU/igloo is monitored for agent once operations are completed
- Movement for destruction:
    - Air monitoring of HWSUs/igloos is performed for first-entry monitoring. Continuous monitoring of the HWSU/igloo is performed while personnel are performing operations inside
    - Items are placed by forklift on a transport vehicle (typically a flatbed truck) and secured by equipment such as a cradle, bracing blocks, ratchet strapping, and/or equivalent to prevent movement of the skids during transport
    - Items are moved from storage for destruction

The following equipment is typically required for movement of hazardous waste:

- Transport vehicle (6-ton flatbed stake truck with 16-foot bed [minimum])
- Forklift (size will be consistent assumptions in Attachment 1)
- 7-ton capacity rollback truck
- 1/2-ton pickup truck
- 1,500-pound maximum capacity drum grip

Figures D-9 and D-10 depict the typical floor layout for skids of containerized WHs and boxes of RMs, respectively. These diagrams demonstrate the adequacy of HWSU/igloo aisle space for necessary equipment, inspections, and satisfaction of applicable codes and regulations.

Attachment 1 provides safety information about the use of a flatbed truck for movement of these items to and from storage in the CLA.

D-1c Containers with Free Liquids and/or F020, F021, F023, F026, and F027 Wastes

Containers that store free liquids have a containment system, as governed by 40 Code of Federal Regulations (CFR) 264.175.

All waste containers in the units having free liquid are placed on secondary containment pallets or have equivalent secondary containment means to contain the waste. The secondary containment for the WHs is the bottom of the skid, and the secondary containment for the overpacked munitions in SRCs is a spill pallet or berm. The HWSU/igloo floor is not the means of secondary containment. The design of the HWSUs/igloos (see Figure D-11) prevents run-on of precipitation into the storage units. To prevent infiltration of rainwater, the HWSUs/igloos have been covered with geomembranes.

Weekly air monitoring of the HWSUs/igloos is conducted to detect chemical agent leaks. When monitoring indicates a leak, the HWSU/igloo is entered and the leaking item(s) identified. Should liquid agent leak into the bottom of the skid, spill pallet, or berm, the leaking item is identified, decontaminated, and placed into an SRC. The skid, spill pallet, or berm is designed in a way that allows liquid to be decontaminated and/or removed. Any liquid accumulated is decontaminated and removed manually. Any items that come in contact with the liquid are decontaminated and placed back into the skid, spill pallet, or berm. The skid and the WH canisters are made of steel, which can be efficiently decontaminated.

D-1c (1) Capacity of Containment System Relative to Number and Volume of Containers to Be Stored

Solid waste containers having free liquid are placed on secondary containment pallets or have equivalent secondary containment means to contain the waste. The secondary containment is sized to have sufficient capacity to contain 10 percent of the volume of containers or 100 percent of the volume of the largest container, whichever is greater.

<u>Containerized WHs on Skids</u>

The skids that contain the containerized WHs (see Figure D-4) are designed to meet the criteria for secondary containment. Each skid contains a maximum of 25 containerized WHs, and an undrained WH contains a maximum of 1.3 gallons of chemical agent. Therefore, the maximum amount of agent on a skid is 32.5 gallons, and 10 percent of the maximum amount of agent on the skid is 3.25 gallons.

The pan on bottom of the skid serves as secondary containment. The bottom of the skid is approximately 42 inches by 42 inches and the pan is 2.5 inches deep. The volume of the four 2x2-inch frame structures was subtracted, as well as the volume displaced by the 25 WHs (each with a diameter of 5 inches), resulting in a volume of 12.3 gallons of liquid, sufficient to contain the contents of an entire WH or 10 percent of the maximum amount of agent that could be on the skid.

<u>Munitions/Components Containing Free Liquid Overpacked into SRCs</u>

Munitions/components overpacked into SRCs are placed on a pallet, which is placed on a larger metal or plastic spill pallet or inside a berm to provide secondary containment. The spill pallet or berm is sized to contain the entire liquid contents of the largest item or 10 percent of the total amount of liquid of items on the pallet.

D-1d Containers Without Free Liquids and/or F020, F021, F023, F026, and F027 Wastes

No wastes with the F020, F021, F023, F026, and F027 waste code designations are stored in HWSUs/igloos. The containers without free liquids to be stored are the RMs in wooden boxes (see Figures D-5 and D-6). The RMs require no secondary containment. The design of the HWSUs/igloos (see Figure D-11) prevents run-on of precipitation into the storage units. To prevent infiltration of rainwater, the HWSUs/igloos have been covered with geomembranes.

D-1e Requirements for Ignitable or Reactive Wastes and Incompatible Wastes

The rockets, WHs, and RMs contain Class A explosives and are classified as Environmental Protection Agency reactive wastes. The HWSUs/igloos meet the design and operational standard of 40 CFR 264.1201 for waste munitions.

All hazardous wastes generated by storage operations are stored in HWSUs/igloos, less than 90-day storage areas, and/or satellite accumulation areas. The HWSUs/igloos have reinforced concrete walls and are at least 400 feet apart.

Incompatible hazardous waste munition items are physically separated (on a different pallet, location within, etc.) and are stored in accordance with Department of Defense requirements.

Equipment used in hazardous waste management is spark resistant, and there is no electrical power inside the HWSUs/igloos. The threat of fire is further reduced by the prohibition of open flames and smoking, as well as the prohibition of work that generates frictional heat or sparks. Equipment requiring gasoline generators must be positioned outdoors and downwind when operating.

D-2 TANKS SYSTEMS

This section is not applicable.

D-3 WASTE PILES

This section is not applicable.

D-4 SURFACE IMPOUNDMENTS

This section is not applicable.

D-5 INCINERATION

This section is not applicable.

D-6 LANDFILLS DESIGN

This section is not applicable.

D-7 LAND TREATMENT

This section is not applicable.

D-8 MISCELLANEOUS UNITS

This section is not applicable.

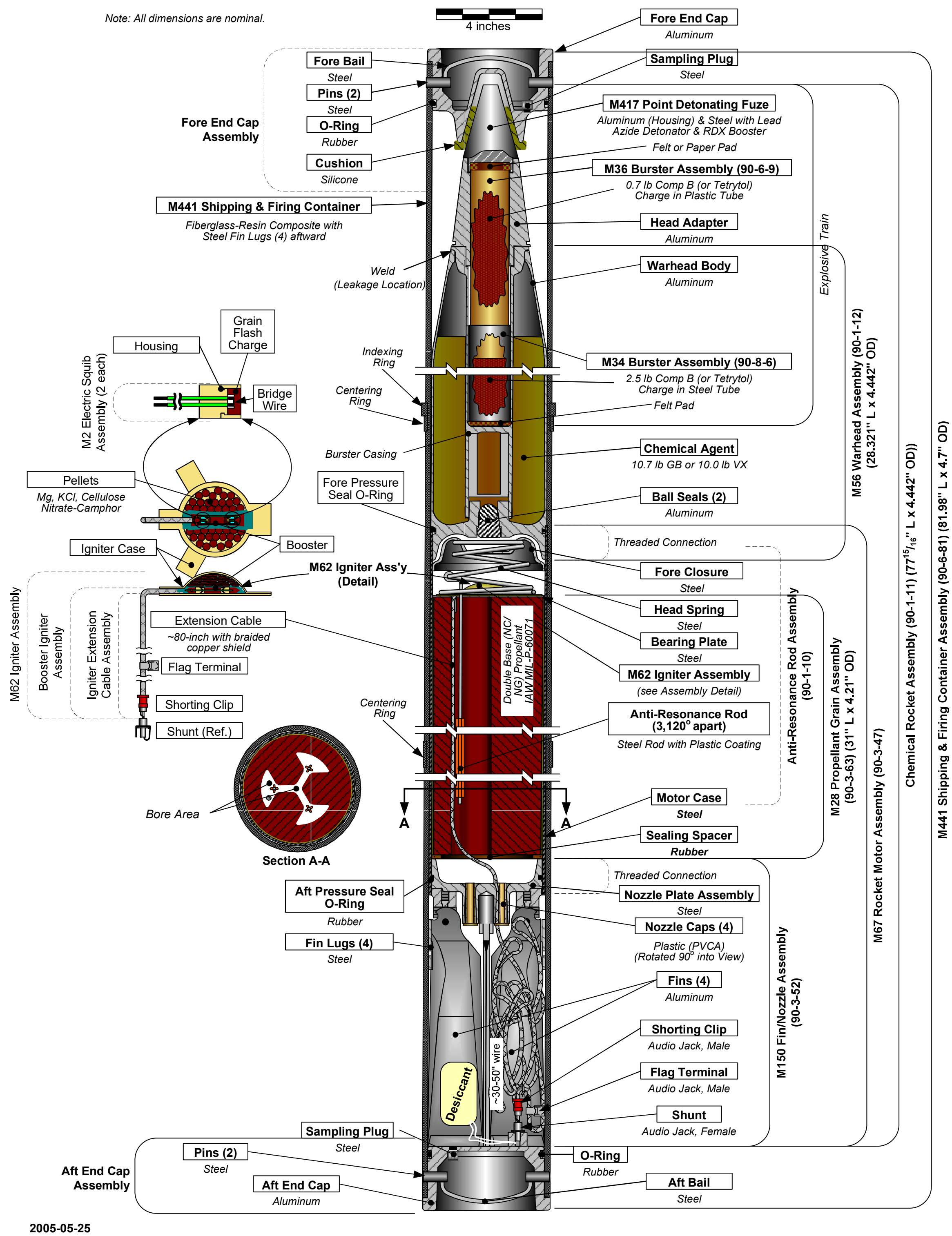

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Figure D-1. M55 115mm Chemical Rocket Assembly

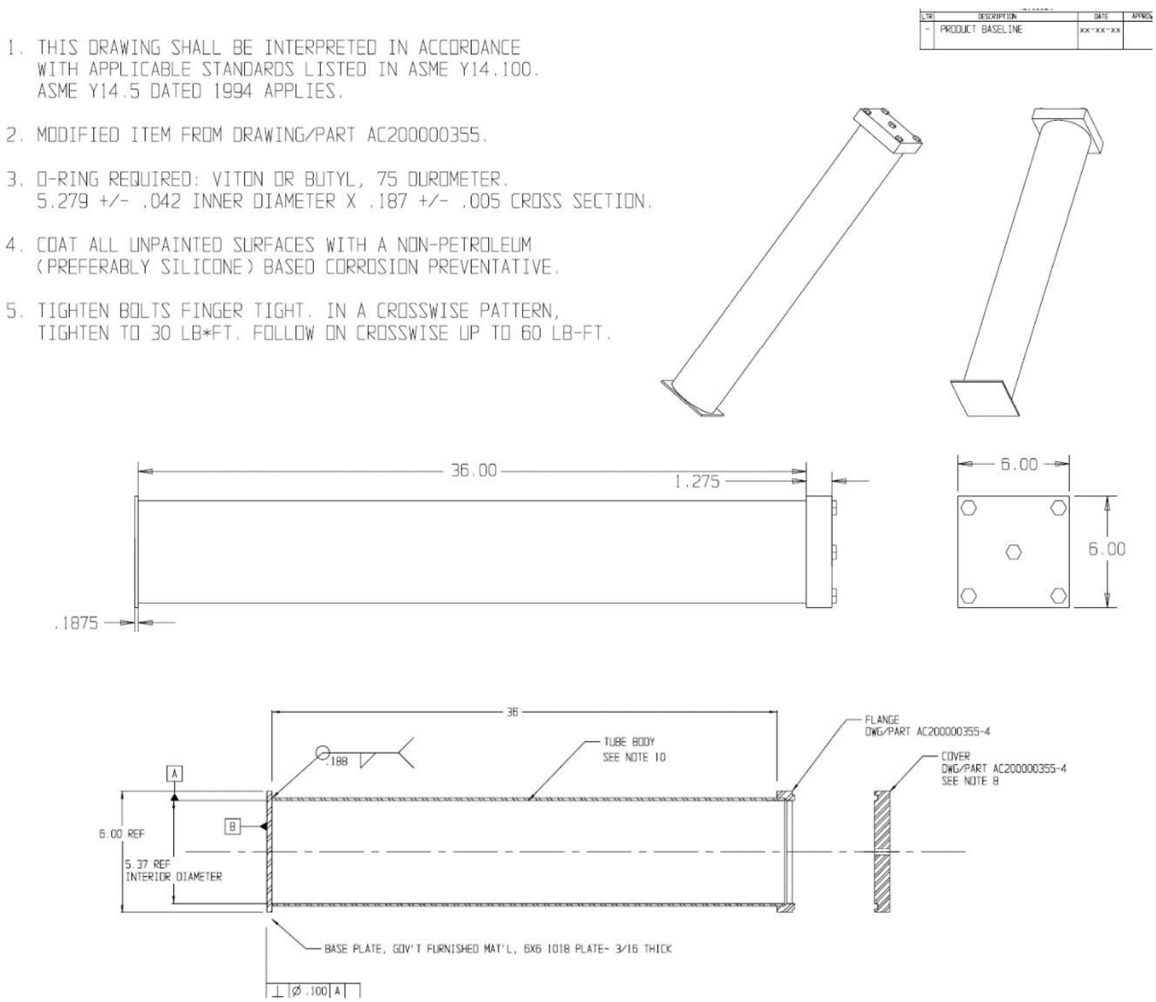

Figure D-2. Typical 5.4x36-inch SRC

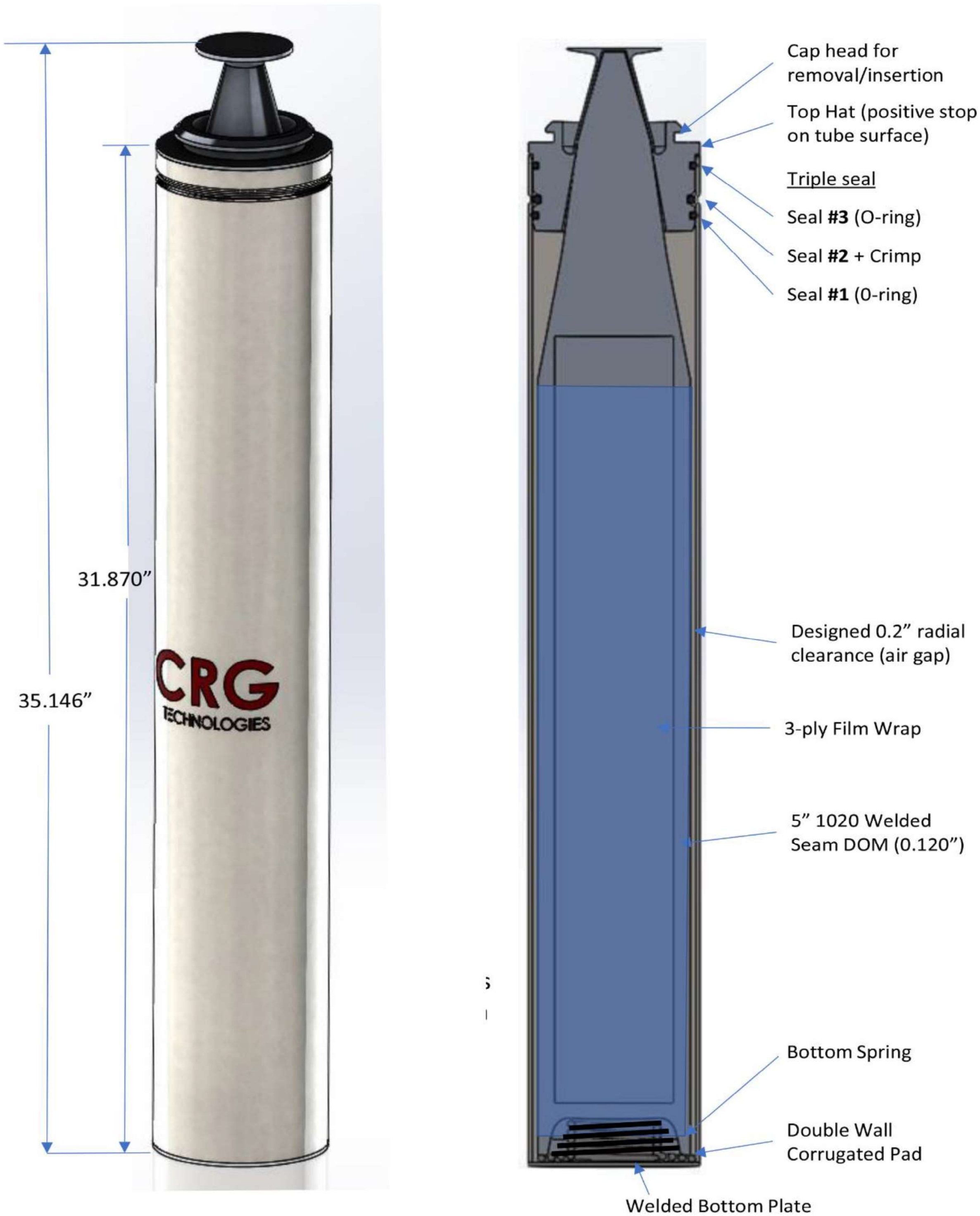

Figure D-3. Typical WH Container

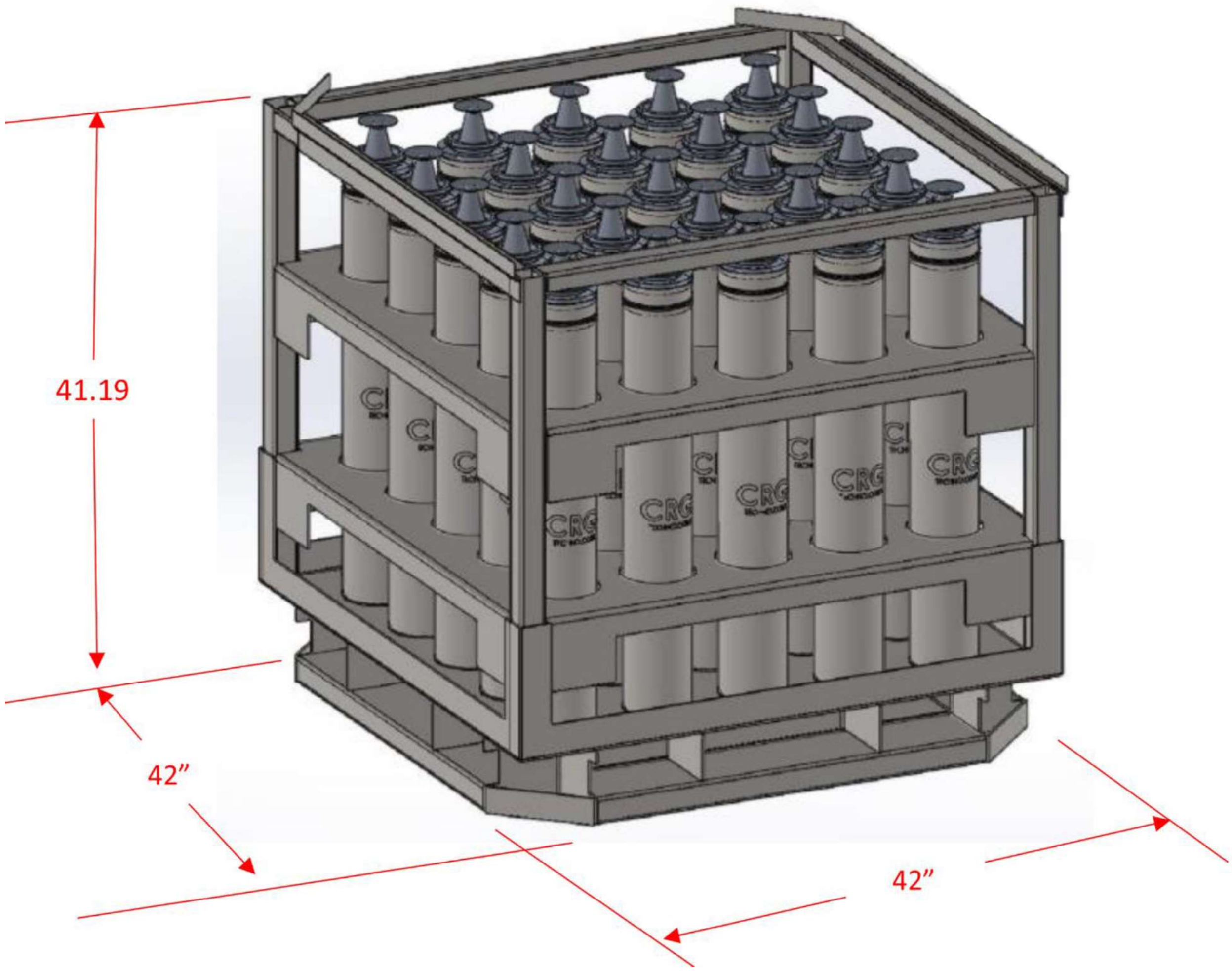

Figure D-4. Typical WH Skid

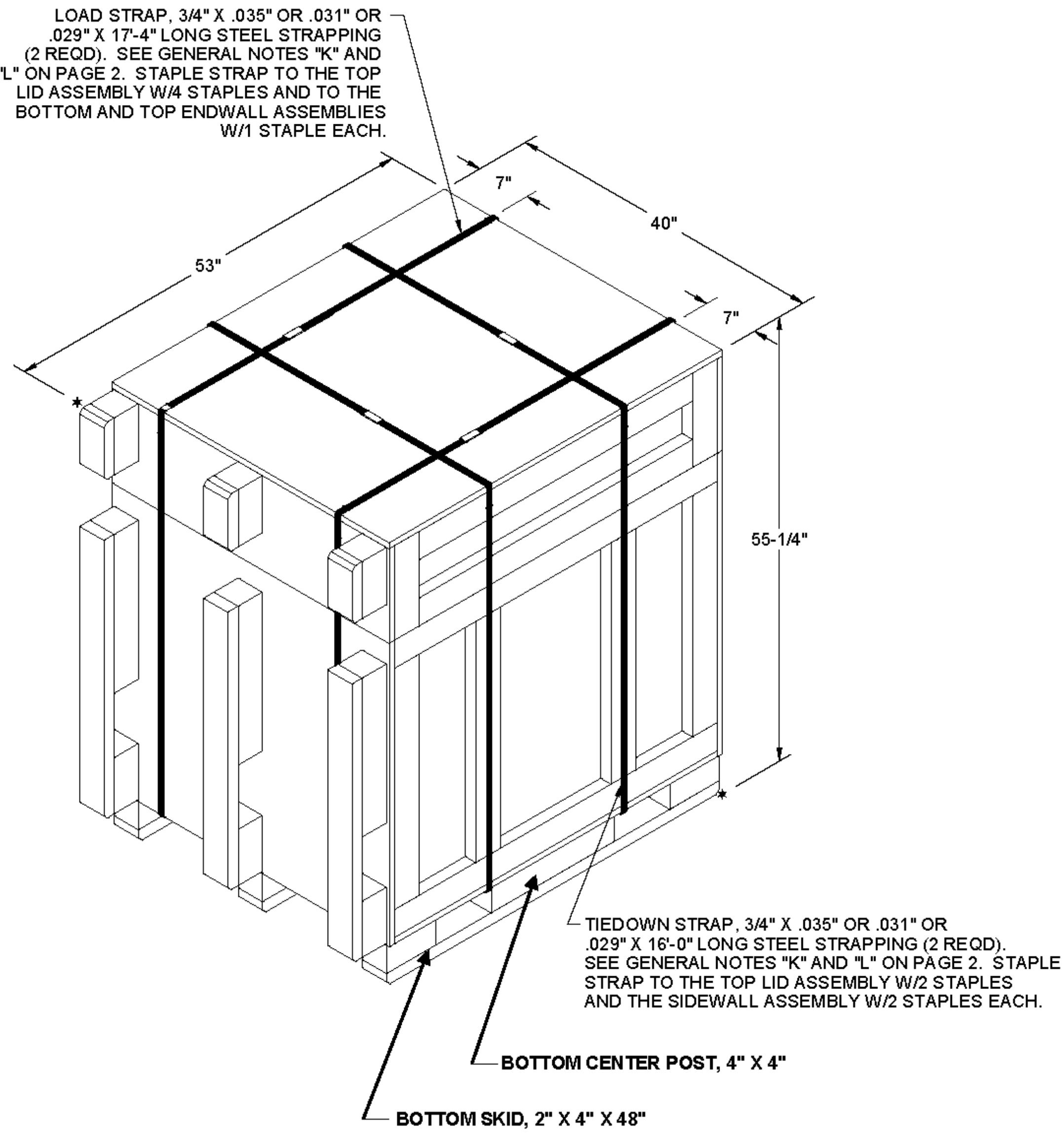

Figure D-5. Typical Wood Box for RMs
Adapted from U.S. Army Materiel Command Drawing, *Unitization Procedures for M67 Rocket Motor in Wooden Crate, Unitized 30 Rocket Motors per Wooden Crate*, Revision 2, December 2018.

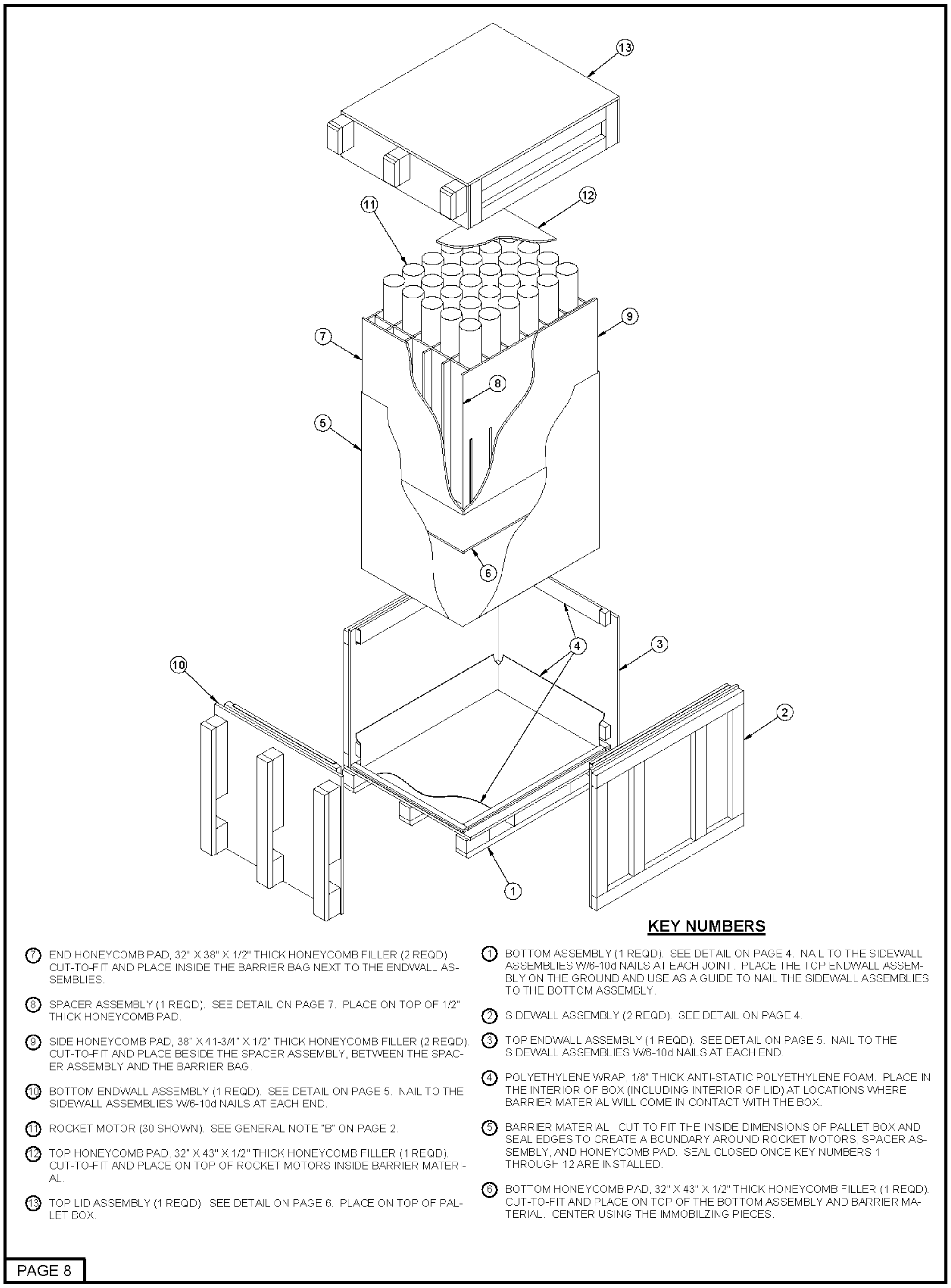

Figure D-6. Typical Wood Box for RMs (Exploded View)

Source: U.S. Army Materiel Command Drawing, *Unitization Procedures for M67 Rocket Motor in Wooden Crate, Unitized 30 Rocket Motors per Wooden Crate*, Revision 2, December 2018.

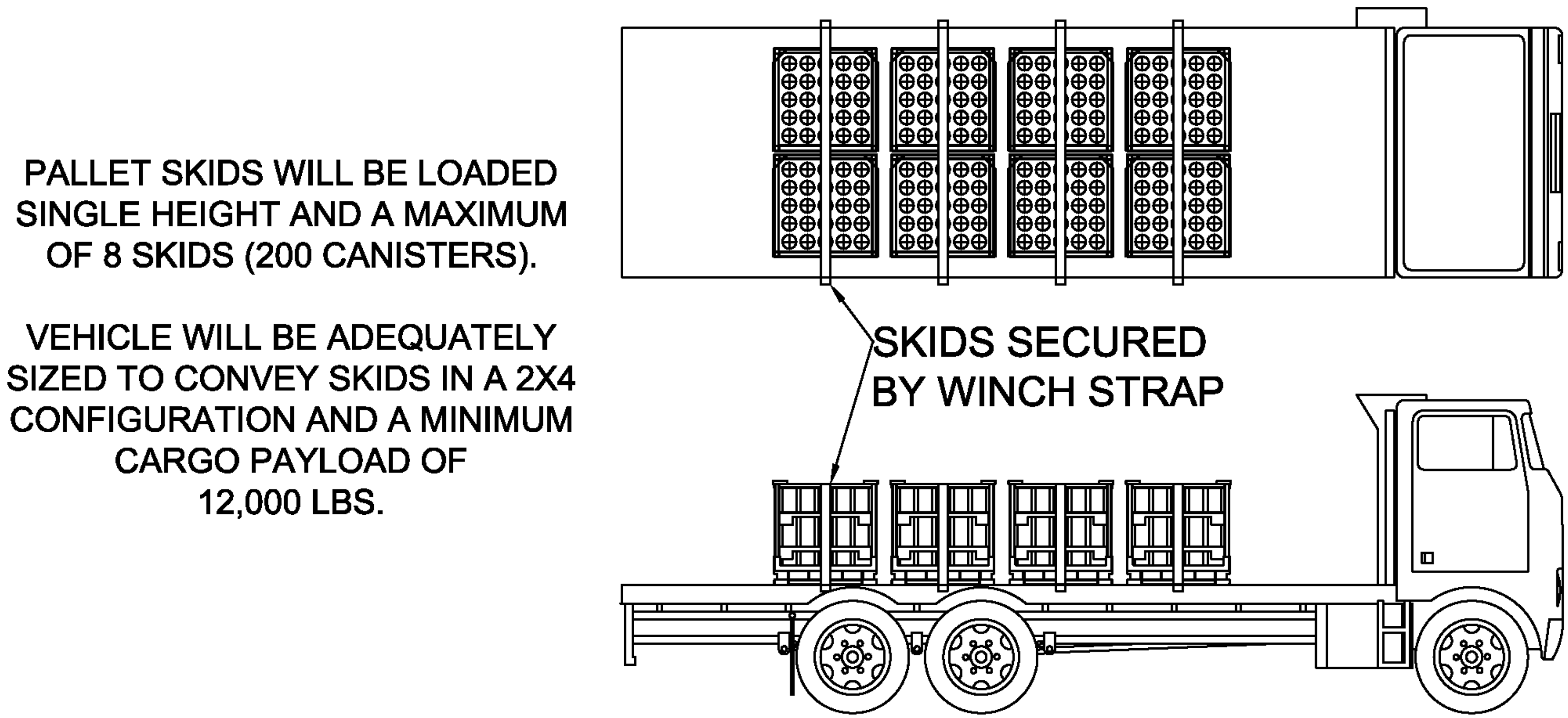

Figure D-7. Typical Loading for WH Skids on Flatbed Truck

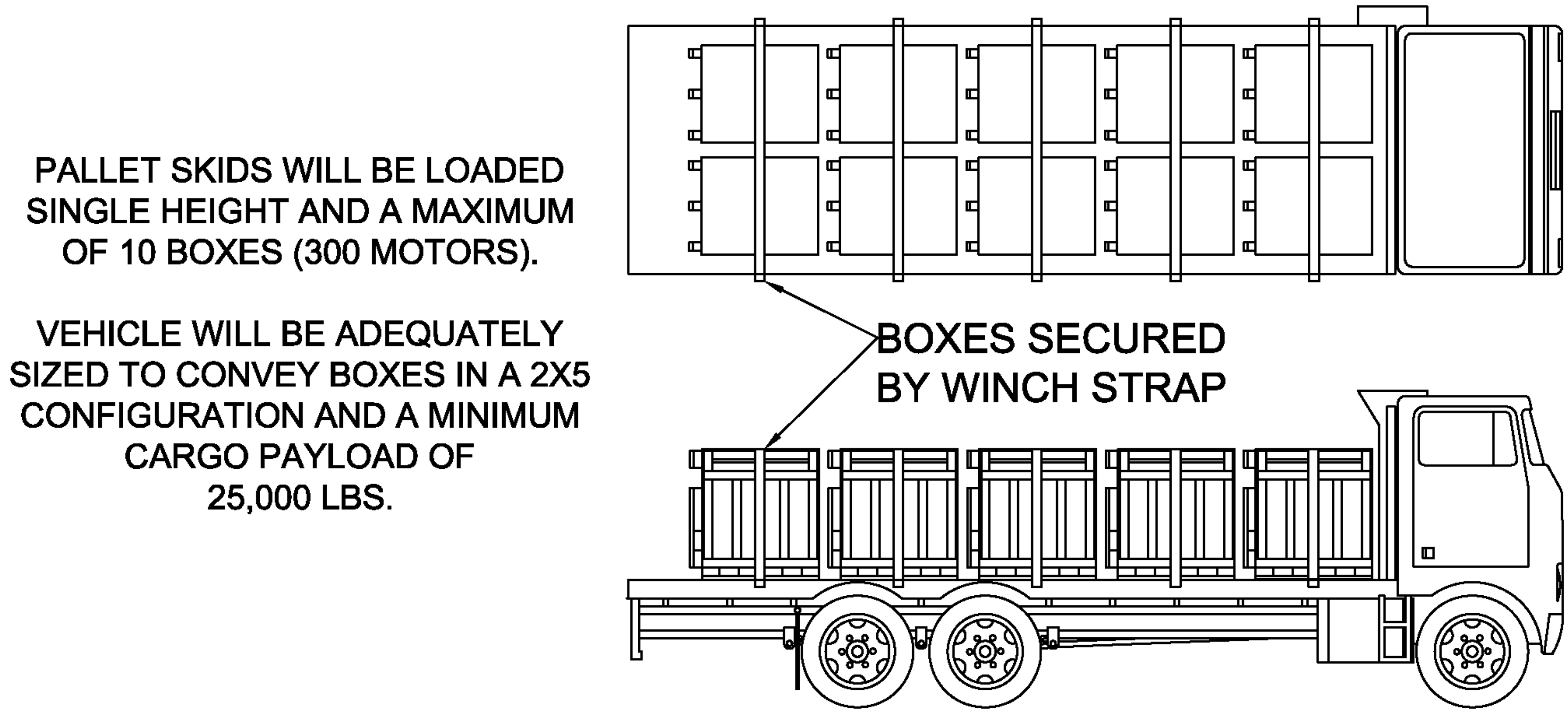

Figure D-8. Typical Loading of RM Boxes

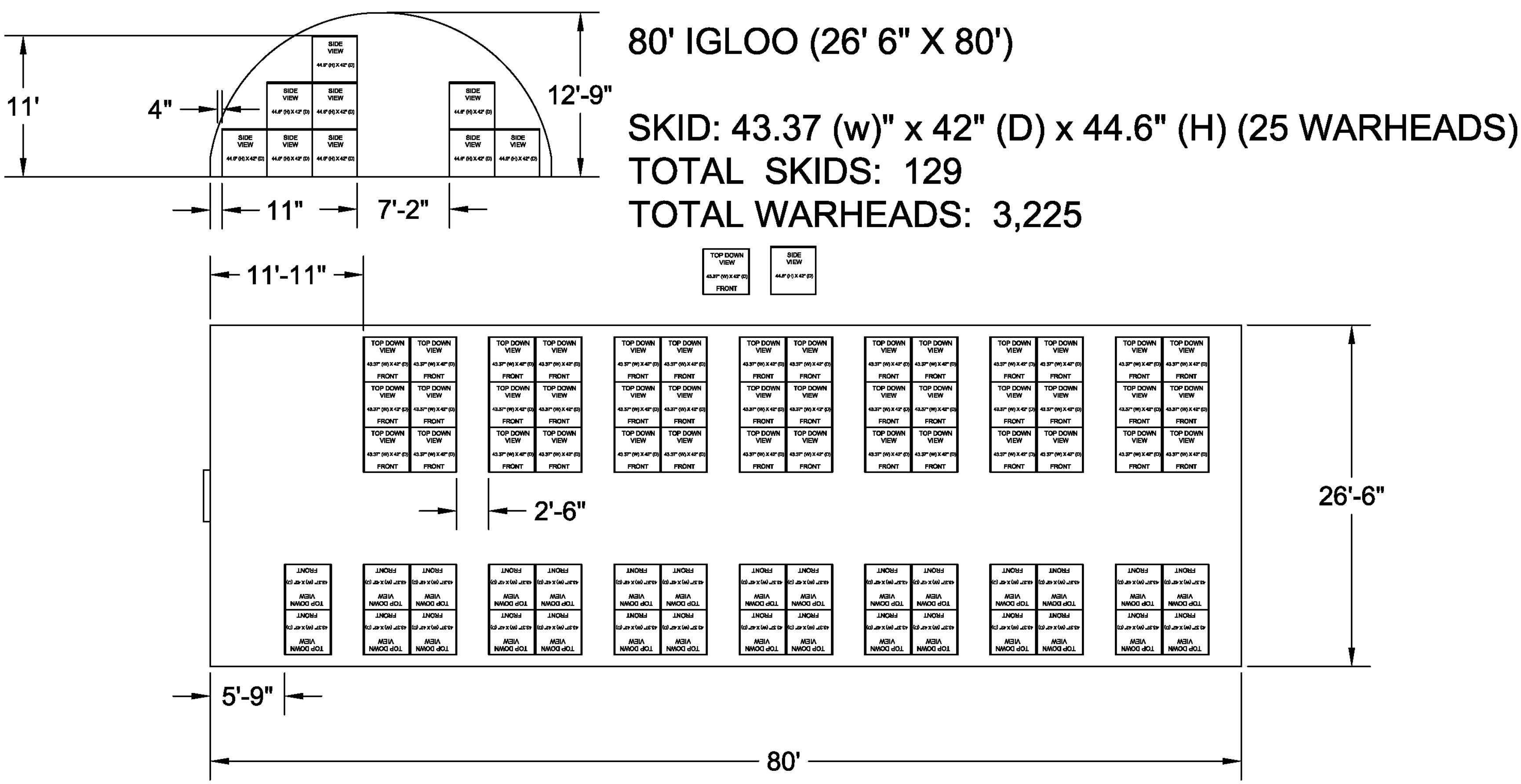

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Figure D-9. Typical WH Skid Storage Configuration

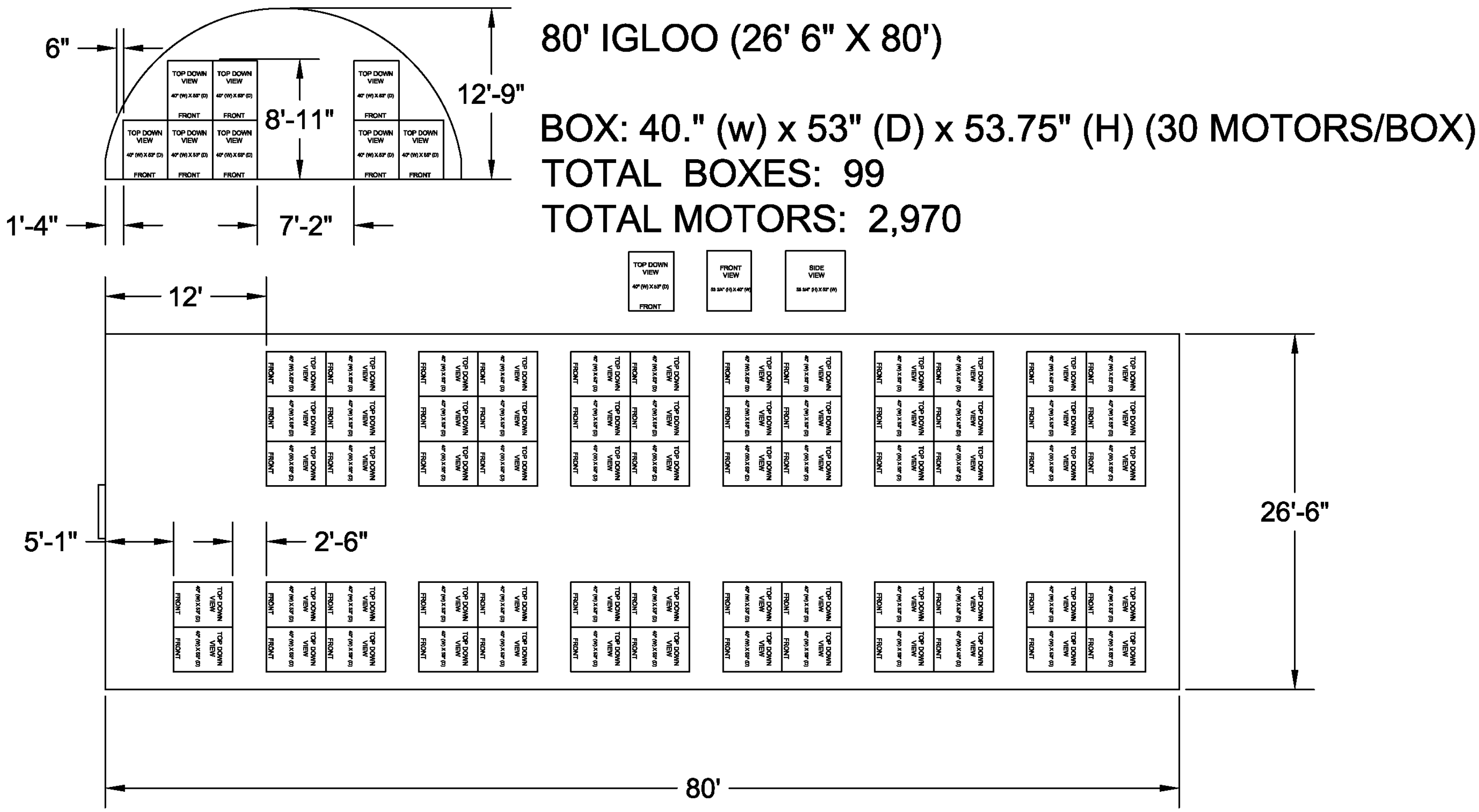

Figure D-10. Typical RM Box Storage Configuration

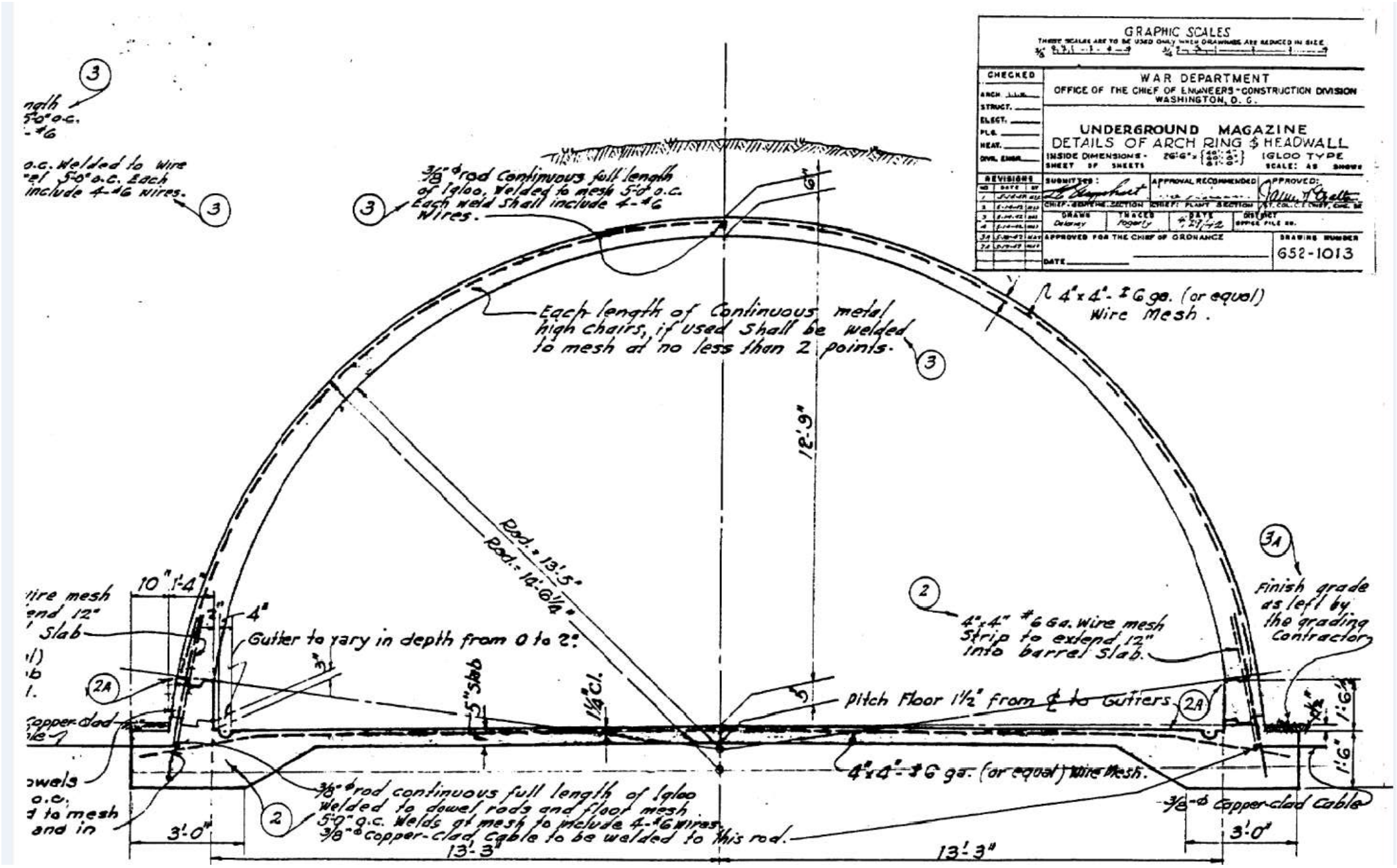

Figure D-11. Basic Igloo and Construction

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PART E GROUNDWATER

Groundwater monitoring requirements are not applicable. The hazardous waste storage units (HWSUs)/igloos in the storage area of the Chemical Limited Area (CLA) are not land-based disposal units. These HWSUs/igloos were designed to contain and control all releases, thereby preventing impacts to the groundwater. Although the HWSUs/igloos may have wastes that contain free liquids (i.e., munitions containing chemical agent), the design and hazard prevention procedures of the facility provide protection for the environment and general public, eliminating the requirement for groundwater monitoring in the vicinity of the facility. Liquid waste will not contact the floor of the storage units because wastes containing free liquids will be stored in secondary containment designed to contain 10 percent of the volume of containers or 100 percent of the volume of the largest container, whichever is greater.

In addition, the storage area of the CLA does not contain any identified solid waste management units (SWMUs) that require groundwater monitoring.

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PART F PROCEDURES TO PREVENT HAZARDS [401 KAR 39:090, Section 1; 40 CFR 264]

Under the direction of Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA), Blue Grass Chemical Activity (BGCA), Blue Grass Army Depot (BGAD), or other government or contractor organizations may provide the following support for the storage of the chemical munitions and components of chemical munitions (hereinafter items; described in Part B Section B-1):

- Transport
- Perform monitoring of storage igloos
- Perform leaker management activities
- Respond to contingencies
- Conduct Resource Conservation and Recovery Act (RCRA) inspections of hazardous waste storage units (HWSUs)/igloos
- Perform partial and final closure activities

F-1 SECURITY

F-1a Waiver

No waiver from the security requirements is requested.

F-1b Security Procedures and Equipment

F-1b (1) 24-Hour Surveillance System

The BGAD restricted area, also known as the ammunition storage area, is separated from the administrative area and the public by fences and security checkpoints. There are specific entry procedures, and all entrants must obtain clearance to enter or be escorted by an individual with clearance authorization.

The Chemical Limited Area (CLA), which is fully contained within the BGAD restricted area, is divided into two areas: (1) the storage area of the CLA, where chemical munitions and components are stored, and (2) the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP), where chemical munitions are destroyed.

Extraordinary precautions are taken to ensure the security of the CLA. It is a secure area, and access requires special procedures. Visitors requesting access to the CLA must first comply with health test, security, and safety procedure requirements. CLA visitors are provided an escort while inside the CLA. Armed security personnel patrol and control/limit access to the area 24/7.

All facility personnel are required to be cleared for entry into the CLA. All personnel must enter the CLA through a security checkpoint. Vehicles entering and exiting the CLA are thoroughly inspected.

F-1b (2) Barrier and Means to Control Entry

Fences surround the BGAD restricted area. The CLA is inside the BGAD restricted area and is surrounded by additional fences. Items are stored in HWSUs/igloos, which are earth-covered magazines designed to store energetic materials and meet ammunition storage requirements. Each HWSU/igloo housing items has a locked/secured door.

F-1b (3) Warning Signs

Posted at both entrances to the BGAD restricted area and the CLA are warning signs that inform visitors and personnel that they are entering a limited access government area.

The fences have warning signs posted approximately every 50 yards. In lieu of placing signs on each HWSU/igloo in the storage area of the CLA, a sign at the entrance to the CLA storage area states “Hazardous Waste Storage Area Authorized Personnel Only.” In addition, entry to the CLA is posted with appropriate personnel protective warning signs. All signs are designed to be legible from a distance of approximately 25 feet.

Personnel are prohibited from smoking and/or carrying open-flame devices (such as matches) or other flammable items. A flame permit is required to use open flames. Smoking within the ammunition restricted area is limited to designated smoking areas only. With this restriction, the need to place “No Smoking” signs on each HWSU/igloo is not considered necessary.

Each storage unit containing liquid chemical agent is posted with a typical 24-inch round sign with 12-inch lettering designating the chemical agent contained within the storage unit. The letter “G” designates GB (Sarin) nerve agent, and the letters “VX” designate VX nerve agent. If the storage unit is empty of chemical agent, then the respective agent sign is removed.

F-2 INSPECTION SCHEDULE

F-2a General Inspection Requirements

The responsibilities for pre-operational inspections belong to PEO ACWA, the generators of waste. Government or contractor organizations implement pre-operational inspections of hazardous waste activities related to storage of wastes for PEO ACWA. Deficiencies are dealt with directly when observed and reported to the appropriate management authority for direction if the issue is programmatic or requires management involvement.

Table F-1[1] provides the equipment maintenance schedule for the facility.

Storage facility inspections include the inspection for storage structure deterioration and the condition of the storage unit apron. Records of inspections are maintained for a minimum of 3 years.

F-2a (1) Types of Problems

Types of problems encountered with each type of equipment are annotated on the inspection schedule at Table F-1. Table F-1 includes some required equipment inspections, inspection forms that identify specific areas for consideration, and general inspection schedules.

F-2a (2) Frequency of Inspections

The inspection schedule provided at Table F-1 incorporates the frequency of inspections. All inspection frequencies are consistent with potential deterioration of the equipment or materials being inspected to ensure the service utility of the items.

F-2b Specific Process Inspection Requirements

HWSUs/igloos storing items that contain chemical agent or that monitor to ≥1 vapor screening level (VSL) at the BGCAPP Main Plant receive weekly air monitoring (conducted in lieu of the weekly visual inspections of the containers) for the respective agent stored therein. Air monitoring has proven to be an effective early warning tool while adhering to the cardinal principle to limit the potential exposure to a minimum number of personnel, for a minimum period of time, and to a minimum amount of the hazardous material consistent with safe and efficient operations. Due to the sensitivity of the low-level monitoring equipment, agent vapor in the HWSU/igloo atmosphere can be detected to 1 VSL and will indicate a vapor leak even when no visible liquid leak is present. In addition to the weekly monitoring, these HWSUs/igloos receive quarterly visual inspections.

HWSUs/igloos containing items that do not contain agent and that monitor to <1 VSL at the BGCAPP Main Plant will receive a weekly visual inspection.

Under normal conditions, items that monitor to <1 VSL and do not contain liquid agent will not be stored with items that monitor to ≥1 VSL or that contain liquid agent. Should items that monitor to <1 VSL be stored with items that monitor to ≥1 VSL or that contain liquid agent, the HWSU/igloo will be air monitored weekly.

If an HWSU/igloo is empty of all hazardous waste, it is inspected weekly or a security seal is placed on the door, and the security seal is visually checked weekly. If the seal is removed, broken, or tampered with, a visual inspection will be conducted.

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[1] Tables are located at the end of this Part.

F-2c Remedial Action

In general, corrective actions for all discrepancies and equipment shortfalls are directed to the appropriate operational directorates and/or divisions for correction through direct discussion, work order, or memorandum. The observing authority handles concerns that do not require extensive response from other directorates/divisions immediately. Any problems impacting RCRA Permit compliance are reported to the government or contractor Environmental Office for immediate attention and resolution.

F-2c (1) Vapor-Emitting/Leaking Containers or Chemical Munitions

When a vapor-emitting/leaking container or chemical munition is suspected or detected during air monitoring or visual inspection, the observations are reported immediately to the BGAD Operations Center operated by BGCA (hereinafter Operations Center) and Contingency Plan (Chemical Accident/Incident Response and Assistance [CAIRA]) operations are implemented. During visual inspections, if evidence of leaking liquid is found in an HWSU/igloo, the suspected liquid is tested with M-8 paper to determine the presence of agent. If the liquid is determined to be VX or GB, the contaminated area is decontaminated and/or the leaking item is overpacked. The leaking/vapor-emitting item is located, and the pallet containing the item is moved to an operation point within the storage unit to be overpacked. The overpacked agent item may be left within the storage unit or removed and placed in a designated HWSU/igloo.

Decontamination mixtures are normally applied with dry wipes soaked in the mixture. This minimizes the generation of decontamination waste. Generally, less than 1 gallon of decontamination mixture is used. After decontamination, the outside of the container is cleaned with a dry wipe or equivalent material.

The expended decontamination mixture, wipes, pallets, metal strapping, plastic throws, dunnage, and leather gloves are placed in a Department of Transportation (DOT)-approved container (typically a 55-gallon drum, but other sizes may be used). Care is taken that the containers selected are compatible for the characteristics of the waste being generated. The DOT container is tented or relocated to a monitoring shed, and the contents are air monitored to confirm that the agent detection level is <1 VSL for the respective agent. If the contents are not below the necessary level, the items are decontaminated again until <1 VSL is reached. The containers are then sealed shut with the appropriate mechanism. Hazardous waste labels are applied to each container at the time of generation indicating the accumulation start date. The containers are placed on clean pallets and left within the HWSU/igloo or moved to an appropriate HWSU/igloo. Stockpile storage mission generated waste that meets the appropriate criteria is normally disposed of through a conventional hazardous waste disposal contract.

F-2c (2) HWSUs/Igloos

If inspection of the exterior of an HWSU/igloo shows signs of nonstandard conditions (e.g., soil erosion, missing hazard markers, unsecured/missing lightning grounds, or stray large rocks in the earth cover), the findings are reported to the BGCA Commander or contractor Site Project Manager and BGAD Facilities Engineering for remedial action and correction of the deficiencies.

If inspections of the HWSU/igloo interior indicate problems other than storage container leaks (e.g., mildew; poor stacking; insufficient aisle space; or damage to floors, walls, locks), these are also reported to the respective parties, BGCA Commander, Director of Chemical Operations, and/or BGAD Facilities Engineering for remedial action.

Inspections are documented and the records kept for a minimum of 3 years.

F-2c (3) Lightning Protection System

If deficiencies are noted during testing of the lightning protection system, the results are reported by a memorandum to the Facilities Engineering. The memo states the location, date inspected, resistance reading, and remarks, including corrective actions taken or required. This memo, together with the response from Facilities Engineering, is kept on file at the government or contractor Environmental Office.

F-2c (4) Personal Protective Equipment

Deficiencies noted during inspection (testing) of personal protective equipment (PPE) (toxicological agent protective [TAP] clothing, commercial equivalent clothing, or masks) could trigger repairs to include parts replacement and retesting. If the item cannot pass the prescribed inspection (testing), it is eliminated from further use. A “passed” item replaces the defective unit in inventory or is issued to the chemical worker.

Corrective actions for discrepancies are directed to the appropriate entity for correction through work order or memorandum. The inspecting authority handles concerns that do not require extensive response from other divisions immediately.

F-2d Inspection Log

Inspection forms used in association with the hazardous waste management will include at a minimum:

- Date and time of inspection
- Name/signature of inspector
- Observations made
- Comments
- Remedial action requirements

F-3 WAIVER OF PREPAREDNESS AND PREVENTION REQUIREMENTS

Hazardous waste management facilities are required to minimize the possibility of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water that could threaten human health or the environment. No waiver is sought to alter these requirements.

F-3a Equipment Requirements

F-3a (1) Internal Communications

Whenever hazardous wastes are being transferred or inspected, a two-way communication device (radio or cellular telephone) is available for the operators to use in case of an emergency. The Operations Center maintains radio communications with personnel during all operations.

Guards within the CLA routinely carry two-way radios. Workers inside HWSUs/igloos work in pairs and must remain in sight of each other at all times. Personnel working inside storage units with chemical agent are watched by someone outside the unit who is in communication with the Operations Center or Security and who is able to report/respond to any problems.

An accident, fire, or explosion is signaled by an alarm activated by the Operations Center. This siren is audible throughout BGAD. During a chemical accident/incident emergency, the primary means of continuing communication is installed radio nets. (The BGAD phone system serves as the secondary communication system.) The radio nets are frequency modulated. Radio silence is declared except for chemical accident/incident emergency communications traffic.

F-3a (2) External Communications

The guard areas within the storage area of the CLA are tied into the BGAD telephone system. Two-way radios or phones can be utilized in emergency situations or conditions to contact other individuals or groups at BGAD to provide support, the Emergency Coordinator, and off-site emergency response groups.

F-3a (3) Emergency Equipment

Each vehicle in the CLA carries a fire extinguisher that is available to crewmembers entering hazardous waste storage units. There is no water supply on site at the HWSUs/igloos; they are serviced by the facility fire department. The fire department tank truck has a 1,200-gallon capacity. A “brush” truck is available with a 250-gallon capacity. Additionally, the fire department has two fire engine pumpers with a total water capacity of 1,060 gallons.

Spill control equipment includes absorbent socks or pads, brushes, brooms, and dustpans used to retrieve and containerize spills.

F-3a (4) Water for Fire Control

The fire hydrant near the entrance to the storage area of the CLA has a flow rate of approximately 730 gallons per minute. The electrical hydrant pumps are connected to a diesel-powered generator for backup power in case of an outage.

F-3b Aisle Space Requirement

Aisle space is sufficient in the HWSUs/igloos to allow unobstructed movement of personnel, fire protection equipment (fire extinguishers), spill control equipment, and decontamination equipment. Munitions are stored according to Department of Defense (DoD) ammunition requirements.

F-4 PREVENTIVE PROCEDURES, STRUCTURES, AND EQUIPMENT

Hazards associated with handling, loading, and unloading operations are minimized through the implementation of Standing Operating Procedures (SOPs) by personnel receiving the proper training as discussed in Part H.

Hazardous waste containers are inspected prior to movement to ensure they are properly closed and tightly sealed. Containers are transported on pallets and loaded/unloaded with a forklift. Ramps facilitate smooth movements of material handling equipment in and out of HWSUs/igloos.

Additionally, personnel conducting waste loading and unloading operations wear protective clothing appropriate to the area and work activity being conducted.

F-4a Loading/Unloading Operations

Movement related to this application involves the transfer of items from BGCAPP to the storage area of the CLA. Items are transferred by a transport vehicle (typically a flatbed truck). The access road is paved and approximately 12 feet wide, and the HWSUs/igloos have wide, paved unloading areas for ease of maneuvering. When operations involving items that contain agent or that monitor to ≥1 VSL at the BGCAPP Main Plant are in process, access is limited to personnel involved in the operation. This limits the number of personnel potentially exposed in the event of a leak of chemical agent.

The container and/or pallet(s) are secured in the transport vehicle by a cradle, straps, and/or bracing blocks to prevent items from being damaged or falling off the vehicle during transport. The transport vehicle moves the items to the designated HWSU/igloo.

One or more pallets containing items to be processed are removed from the HWSU/igloo and secured onto the transport vehicle for transport to the disposal location. Movement could occur up to 7 days/week. Management/unloading of the items at BGCAPP will be covered in the BGCAPP Application of the Main Plant Part B Permit.

F-4b Runoff

The items are stored in secure HWSUs/igloos designed for explosive materials. All storage containers are kept closed. The storage units are designed to minimize run-off. Periodic maintenance is required to ensure continued protection. None of the facilities are in flood hazard zones. These features prevent waste from entering into the environment.

F-4c Water Supplies

BGAD obtains its drinking and process water from Lake Vega. None of the HWSUs/igloos drain into the Lake Vega drainage area. All spills are contained within the storage unit and immediately mitigated to preclude release outside the storage unit. These measures prevent contamination of clean water, process water, and potable water systems.

F-4d Failure of Equipment and Power Supply

There is no electrical power supply inside the HWSUs/igloos. If electrical power is required within a unit, the power is provided by an external generator. Any electrical lighting or equipment is safe for use in an ammunition environment.

Emergency backup generators provide power for the Intrusion Detection Systems in the event of a power outage. The Operations Center has backup emergency generators to operate computers, sirens, and communications equipment in the event of a simultaneous accident/incident and power outage.

The security lighting around the area is powered through the BGAD utilities system. There is a backup generator in the event of a power failure. Mobile light sets and electrical generators are also maintained.

Backup equipment for lifting, hauling, and decontamination is maintained for replacement of any inoperable equipment.

F-4e Personal Protective Equipment

All personnel moving hazardous waste at storage facilities are required to wear shirts, trousers (personnel frequently wear long-sleeved coveralls), and boots with safety toes. In addition, eye, hearing, and hand protection are available. The usage of PPE is dependent on the working environment. Eye and hand protection are required during the handling of hazardous materials.

Various levels of PPE are worn to protect workers from chemical exposure. Stocks of PPE appropriate for all hazardous materials are maintained onsite. The potential for exposure of personnel to any hazardous materials or wastes during operations is minimized through monitoring and decontamination of PPE and other equipment before, during, and after use in a contaminated or potentially contaminated area. PPE is monitored to assure it is safe before it is issued for reuse.

Personnel entering the storage area of the CLA either wear or carry a protective mask. For administrative type areas, the mask may be readily available to the wearer instead of in a slung position. Each protective mask carrier is supplied with three Antidote Treatment Nerve Agent Autoinjectors (ATNAAs) for nerve agent (GB or VX) for use in emergency exposure. PPE used during operations is dictated by the operation being performed. PPE provided to the workers is in a serviceable condition and properly fitted to the wearer. Each worker required to wear PPE is given instructions on the care and inspection of each piece of equipment issued.

Potential routes of entry of the agents are through vapor inhalation, ocular, skin absorption, and injection. Operational constraints when using PPE are employed and based on the nature of the work performed and the type of protective equipment in use. The selection of protective equipment worn throughout operations is determined by a combination of air monitoring levels and mandates of SOPs based upon risk level. Table F-2 summarizes the various protection levels and the procedures that are followed dictating the level of PPE.

Trained emergency personnel responding to a chemical event (accident or incident) or emergency situation will wear the level of protection that is indicated by the conditions that exist.

F-4f Prevention of Releases to Atmosphere from HWSUs/Igloos Containing Chemical Agent

At HWSUs/igloos storing items containing agent or that monitor to ≥1 VSL at the BGCAPP Main Plant, procedures are employed to detect and prevent the release of agent to the atmosphere. The storage units are air monitored weekly to detect vapor from leaking munitions. Monitoring for agent vapor is conducted in lieu of the RCRA required visual inspections of the containers (munitions). See Table F-1.

Chemical agent air monitoring is accomplished using MINICAMS®, Depot Area Air Monitoring System (DAAMS), and/or equivalent approved equipment. MINICAMS is an automated near real-time air monitoring system. The DAAMS collects samples via an adsorbent tube over an extended period of time.

Suspected agent leaks confirmed by procedural testing are controlled by the placement of a filter apparatus with a series of 1,000 cubic foot per minute (CFM) carbon filters on the rear vent of the impacted storage unit. When the 1,000 CFM filter is attached and operational, the air enters through the front vent, flows from front to rear of the HWSU/igloo, and exits the rear vents, where it is processed through the filter banks. The filter is operated continuously (24/7) until the storage unit atmosphere has been tested to permissible levels.

F-5 PREVENTION OF REACTION OF IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTES

F-5a Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Waste

HWSUs/igloos are protected from sources of ignition and/or reaction by restricting entry of individuals in possession of sources of ignition and the following administrative controls:

- Prohibition of open flames and open-flame devices such as lighters and matches
- Prohibition of smoking
- Prohibition of work that generates frictional heat or sparks (electrical, mechanical, or static)
- Prohibition of storage of incompatible wastes in same room or location
- Proper selection of individual transport and storage containers (design/material)

HWSUs/igloos are designed to store energetic materials. Storage units are separated by at least 400 feet. Equipment used is spark and explosion resistant. Gasoline-powered generators are positioned outdoors so as not to provide an ignition source inside the storage unit. Vehicles are required to carry fire extinguishers.

Fire control is accomplished through security measures limiting ignition sources in the waste storage area and keeping ground cover minimized. Routine mowing in the storage area of the CLA keeps the grass controlled and reduces the chance of fire during periods of drought.

Workers are trained annually in proper handling and storage of hazardous waste. Training provides instruction for proper handling and protection from sources that could ignite or cause a reaction with munitions. The worker training also instructs on the proper handling of munitions and related waste. Training is addressed in Part H.

F-5b General Precautions for Handling Ignitable or Reactive Wastes and Mixing of Incompatible Wastes

The hazardous wastes stored are managed using precautionary measures for handling wastes based on ignitability, reactivity, and incompatibility. The HWSUs/igloos are designed to hold energetic materials. Workers are specifically trained in handling, transferring, and hauling explosive materials. No wastes are mixed. There are no sources of ignition at the storage units.

Only munitions, munitions components, or items containing chemical agent of the same type will be stored/managed in any given HWSU/igloo at any one time. A storage unit will only contain one type of agent (GB or VX).

F-5c Management of Ignitable or Reactive Wastes in Containers

HWSUs/igloos are more than 50 feet from the BGAD property line as required by regulation. Other management activities are described in Section F-5a.

F-5d Management of Incompatible Waste in Containers

There is no contamination of the munition overpack containers from prior use.

Only one type of agent munition is stored in a given HWSU/igloo at any one time.

The government or contractor organization follows established procedures that direct the waste accumulation, container selection, marking and labeling, movement, and storage of hazardous waste. The government or contractor Environmental Office and operational employees who generate and deal with hazardous waste are routinely trained on the importance and practice of proper waste management. Periodic internal and external agency inspections for compliance with these established standards assure the shortcomings are quickly identified and resolved.

Table F-1. Equipment Maintenance Schedule

Equipment Type	Description	Types of Problems	Inspection Maintenance Frequency
Air Monitoring	Low-level monitoring equipment	• Chemical agent standard not in specified range • Equipment inoperative	Before and after use daily
Vehicles	RTAP	Inoperative	6 months
	M12A1 power driven decontamination apparatus	• Decontamination equipment inoperative • Missing materials or items, leaks, or deterioration	Quarterly
	Forklift truck (vehicle preventive maintenance)	Inoperative	6 months
	Forklift truck (lift testing)	Inadequate load capacity	Annually
	Flatbed truck (vehicle preventive maintenance)	Inoperative	6 months
Safety and Emergency Equipment	SCBA	• Inoperative • Pressure levels • Seals and valves, missing parts	Annually
	Igloo air filters	Throughput deterioration	Semiannually
	1,000 CFM igloo powered ventilation equipment	Inoperative	Before, during, and after use
	Personal protective equipment (TAP butyl rubber suits or commercial equivalent)	Deterioration of fabric and/or seal seams	6 months
	Fire extinguishers (in vehicles)	Not charged	Daily during operating days
	Fire pumps and hydrant system	Inoperable	Yearly
	Fire trucks	Inoperable	Weekly
	Emergency spill equipment (broom, dustpan, drum)	• Not present • Deteriorated	Weekly

Table F-1. Equipment Maintenance Schedule

Equipment Type	Description	Types of Problems	Inspection Maintenance Frequency
Safety and Emergency Equipment (Continued)	First-aid equipment and supplies	Expired shelf life	Yearly
		Failed to replenish after use	After use
	Phone emergency telephone system (red phone system)	Inoperative or malfunctioning	Daily during operating days
Security Devices	Perimeter fence	Inoperative or malfunctioning	Twice daily
	Backup power generator and lighting	Inoperative or malfunctioning	Weekly
	Locking devices on HWSUs	Inoperative or malfunctioning	6 months
	Intrusion detection system	Inoperative or malfunctioning	Quarterly
	Warning sirens	Inoperative or malfunctioning	Twice monthly
HWSUs/Igloos in Storage Area of CLA operated by PEO ACWA (up to 46 units)	HWSUs/igloos containing overpacked chemical munitions and munitions components, containing chemical agent, or that monitor to ≥1 VSL at the BGCAPP Main Plant (GB or VX); hazardous waste igloos operated by PEO ACWA	• Deterioration of containers • Leaks/vapor emissions • Igloo apron deteriorated • Water Infiltration	• Weekly air monitoring [a] • Quarterly visual inspection
	HWSUs/igloos containing no hazardous waste, or non-operating HWSUs/igloos	• Broken or missing security seal • Presence of containers • Igloo leaks • Igloo apron deteriorated	• Weekly visual, unless security seal placed on door • Security seal checked weekly. If seal is removed, or broken, visual inspection conducted.
	CLA HWSUs/igloos (structural inspection)	• Leaks, cracks, structural deficiencies • Igloo apron deteriorated, vents	Annually
	HWSUs/igloos containing RMs/items that monitor to <1 VSL at the BGCAPP Main Plant	• Deterioration of containers • Igloo apron deteriorated • Water infiltration	Weekly visual inspection

Table F-1. Equipment Maintenance Schedule

Notes:

a Weekly air monitoring for agent vapor is in lieu of the RCRA required visual inspections of the containers (overpacked chemical munitions or components of chemical munitions)

BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
CFM	cubic feet per meter
CLA	Chemical Limited Area
GB	nerve agent (Sarin)
HWSU	Hazardous Waste Storage Unit
PEO ACWA	Program Executive Office, Assembled Chemical Weapons Alternatives
RCRA	Resource Conservation and Recovery Act
RM	rocket motor
RTAP	Real-Time Analytical Platform
SCBA	self-contained breathing apparatus
TAP	Toxic Agent Protective
VSL	vapor screening level
VX	nerve agent

Table F-2. Personal Protective Equipment (PPE)

Protective Level	Ensemble Descriptions	Criteria for Selection
Level A	Encapsulating suit with positive pressure (SCBA)	Provides greatest level of protection to skin and respiratory system from splash, immersion, vapor exposure (expected and unexpected), particulate doses harmful to the skin, or when operating in confined, poorly ventilated areas, and the absence of conditions requiring Level A has not yet been determined
Level B	Positive pressure SCBA with hood or hooded chemical resistant suit or commercial equivalent, gloves (inner and outer), boots, taped cuffs	Provides the highest level of respiratory protection when the type and atmospheric concentration level of substances are identified but a lesser level of skin protection is needed
Level C	Military mask (M40) with hood, apron or commercial equivalent, boots, gloves (inner and outer), and government-issued soft clothing	Provides the protection of the air-purifying respirator when the type and airborne concentration of substances have been identified and measured, and an air-purifying respirator capable of removing the contaminants is available, and the atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect nor be absorbed through any exposed skin
Level C (Modified)	Military mask (M40), government-issued soft clothing, gloves (inner and outer), boots (steel toe)	Provides personal protection when the atmosphere contains no known hazard and the work function reasonably precludes splashes, immersion, or the potential for unexpected inhalation of, or contact with, hazardous levels of any chemical agent
Level D	Military mask (M40) slung, government-issued soft clothing, boots (steel toe), gloves	Provides personal protection when the atmosphere contains no known hazard and the work function reasonably precludes splashes, immersion, or the potential for unexpected inhalation of, or contact with, hazardous levels of any chemical agent
Non-chemical Workers	Street clothes and slung military mask (M40)	Provides a comparable level of protection to that of Level D for “transient” non-chemical workers

Notes:

SCBA self-contained breathing apparatus

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PART G CONTINGENCY PLAN [401 KAR 39:090 Section 1; 40 CFR 264.50, 264.56, and 264.196]

As permitted hazardous waste storage units (HWSUs)/igloos in the storage area of the Chemical Limited Area (CLA) under the operational control of the Blue Grass Chemical Activity (BGCA) are emptied of their chemical munitions, operational control transfers to the Program Executive Office Assembled Chemical Weapons Alternatives (PEO ACWA), as needed, for storage of chemical agent munitions and components of chemical agent munitions (hereinafter items). In addition, rocket motors (RMs)/items that monitor to <1 vapor screening level (VSL) at the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) Main Plant may be stored in HWSUs/igloos inside or outside the CLA. Blue Grass Army Depot (BGAD) and BGCA provide response to emergencies that occur during storage and transportation activities relative to this permit application.

This Contingency Plan was developed to minimize the hazards to human health or the environment from fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water.

The identification or notification of an actual or suspected chemical accident/incident initiates a Chemical Accident/Incident Response and Assistance (CAIRA) Plan response phase. The BGAD Operations Center operated by BGCA (hereinafter Operations Center) staff notifies the BGAD Installation Commander, who immediately assumes the role of Incident Commander (IC) and designates alternates. Immediate actions are taken to save lives, preserve health and safety, secure chemical agent, protect property, prevent further damage to the environment, and promote public confidence. In the event of an emergency occurring in the storage area of the CLA and/or an emergency involving chemical agent, response actions are carried out in accordance with the guidelines in the Permit Application for Chemical Munition Related Items, Part G (Contingency Plan), Figure G-1 (Annex C to BGAD Installation Emergency Management Plan) (hereinafter CAIRA Plan). The CAIRA Plan is used to manage all chemical emergency response activities associated with the storage area of the CLA.

G-1 GENERAL INFORMATION

This Contingency Plan is for the storage of items that contain agent or that monitor to ≥1 VSL at the BGCAPP Main Plant, as well as RMs/items that monitor to <1 VSL at the BGCAPP Main Plant. The items will be transported and stored in HWSUs/igloos in the storage area of the CLA, which has been fenced off and is located in north central BGAD. There are 49 HWSUs/igloos in the storage area of the CLA. Of these, 47 are used to store items containing chemical agents and/or secondary waste (hazardous waste). The other two igloos store miscellaneous materials in support of chemical operations. The items stored as part of this application are leaking and reject nerve agent (sarin [GB] and VX) rockets and 155mm projectiles that have been overpacked, as well as nerve agent rocket components (warheads and RMs).

Whenever the Contingency Plan is revised, BGAD will ensure revisions are distributed to BGAD departments and offices that perform hazardous waste operations. BGAD will also distribute revisions of the plan to external agencies that are designated in Section G-6.

This Contingency Plan will be reviewed and immediately amended by BGAD when any of the following conditions exist:

- The facility Part B permit is revised
- The Contingency Plan fails in an emergency
- The facility changes in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous constituents, or changes the response necessary in an emergency
- The list of emergency equipment changes in a manner that reduces facility capabilities

G-2 ROLES AND RESPONSIBILITIES

G-2a Incident Commander

The BGAD Installation Commander is the IC for all contingency operations, and fulfills the role of Emergency Coordinator as described in 40 Code of Federal Regulations (CFR) §264.55. Within this Contingency Plan, the term IC is interchangeable with Emergency Coordinator. The Installation Commander appointed the following two alternate ICs for all contingency operations—both CAIRA and non-CAIRA:

1. First Alternate IC – BGCA Commander
2. Second Alternate IC – BGAD Chief of Staff

As it relates to activities associated with this module of the permit application, all potential ICs are thoroughly familiar with and have authority and responsibility for the following:

- All aspects of the Contingency Plan in the Permit Application for Chemical Munition Related Items, Part G
- All operations and activities
- Location and characteristics of waste handled
- Location of all records
- Storage area layout
- Committing the resources necessary to carry out this Contingency Plan

During response to this Contingency Plan, the Installation Commander, as the IC, has full authority to designate alternate Environmental Coordinators to take appropriate actions and make assessments. An alternate assigned by the IC shall have full authority to commit any resources that may be necessary when implementing this Contingency Plan.

The BGAD IC and/or an alternate are on the premises or on call at all times. The designated IC can reach the facility quickly. In the event of an emergency, the observer of the accident or incident will notify the Operations Center at (859) 779-6888 or by radio. Upon receiving information about an accident/incident, the Operations Center uses the notification system to contact all first responders and CAIRA team members. The Operations Center is staffed and operational 24/7.

G-2b Environmental Coordinator

Hazardous waste regulations have very specific requirements defining the duties of an Environmental Coordinator, including the following:

- Notify facility personnel and request necessary assistance
- Identify the quantity and type of wastes involved
- Assess hazards due to the wastes
- Report the incident to the involved regulatory agencies, to include state and local agencies, and assist in evacuation, if necessary
- Attempt to keep the emergency from spreading
- Ensure that operations:
    - Do not result in danger due to incompatible wastes reacting
    - Do not resume until all emergency equipment is replenished
- Arrange for disposal of debris after the emergency is over
- Submit a written report to required regulatory agencies within 15 days of the emergency

G-3 IMPLEMENTATION

The decision to implement the Contingency Plan depends upon whether an imminent or actual incident could threaten human health or the environment. If a spill does not meet any of the situations listed in this section and personnel are definitively not at risk, a spill may be contained and abated by operating personnel. The provisions of BGAD's contingency plan will be carried out immediately whenever any of the following identified events occur within the hazardous waste storage areas:

- A fire causes the release of toxic fumes in quantities that migrate off-site or cause harm to personnel
- The fire spreads and could possibly ignite materials at other locations on-site or could trigger heat-induced explosions
- The fire could possibly spread to off-site areas
- Use of water and/or chemical fire suppressants could result in contaminated runoff
- An imminent danger exists that an explosion could occur, causing a safety hazard because of flying fragments or shock waves
- An imminent danger exists if an explosion could ignite other hazardous waste at the facility
- An imminent danger exists if the explosion could result in an uncontrolled release of hazardous constituents into the environment
- An explosion has occurred
- A spill or material release has occurred

The IC will make the determination based upon the hazard assessment of the level of action and response necessary for contingency operations.

G-4 EMERGENCY RESPONSE PROCEDURES

This Contingency Plan is to be used in coordination with the CAIRA Plan.[1]

In the event of a chemical accident or spill, the CAIRA Plan assumes operations priority and is executed by the IC in the Operations Center. Once activated, personnel assigned to the Operations Center follow notification procedures for reporting to Army, federal, state, and local emergency agencies. In an emergency, the exact sequence and timing of events are at the discretion of the IC. The purpose of this section is to provide guidance to the IC regarding roles, responsibilities, and procedures that should be considered and, when appropriate, successfully completed during implementation of the Contingency Plan.

[1] See the Permit Application for Chemical Munition Related Items, Part G (Contingency Plan), Figure G-1 (Annex C to BGAD Installation Emergency Management Plan).

G-4a Notification

BGAD and tenant organizations have established reliable communication channels that allow rapid communications. These channels ensure officials responsible for emergency response receive swift, accurate, and complete information and assessments. In all cases of a fire, explosion, or spill event triggering this plan, the IC will be notified. The following Information will be provided to the IC:

- Location of the accident/incident
- Material involved, quantity, and extent or potential for contamination of soil, air, or water
- Known injuries and estimated risk to human health
- Initial response actions taken

Upon discovering that a fire, explosion, spill, or other release has occurred or potentially may occur, the operator immediately relays the known information to the Operations Center. The Operations Center is responsible for notifying workers in the surrounding area of the emergency or impending emergency. In all cases, BGAD's Fire Department and Environmental Team are notified.

Upon notification of an accident or incident, the Operations Center will attempt to classify the emergency based on the available information. The onsite supervisor will attempt to determine whether it can be handled by operating personnel. The Operations Center will inform Environmental Team personnel with as much of the information as possible about the emergency including:

- Location and time of the emergency
- Type and quantity of the released material
- Person responsible for the emergency
- Any injuries and the extent of those injuries
- Any action taken to contain or clean-up the material

If the on-site supervisor determines that a threat to human health and the environment exists, the Operations Center will be contacted by telephone or two-way radio and informed of the emergency. In all circumstances, whether a human health or environment threat exists or an event that can be handled by on-scene personnel, the IC will be notified and apprised of the situation. Based upon the hazard assessment discussed in Section G-4c of this plan, the IC will determine response actions.

The IC, based upon the information provided, will direct the notification of agencies as required in accordance with the CAIRA Plan for all CAIRA events and in accordance with 40 CFR Part 302 under the Federal Comprehensive Environmental Response Compensation and Liability Act of 1980, as amended; for all other extremely hazardous substances releases as designated in 40 CFR Part 355 under Title III of the Superfund Amendments and Reauthorization Act of 1986; 40 CFR Part 265, Subpart D Contingency Plan and Emergency Procedures; and any other reporting required by law.

If the IC determines that the facility has had a release or explosion that could threaten public health or the environment outside the facility, he/she must immediately notify appropriate local authorities and be available to help appropriate officials decide whether local areas should be evacuated.

If this assessment indicates that on-post area(s) are affected, the Operations Center will notify the on-post personnel and provide a Protective Action Decision for areas to avoid on the installation. If the assessment indicates the off-post may be affected, the Operations Center will provide a Protective Action Recommendation to the off-post community. If certain thresholds are met, the Operations Center must notify the National Response Center (NRC) by using the website or the 24-hour toll-free number (800) 424-8802. The NRC report must include:

1. Name, address, and telephone number of reporter
2. Name, address, and telephone of facility
3. Date, time, and type of incident (e.g., release, fire)
4. Name and quantity of material(s) involved, to the extent known
5. Extent of injuries, if any
6. Possible hazards to public health or the environment outside facility
7. Estimated quantity and disposition of recovered material resulting from the incident
8. Name of the IC

If an Environmental Protection Agency (EPA)-designated substance is released into the environment, specifically a hazardous substance listed in Table 302.4 (40 CFR Part 302), during any 24-hour period and its quantity equals or exceeds its reportable quantity, the IC will direct personnel to notify the Kentucky Department for Environmental Protection (KDEP) Emergency Response team and the NRC by using the website or calling (800)-424-8802. The NRC notification will identify the time and type of incident, quantity of materials involved, extent of any injuries, and possible hazards to human health or the environment.

In the case that an extremely hazardous substance (EHS) listed in Appendix A to 40 CFR Part 355 is released at or above its reportable quantity, potentially resulting in exposures to persons outside the facility boundaries, the IC will direct personnel to provide information known at the time of the release to the off-post agencies, Madison County Emergency Management Agency, Local Emergency Planning Committee(s) (for the areas likely to be affected by the release), and Kentucky's State Emergency Response Commission.

EHS notification must provide:

- Substance(s) released (or threatened to be released) and whether the substance is an EHS
- Quantity of the materials involved
- Time and duration of the incident
- Medium or media into which the release occurred
- Known or anticipated acute or chronic health risks
- Advice regarding medical attention necessary for exposed individuals
- Proper precautions to take (including evacuation)
- Name and telephone numbers of persons to be contacted for further information
- Location of the release or threatened release
- Approximate quantity and concentration of the release

Telephone numbers for all agencies to be contacted at the direction of the IC are provided in Table G-1.[2] The IC may direct additional notifications.

An "all clear" notification will be given by radio and/or telephone when the fire has been extinguished, the release has been contained, and the safety of personnel is no longer endangered.

G-4b Identification of Hazardous Materials

Facility personnel will immediately identify the characteristics, exact source, amount, and extent of the release. This may require review of the waste inventory and facility manifests. At the direction of the IC, installation personnel or ancillary personnel reporting directly to the Operations Center may assess the identification and extent of the release.

Environmental monitoring will begin as soon as possible and focus on defining the extent of hazard areas in space and time. Air monitoring will initially be used in conjunction with hazard prediction models to establish the approximate no-effects

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[2] Tables are located at the end of this Part.

hazard area. Monitoring will be conducted from outside the expected hazard area toward the areas of expected hazard. Subsequent air monitoring can serve to verify the adequacy of decontamination and containment operations.

Current weather and wind conditions from BGAD instruments, and computer modeling in the Operations Center, may be used to quantify the aerial extent on the release.

G-4c Hazard Assessment

The hazard modeling products or Protective Action Recommendation-Protective Action Decision matrix will be used by the Operations Center to determine the need for protective actions inside and outside the depot. Approved agent detection devices are utilized to monitor for agent releases. The data used to support modeling will be the description of the possible release and the meteorological data from the meteorological system.

For agent releases, the areas that may be exposed to Acute Exposure Guideline Level (AEGL)-3 will be determined by hazard modeling based upon the meteorological data. Protective actions will be recommended for areas at risk for AEGL-3 exposures. The protocol for this procedure is established in a Memorandum of Agreement between the Madison County Emergency Management Agency, the Judge Executive, and BGAD.

The Operations Center will assess possible hazards, both direct and indirect, to human health or the environment. The waste inventory records and waste characteristic data will provide useful information for hazard assessment.

In the event of a fire, the primary potential hazards will involve burns; smoke inhalation; ignition of adjacent structures, grass, and trees; and initiation of explosions. If a fire is concentrated at the source, the Operations Center will determine the need for evacuation of personnel downwind.

Explosions may present the same hazards as fires, as well as flying debris. During rainy periods, contamination of surface water and groundwater may be of concern.

In all cases where the Contingency Plan is initiated, the IC will make or direct the report of the incident in accordance with Section G-4a.

On-post notification of an evacuation will be through sirens, radio, Alert Advisory radios, and the public address system, and established evacuation routes will be followed. All personnel have been familiarized with evacuation procedures and means of exit from their respective work areas.

G-4d Control Procedures

This section discusses specific responses and control procedures to be taken in the event of a fire, explosion, or release.

G-4d (1) Fire Incidents

In the event of a fire, the IC will make the determination as to whether any portions of the installation should be evacuated. Early containment of fires can significantly decrease total damage. Initial control efforts will focus on preventing the fire from spreading. The following fire control actions will be taken as appropriate:

1. Routine work in all affected areas will be shut down
2. The discoverer will notify the Operations Center using two-way radios or cell phone
3. Fire Department and Environmental Office will be notified
4. The IC will be contacted and, if needed, external support assistance will be requested.
5. The area will be cleared of all personnel not actively involved in fighting the fire, containing the release, or securing the scene.
6. All injured persons will be removed and qualified personnel will administer medical treatment.

Firefighting and other emergency vehicles and equipment can access all HWSUs/igloos. Firefighting efforts will be performed by the BGAD Fire Department if the fire can be fought without unnecessary risk. If the event is beyond BGAD's Fire Department capabilities, assistance will be requested utilizing the Memorandum of Agreement with Madison County Fire Department.

All emergency equipment used will be cleaned and fit for use prior to resumption of operations in the affected area.

G-4d (2) Spills and Leaks

In the event of a major emergency involving a hazardous waste spill (excluding a CAIRA event), the following general procedure will be used for rapid and safe response and control of the situation.

If an employee discovers a spill, they will immediately report it to their supervisor. The supervisor will notify Fire Department personnel and the Operations Center. The Operations Center will notify the Environmental Office. The on-site supervisor will provide, at a minimum, the following information to the Operations Center:

- Material spilled or released
- Location of the release or spill
- Estimate of quantity released and the rate at which it is being released

- Direction in which the spill is heading
- Any injuries involved
- Fire and/or explosion or possibility of these events
- Area and materials involved and the intensity of the fire or explosion

Because fire is always a potential hazard in spills involving explosives, all potential ignition sources, such as motor vehicles, will be kept at least 100 feet away from the probable ignition area. If a large quantity of explosive waste is released, all nonessential personnel in the immediate area will be removed. Such restrictions will be imposed until the spill is contained and safety is restored.

If the incident is determined to be within BGAD's emergency response capabilities, the Operations Center will contact and deploy the necessary personnel. If the incident is beyond BGAD's capabilities, the Operations Center will contact the appropriate agencies. The Operations Center will notify state and federal agencies if a spill or leak is of a type that triggers notification requirements. The Operations Center will notify local agencies and authorities if there is an imminent hazard to the health and welfare of the local population or environment.

The initial response to any emergency will be to protect human health, safety, and the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If a spill occurs outside of the HWSUs/igloos, any drainage away from the storage unit will be blocked immediately. The IC will direct the use of absorbent materials and other equipment as deemed necessary to contain and collect the spill.

Any overturned or leaking container will be managed to reduce the amount of spilled wastes. All wastes contained in a damaged container will be transferred to a new container or the existing container will be overpacked.

When any spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. The impacted spill area will be clearly identified and access limited.

BGAD personnel will accomplish the control and cleanup of a spill, release, or fire. If the IC determines BGAD is unable to handle the emergency, an Army spill response contractor or augmentation unit may be contacted.

Emergency procedures and cleanup operations at the site will include the following procedures:

1. Make sure all unnecessary persons are removed from the hazard area
2. Don protective clothing (gloves, etc.), where applicable

3. Remove all ignition sources
4. If possible, try to stop or contain the spill
5. Remove all surrounding materials that could be reactive with materials in the waste
6. Use absorbent, earth, sand, and other inert materials to contain, divert, and clean up the spill
7. Place all containment and cleanup materials in properly labeled drums for proper disposal.

G-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases

During an emergency, BGAD will take the necessary steps to ensure fires, explosions, or releases do not occur, reoccur, or spread to other hazardous waste or activities at the BGAD site. Upon discovering an emergency incident, operating employees will halt operations and notify the appropriate individuals. Provided no threat to human health or safety is present and personnel can avoid exposure (e.g., inhalation of released fumes), employees will relocate containers, pallets, and other materials that may either catch on fire or be incompatible with the spilled material. These items will be moved to unaffected (and compatible) areas, thereby, isolating the emergency incident and affording emergency personnel sufficient area to conduct response activities.

The HWSUs/igloos were specifically designed to house energetic materials. The potential for spread of fires, explosions, or releases is reduced by using these ammunition storage units. The HWSUs/igloos were designed with safety features, (distance requirements, safety closing vents, etc.) to preclude the spread of fires or explosions from one storage unit to another.

Collection, containment, and treatment of released wastes are accomplished using Department of Transportation (DOT)-approved containers, overpack containers, salvage drums, and spill control equipment on site. Equipment is readily available for use in collection and containerization of released wastes. No treatment would be performed on these wastes due to the characteristic of the wastes stored. Other necessary overpack equipment is retrieved using the crew trucks or flatbed trucks. Section G-5 describes available emergency response equipment.

Removal and isolation of containers can be performed with the use of fork trucks that are brought on mobile units to the HWSUs/igloos as necessary.

By design, the HWSUs/igloos are built to preclude spread of any fires or explosions that may occur inside of the storage unit. The storage unit vents are normally open; if a fire occurs inside or outside the unit, fusible links trigger the vents to close and reduce potential ventilation. All of the storage units contain an earthen cover to help preclude fires outside the storage units. Security provisions strictly forbid the introduction of any ignition sources (such as cigarette lighters and matches) into the CLA.

G-4f Storage and Treatment of Recovered Material

Because the HWSUs/igloos are used only for the storage of hazardous wastes and do not include ongoing generation activities, BGAD does not anticipate the need to monitor for leaks, pressure buildup, gas generation, or ruptures as a result of halting operations.

G-4g Separation of Incompatible Wastes

BGCA or other government or contractor environmental personnel will ensure that incompatible wastes are not treated, stored, or located in any area involved in a fire, explosion, or release. The IC will acquire appropriate information pertaining to the items involved in the incident and will ensure decisions to store the items are based on this knowledge.

G-4h Post Emergency Equipment Maintenance

Personnel and equipment used during response to emergency incidents may become contaminated in a number of ways, including contacting vapors, gases, mists, or particulates in the air; being splashed by materials while sampling or opening containers; walking through puddles; and laying equipment or sitting/kneeling on contaminated concrete or soil. Good work practices reduce contamination but even with safeguards, contamination may occur.

The IC will establish work zones and implement personal protective equipment (PPE) and equipment decontamination in designated area(s). Decontamination—the process of removing or neutralizing contaminants that have accumulated on personnel and equipment—combined with correct doffing of PPE and the use of site work zones minimizes the spread of contamination. Prior to implementing response actions, a decontamination area will be established in an area that minimizes the exposure of uncontaminated employees, environmental media, and equipment to contamination. Decontamination areas will be far enough from the incident to avoid contamination and exposure yet close enough to the scene to be readily available and not cause off-scene contamination. The initial location will assume personnel and equipment leaving the Exclusion Zone are grossly contaminated. The decontamination area will consist of at least one wash and rinse and will consider the type and amount of contamination, levels of protection required, type of protective clothing worn, and type of equipment needed to accomplish emergency response activities. Trained personnel wearing appropriate PPE will conduct final decontamination procedures.

When decontaminating protective clothing and emergency equipment, material used in the decontamination process (brushes, rags, soap) will be accumulated. Cleaning procedures will include scrubbing, water rinses, neutralization, and solvent rinses as needed. All contaminated rinse liquids and removed solids will be stored in appropriately labeled containers and disposed of in an environmentally sound manner as defined by their chemical and physical characteristics.

Prior to resuming operations, all safety equipment will be inspected for the types of problems listed in the Equipment Maintenance Schedule (Part F, Table F-1). All safety equipment and PPE used in the emergency must be restocked, cleaned, inspected, and prepared for re-use in a subsequent emergency. If safety equipment or PPE cannot be adequately decontaminated, it will be disposed of in an environmentally sound manner and replaced promptly prior to resumption of operations.

The IC will notify the appropriate state and local authorities that no waste incompatible with the released material is being stored in the affected area and that all emergency equipment listed has been cleaned in accordance with this plan and is fit for its intended further use.

G-4i Container Spills and Leakage

When container spills or leaks do occur, every effort will be made to minimize the quantity of waste and spill residue generated consistent with applicable regulations and requirements of KDEP, EPA, and the Army. Spills will be confined, if possible, to prevent mixing with other materials and to prevent possible contamination of groundwater and property.

G-5 EMERGENCY EQUIPMENT

Spill control and fire control equipment available at BGAD is listed in Table G-2. All equipment that would be used for response in an emergency situation is dynamic, with each directorate or office responsible for the maintenance, inspection, and daily tracking of equipment availability and location.

The Department of Defense (DoD) Alert System, telephones, radios (including handheld sets), sirens, and Alert Advisory radios are available throughout BGAD for emergency communications. Personnel are provided radios or cellular telephones to carry with them in the vehicles to notify workers inside and outside of the storage area of an emergency.

Emergency medical and spill response equipment is maintained on mobile units. Emergency medical equipment is available on ambulance units operated by both the Health Clinic and the BGAD Fire Department.

G-6 COORDINATION AGREEMENTS

BGAD has coordination agreements with off-post responders and other DoD agencies. The most current Memorandums of Agreement/Understanding are maintained at BGCA and are available to regulators upon request. Non-procedural changes to a Memorandum of Agreement or Understanding do not warrant a modification to this application.

The following agencies/organizations have coordination agreements with BGAD:

- Kentucky State Police, Post 7

- Madison County Sheriff's Office
- Berea Police Department
- Richmond Police Department
- Clark County Medical Center, Winchester, Kentucky
- Berea Hospital, Berea, Kentucky
- Baptist Health Hospital, Richmond, Kentucky
- Madison County Emergency Medical Services
- Madison County Fire Department
- Richmond Fire Department
- Agreement between BGCA, BGAD, and Madison County for Meteorological Data and Meteorological Services
- Madison County, Kentucky

Periodic emergency exercises are conducted both on- and off-post in coordination with emergency response agencies. These exercises ensure that local fire departments, hospitals, and state and local emergency response teams are familiarized with their roles in the case of an emergency. BGAD and BGCA emergency personnel will respond to specific activities on the installation, in accordance with the CAIRA Plan. Outside agencies with which BGAD/BGCA has agreements will provide ambulance service, medical treatment, community notification, and traffic control.

An up-to-date copy of the Contingency Plan is submitted to the following organizations:

- BGAD: Commander, Fire Department, Environmental Office, Directors, Chiefs, and Tenant Organizations
- BGCA: Commander, Directors, and Chiefs
- Local Emergency Planning Committee of Madison County, to include local authorities and hospitals
- Kentucky Emergency Response Commission
- Kentucky Department of Environmental Protection, Division of Waste Management
- EPA Region IV (as needed)

G-7 EVACUATION PLAN

The IC, upon assessment of emergency situations, will determine which portions of the Contingency Plan need to be implemented, including relocation on the installation.

If the IC determines that employees must be relocated, the CAIRA Plan[3] will be implemented and the Security Force will serve to direct traffic and guide employees from the area of concern.

A number of notification methods may be employed to notify employees of the relocation, dependent upon their location in respect to the affected area. Communications that may be utilized include announcement on radio, red-phone notification, telephone communication, DoD Alert System, Alert Advisory radios, and sirens. Relay of relocation instruction will be the responsibility of the supervisor receiving the information.

All site contractors and visitors have a government point of contact (POC). It is the responsibility of the government POCs to ensure their contractors are notified in emergencies. These notifications will be made in person, by telephone, or by radio. As a part of the security in-brief process, prior to entering the other areas of the installation, personnel are informed of their requirements when an emergency situation has been announced.

Traffic control points will be monitored by the Security Force to defer traffic from the hazardous area and to assist in the egress of personnel. Government POCs will escort visitors from the area. Supervisors and POCs will account for all personnel at their designated rally points, and notify the accountability desk in the Operations Center of anyone not accounted for.

Emergency teams responding to a chemical accident/incident will not evacuate the area unless specifically directed to do so by the Operations Center.

If any area outside the installation boundary is affected during an event, the Operations Center will provide a Protective Action Recommendation to Madison County EMS within 5 minutes.

Evacuation of the surrounding local community will be accomplished through notification of the Madison County emergency management agencies. Local emergency plans will be instituted utilizing their respective Contingency Operations with full support from the Installation Commander.

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[3] See the Permit Application for Chemical Munition Related Items, Part G (Contingency Plan), Figure G-1 (Annex C to BGAD Installation Emergency Management Plan).

G-8 REQUIRED REPORTS

After Contingency Plan implementation, the time, date, and details of any incident will be noted in the operating record.

Within 15 days after the incident, a written report will be submitted to the KDEP. The report will include:

1. Name, address, and telephone number of the owner and operator
2. Name, address, and telephone number of the facility
3. Date, time, and type of incident (e.g., fire explosion)
4. Name and quantity of material(s) involved
5. The extent of injuries, if any
6. An assessment of actual or potential hazards to human health or the environment, where this is applicable
7. Estimated quantity and disposition of recovered material that resulted from the incident

Any reports submitted in accordance with CAIRA Plan guidelines will be forwarded to KDEP to meet this requirement.

Table G-1. Off-Facility Emergency Notification Numbers and Agencies

Agency	Contact Information
National Response Center (NRC)	800-424-8802 (The online reporting tool may also be used: http://nrc.uscg.mil/)
Local Emergency Planning Committee (LEPC) of Madison County (Madison County Emergency Management Agency Director)	859-624-4787
Commonwealth of Kentucky 24-hour Emergency Response Line (Kentucky Emergency Response Commission [ERC])	800-928-2380 or 502-564-2380

Table G-2. Emergency Response Equipment

Description	Capabilities	Location
Broom, dust pan, 55-gal container	Spill control and cleanup	All
Forklift trucks: • Electric 4,000 lb capacity carloader sidewinder, double E rated, 44-inch maximum width • Electric 6,000 lb capacity carloader, double E rated, 44-inch maximum width • 6,000 lb rough terrain	Spill control and cleanup	CLA
6-ton flatbed stake truck with 16-foot minimum bed	Spill control and cleanup	CLA
10-ton capacity double axle retriever trailer	Spill control and cleanup	CLA
1/2-ton pickup truck	Spill control and cleanup	CLA
M-1 lifting beam and boom assembly (APE)	Spill control and cleanup	CLA
1,500 lb maximum capacity drum grip	Spill control and cleanup	CLA
Two-way radios	Emergency communication	Location dynamic (with operator)
Emergency notification and broadcast system (air-raid sirens and Alert Advisory radios), public address system, DoD Alert System	Emergency communication	Throughout BGAD and in local community
Ambulance	First-aid and medical treatment	Location dynamic; tracked by Health Clinic and Fire Department
First-aid and medical supplies	First-aid and medical treatment	Building S-1, Health Clinic Also available on ambulances tracked by Health Clinic and Fire Department
SCBA	PPE	Fire Department and Chemical Crew at Building 1146
Fire extinguishers (in vehicles)	Fire control	Location dynamic; tracked by vehicle operator
Fire trucks (tankers)	Fire control	Location dynamic; tracked by Fire Department
9"x41" SRCs	Overpack for 155mm projectile	Building 59
M55 SRCs	Overpack for M55 rocket	CLA – Toxic Chemical Maintenance Building

Table G-2. Emergency Response Equipment

Description	Capabilities	Location
10"x96" SRCs	Overpack for M55 SRC	CLA – Toxic Chemical Maintenance Building
12"x56" SRCs	Overpack for M10/M16 prop charge can	CLA – Toxic Chemical Maintenance Building

Notes:

APE Ammunition Peculiar Equipment
BGAD Blue Grass Army Depot
CLA Chemical Limited Area
DoD Department of Defense
lb pound(s)
PPE personal protective equipment
SCBA self-contained breathing apparatus
SRC single round container

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PART H PERSONNEL TRAINING PLAN [401 KAR 39:090, Section 1 and 40 CFR 264.16]

H-1 OUTLINE OF TRAINING PROGRAM

H-1a General Training

Under the direction of the Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA), Blue Grass Chemical Activity (BGCA), Blue Grass Army Depot (BGAD), or other government or contractor personnel providing support relative to this permit application are required to complete combinations of on-the-job training and/or classroom training within 6 months of initial assignment to ensure they are competent to correctly and safely perform their duties. Personnel who have not received initial training work under the direct supervision of a trained supervisor until completion of on-the-job training and/or classroom training, and are not allowed to work autonomously during the handling of hazardous material.

After initial training, annual refresher training is provided by means of classroom instruction and/or instruction through job-specific Standing Operating Procedures (SOPs) outlining procedures to be followed and hazards involved. Training provided is designed to address the specific hazards that employees work with and to ensure the level of employee proficiency meets or exceeds regulatory standards for handling hazardous wastes. The training program ensures the safety of the trainees, the safety of others, and the protection of the environment.

Personnel working in hazardous waste management receive training that includes methods to effectively respond to emergencies. Personnel are taught emergency procedures, equipment availability, and emergency system operations. Included as an integral part of this training is instruction in the following:

- Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment
- Operation of communications systems
- Appropriate response to fires or explosions
- Response to potential groundwater contamination incidents
- Shutdown of operations

There are no automatic waste feed cutoff systems used in the storage of the hazardous waste relative to this permit application.

H-1b Specific Hazardous Waste Management Training

Employee training is crucial to the safe storage and transportation of chemical agent munitions and components. The requirement to provide environmental training is a top priority. The Hazardous Waste Management Training Program (HWMTP) is a formal program designed to enhance the environmental competencies of its participants and to promote responsible environmental practices throughout the organization. This training was developed and implemented for personnel involved in hazardous waste operations. Specific training requirements have been outlined for this training program.

The HWMTP has evolved into a comprehensive approach of integrating the requirements to the Resource Conservation and Recovery Act (RCRA); Occupational Safety and Health Act (OSHA); BGAD Installation Spill Prevention, Control and Countermeasures Plan; BGAD Installation Spill Contingency Plan; Chemical Accident/Incident Response and Assistance (CAIRA) Plan; and other meaningful training. The primary purpose of the HWMTP is to ensure the employees have the skills to perform their assigned duties in a safe manner to protect themselves, other employees, the public, and the environment.

40 Code of Federal Regulations (CFR) 264.16(d)(2) requires a written job description for each employee and position. Position (job) descriptions will be maintained and available upon request. See Table H-1[1] for a list of typical job positions.

H-2 SCOPE AND APPLICATION

Employees receive initial training in Chemical Surety (for chemical agent workers) and Hazard Communication. Employees involved in managing, storing, and/or handling of hazardous waste relative to this permit application, including those on temporary appointment, are required to complete HWMTP. The types of duties an employee may engage in when dealing with hazardous waste include but are not necessarily limited to engineering, technical work, transportation, containerization, labeling, storage, identification, record keeping, emergency response, and treatment.

H-3 PROGRAM ADMINISTRATION

H-3a Recordkeeping/Reports/Documentation

Personnel training is documented and the appropriate records are maintained. Training records for current employees are kept until chemical agent operations are completed. Training records of former employees are kept for 3 years from the date that the employee last worked.

Government or contractor environmental personnel administer the HWMTP and are responsible for coordinating the initial training and annual retraining of personnel, assisted by the Training Officer. Environmental personnel review and approve the content, method of presentation, and evaluation techniques for courses developed in support of the HWMTP. The environmental staff, Training Officer, or certified contractor

[1] Tables are located at the end of this Part.

conducts the RCRA and hazardous waste management training. Program trainers are subject matter experts in the topics of instruction.

H-3b Job Description

Hazardous waste training for new personnel is initiated when they start work and is normally completed within 6 months. Personnel are not allowed to work unsupervised until training requirements have been completed. Personnel are not permitted to respond to emergency response situations until training in the appropriate responses is completed.

Table H-2 presents the hours required to complete the Hazardous Waste Operations Emergency Response (HAZWOPER) Training Program, The initial training for employees involved in hazardous waste operations (see Table H-1) is 40 hours, and the annual refresher training is 8 hours. New personnel, or personnel who transfer to hazardous waste operations from other areas, will have successfully completed the training program within 6 months of their transfer. The timeframe for annual refresher training is defined as within 13 months.

The following information is maintained:

1. A list of job titles and positions with the name of each employee filling that position

2. A written job description for each position that lists the required skills and hazardous waste management/handling duties that may be required

It is the responsibility of the employee's supervisor or director to notify the Training Officer when an employee is to be added to or removed from the HWMTP.

Generally, RCRA training requirements for 40 CFR Part 265 personnel will include:

- Communications or alarm systems

- Operating procedures for using, inspecting, and turning in facility emergency equipment

- The use and limitations of personal protective equipment (PPE)

- Response to fires, explosions, groundwater contamination incidents, and shutdown of operations

Employees identified as performing hazardous waste duties have that expectation included in their job description. Hazardous waste duties may involve management, coordination, engineering, or technical work involving hazardous waste management equipment, programs, or projects; and/or movement, containerization, storage, identification, recordkeeping, emergency response, treatment, and/or disposition of hazardous waste. Duties require the ability to interpret and implement environmental regulations, knowledge of hazardous waste products and safety regulations, the skill to effect regulatory requirements, and the ability to ensure proper management and/or handling of hazardous wastes.

H-4 EMERGENCY RESPONSE

Emergency response will be handled in accordance with the BGAD Installation Spill Contingency Plan and/or the BGAD Installation Spill Prevention, Control and Countermeasures Plan. If the accident/incident involves chemical surety material, the BGAD CAIRA Plan will be implemented and will take precedence.

The HWMTP is also designed to ensure that designated personnel, temporary employees, contractors, and other personnel are able to respond effectively to emergencies. Periodic test exercises that simulate emergencies at BGAD are conducted to practice the implementation of emergency response plans. At the conclusion of each test exercise, an After Action Review session is conducted to discuss ways to improve the emergency response.

H-5 COURSE OUTLINES

The HWMTP consists of four separate initial training courses, each having an annual refresher training requirement. The initial courses are as follows:

- Chemical Surety Basic Course (for chemical agent workers)
- Department of Defense Hazard Communication Course
- RCRA Compliance and Hazardous Waste Management Course
- HAZWOPER
- On-the-job training

Each employee in the HWMTP must successfully complete the classroom study. A Surety examination helps determine successful completion of the Chemical Surety portion. Personnel who do not complete this training or fail to achieve a passing score on the test are given remedial training to ensure they have an adequate understanding of Chemical Surety and are then retested.

Table H-2 lists the scheduled length of each training course.

The training is a dynamic program that is updated in response to new information and changes in the regulations. Each course outline remains relatively stable but the content is revised as necessary to remain current.

H-5a Chemical Surety Training

A typical outline of the chemical surety basic course initial and annual refresher instruction blocks includes the following lessons:

- *Chemical Munitions (Initial and Refresher).* This lesson describes the different types of chemical munitions and their various configurations including packaging and storage.
- *Chemical Personnel Reliability Program (Initial Course Only).* This lesson identifies the positions that fall under the guidelines of Army Regulation 50-6 and provides a means of assessing the reliability of personnel in these positions. Refresher training will be provided by position.
- *Classification and Effects of Chemical Agents (Initial and Refresher)*. This lesson covers the types of nerve and blister agents, their physical characteristics, the physiological effects on the body, and the persistency of each agent.
- *Protective Mask and Protective Clothing (Initial and Refresher)*. This lesson reviews protective masks, their proper use, and care. Different types of protective clothing and equipment available to personnel on Table H-1 for protection from agents will be provided independently.
- *Chemical Agent Alarms/Detectors/Monitors (Initial and Refresher)*. This lesson describes the alarms for an agent emergency, the types of detection equipment used, and the monitoring methods used to detect and quantify agent concentrations.
- *Self-Aid/First Aid and Decontamination*. This lesson discusses the different decontamination solutions for chemical agents and the proper use of the nerve agent antidote kit. Basic first aid is taught.
- *Chemical Accident/Incident Control.* This lesson discusses the different levels of a chemical event/accident, the response procedures during an incident, and the various teams that respond.

H-5b Department of Defense Hazard Communication Course

A typical outline of the Department of Defense hazard communication initial and annual refresher instruction block includes the following lessons:

- *OSHA Hazard Communication Standard*. This lesson stresses that employees must be informed about hazardous chemicals in their workplace and be trained to work safely with them.
- *Physical Forms and Exposure Hazards*. This lesson discusses the three basic physical forms: solids, liquids, and gases. Types of exposure hazards, which include physical hazards and health hazards, are discussed.

- *Types of Physical and Health Hazards*. This lesson discusses physical hazards, which are chemicals that cause explosion, fires, violent chemical reactions, or other hazardous situations. Health hazards, chemicals that can cause illness or injury when inhaled or swallowed, or through contact with the skin or eyes, are also discussed.

- *Controlling Chemical Hazards*. This lesson discusses the basic methods of controlling chemical hazards, which are engineering controls, PPE, and administrative controls.

- *Introduction to Safety Data Sheets (SDS) and SDS Physical Hazard Information*. This lesson discusses the general layout of an SDS and how to find and understand the information in the sections for physical data, fire and explosion hazard, reactivity data, and precautions for safe handling and use. The SDS health hazard information lesson teaches how to find and understand the information in the sections for hazardous ingredients, health hazards, and control measures.

- *Using Labels and the Hazardous Chemical Inventory*. This lesson discusses labeling requirements. Labels must contain all appropriate hazard warnings. The name must be the same on the label, the SDS, and the hazardous chemical inventory list. Hazardous chemical inventory lists must be available and kept up to date.

H-5c RCRA Compliance and Hazardous Waste Management Course

A typical outline of the hazardous waste management initial and annual refresher instruction block includes the following lessons:

- *RCRA, Federal, State, and Army Regulations.* This lesson is a brief overview of various regulations including hazardous materials regulations. Permit background at BGAD, permit training requirements, and the penalties that may be imposed for noncompliance are also discussed. RCRA regulatory, review, and local controls are covered.

- *Hazardous Waste Identification.* This lesson discusses when a material becomes a solid waste/hazardous waste, and gives an overview of waste streams (including a list of various materials managed as hazardous waste) and requirements of the hazardous waste label.

- *Hazardous Waste Management.* The focus of this lesson is on managing hazardous waste to include the permitted unit(s), less than 90-day accumulation areas, and satellite accumulation areas. A description of the information required for the Waste Identification and Certification form is used to capture hazardous waste storage information presented during this training. Additional recordkeeping requirements, spill or release notification requirements, the permitted storage areas, and hazardous waste movement between these areas are also covered.

- *Mission Operating Procedures.* This lesson discusses the importance of careful application of procedures called out for each activity undertaken in the storage area of the Chemical Limited Area (CLA). Examples of environmental controls incorporated into the SOP are identified and reviewed.

- *Waste Analysis.* Lesson topics include the general requirements of the Waste Analysis Plan, hazardous waste characteristics, laboratory certification, and documentation of waste analysis.

H-5d HAZWOPER Training Program

As listed in Table H-1 and outlined in 29 CFR 1910.120, all facility positions that participate in the actual cleanup of the incident/accident site initially must complete the 40-hour HAZWOPER training course, and subsequently 8 hours of HAZWOPER refresher training annually. A course outline of the training is maintained and documented by the Training Office. All permit training requirements are maintained and documented with a course outline of the training.

H-5d (1) 40-Hour Initial HAZWOPER Training

HAZWOPER initial instruction typically includes the following areas of instruction.

- *Legal Rights and Responsibilities.* This lesson focuses on what is hazardous material/waste and the regulatory background is targeted.

- *Hazard Recognition.* This lesson includes basic principles of toxicology, hazard classes, material identification, placards and labels, chemical incompatibilities, and National Institute for Occupational Safety and Health (NIOSH) pocket guide training.

- *Hazard Control.* This lesson includes types of hazard control, emergency response plans, the incident command system, establishing site security and control, and the medical surveillance program.

- *Work Practices.* This lesson focuses on SOPs, material handling and transfer, spill control, equipment and vehicle operation, special control equipment, and confined-space entry.

- *Personal Protective Equipment.* This lesson addresses use and limitations of PPE including respirator and self-contained breathing apparatus; characteristics and properties of chemical protective clothing (CPC); precautions when wearing CPC; inspection, maintenance, and storage of CPC; and exercises in the use of CPC.

- *On-the-Job Training*. This lesson covers air monitoring and environmental sampling including calibration and sampling protocols, with a review of sampling equipment, recordkeeping, and document control.

- *Decontamination.* This lesson focuses on the chemicals used and decontamination steps essential to decontamination of equipment, environmental media, and personnel. A decontamination exercise with available decontamination equipment and waste containerization resources is undertaken with training provided on waste accumulation, marking, and labeling.

H-5d (2) 8-Hour Refresher HAZWOPER Training

All facility positions that participate in the actual cleanup of the incident/accident site must complete 8 hours of HAZWOPER refresher training every year. A typical outline of the HAZWOPER annual refresher instruction block includes the following topics:

- *Chemical Surety* (for chemical agent workers). This lesson reviews the Chemical Surety Basic Course.

- *Hazard Communication*. This lesson provides a review of the Department of Defense Hazard Communication Course.

- *Response to Fires*. This lesson details response to fires and non-agent spills and explosions inside and outside the storage area of the CLA, including response to groundwater contamination incidents.

- *Inspection*. This lesson walks through inspection, use, repair, and replacement of emergency/monitoring equipment including Transvector, Real-Time Analytical Platform, 1,000 cubic feet per meter filters, spill kits, M1A1 filters, and Depot Area Air Monitoring System.

- *Emergency Operations Center Communications*. This lesson describes Emergency Operations Center communications and radio alarm system procedures.

- *CAIRA/Chemical Stockpile Emergency Preparedness Program (CSEPP) Objectives* (for chemical agent workers). The lesson covers CAIRA/CSEPP objectives, lessons learned regarding emergency preparedness, response, and recovery.

H-5e On-the-Job Training

Personnel receive on-the-job training based on the individual's job description. The training includes Contingency Plan implementation, familiarization with emergency procedures, and the methods and equipment applicable to the employee's work area. The training addresses applicable SOPs, Letters of Instruction, and Internal Operating Procedures. At regular intervals, employees must review and confirm that they have read and understand the procedures outlined in each SOP applicable to their duties. Additional on-the-job training occurs when a new hazardous material is introduced to the work place, or a new procedure is implemented. Credit for completion of CAIRA exercises every quarter can be utilized as training credited for the annual HAZWOPER refresher when proper records are maintained. CAIRA/CSEPP exercises conducted annually incorporate the following elements into the drills as per OSHA 29 CFR 1910.120: structure of authority, training and communication, evacuation routes and procedures, use of PPE, decontamination processes, emergency medical treatment, and emergency alarm procedures. Though the CAIRA exercise is a community requirement, the training during the exercise is essential for “hands-on” experience. HAZWOPER refresher training is conducted in a classroom environment.

Table H-1. HWMTP Typical Job Titles

Typical Job Titles	Chemical Surety Training	DoD HAZCOM Course	RCRA Compliance Course	HAZWOPER
Chemist, Supervisory	X	X	X	
Chemists	X	X	X	
Physical Scientist	X	X	X	
Physical Science Technician and Lead	X	X	X	
Supervisory Physical Scientist/Environmental Engineer	X	X	X	
Toxic Material Handler/Explosive Inspector, Leader and Supervisor	X	X	X	X
Supervisory Monitoring Systems Analyst	X	X	X	
Electronics Mechanics and Lead	X	X	X	
Surveillance Ammunition Inspector	X	X	X	X
Monitoring System Operator/Mechanics and Lead(s)	X	X	X	
General Equipment Maintenance Mechanic	X	X	X	
Protective Equipment Mechanic/Inspector	X	X	X	
Environmental Protection Specialist	X	X	X	
Chemical Operations Manager/Supervisor	X	X	X	
QASAS	X	X	X	X
QASAS (QA/QC positions)	X	X	X	
Inventory Management Specialist	X	X	X	
Tools and Parts Attendant	X	X	X	
Hazardous Material/Waste Coordinator	X	X	X	X

Notes:

DoD	Department of Defense
HAZCOM	Hazard Communication
HAZWOPER	Hazardous Waste Operations and Emergency Response
QA/QC	Quality Assurance/Quality Control
QASAS	Quality Assurance Specialist Ammunition Surveillance
RCRA	Resource Conservation and Recovery Act

Table H-2. HWMTP Typical Course Length

Course	Initial Training	Annual Refresher Training
Chemical Surety	3 hours	Up to 3 hours [a]
DoD HAZCOM	1 hour	1 hour
HAZWOPER	40 hours	8 hours
RCRA Compliance and Hazardous Waste Management	3 hours	3 hours
Total	**47 hours**	**15 hours**

Notes:

a Overlapping of subjects occurs between Chemical Surety and HAZWOPER Refresher and may adjust the Chemical Surety course time.

DoD Department of Defense
HAZCOM Hazard Communication
HAZWOPER Hazardous Waste Operations and Emergency Response
RCRA Resource Conservation and Recovery Act

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PART I CLOSURE PLANS, POST CLOSURE PLANS, AND FINANCIAL REQUIREMENTS [401 KAR 39:090 Section 1; 40 CFR 264.111–115, 264.178, and 264.601]

I-1 CLOSURE PLAN

This section is submitted in accordance with the 401 Kentucky Administrative Regulations (KAR) 39:090. This plan identifies the steps necessary to permanently close the hazardous waste storage units (HWSUs)/igloos located within the storage area of the Chemical Limited Area (CLA) relative to this permit application. The Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA) is the operator of the HWSUs/igloos that have been turned over from Blue Grass Chemical Activity (BGCA) or Blue Grass Army Depot (BGAD). BGCA, BGAD, or another government or contractor organization may assist PEO ACWA in the closure of these HWSUs/igloos. These HWSUs/igloos will be clean closed, and this Closure Plan contains all steps necessary for clean closure.

The BGAD Environmental Office will maintain a copy of the Closure Plan and all revisions to the plan until the units are certified as clean closed.

Closure of each unit could occur independently. The closure process for all units will be identical. This plan identifies all the steps necessary to complete a final closure of the HWSUs/igloos. Once implemented, this plan is designed with the intent of closing the storage units in a manner that is protective of human health and the environment. This Closure Plan is sufficiently descriptive such that an independent third party could perform closure of the storage units.

I-1a Closure Performance Standards

The intent of this Closure Plan is to ensure that the HWSUs/igloos are closed in a manner that is acceptable to Kentucky Department for Environmental Protection (KDEP), minimizing the need for further maintenance. The plan is designed to provide closure that controls, minimizes, and/or eliminates threats to human health and the environment. To meet the closure performance standard, the units will undergo a clean closure procedure.

Upon initiating final closure, all hazardous waste and hazardous waste containers will be removed from the unit. The wastes will be disposed of in accordance with all applicable federal, state, and local environmental regulations. Disposal will be documented and copies will be kept on file at the BGAD Environmental Office for a minimum of 3 years. Each HWSU/igloo will be decontaminated to ensure the removal of hazardous waste residues—from flooring, walls, drains, etc.—contributed by hazardous waste stored and/or operations performed within the storage unit.

I-1b Closure Activities

This Closure Plan addresses the final closure of the HWSUs/igloos. These closure activities constitute partial closure as it relates to the installation as a whole. Upon closure of any storage units, all hazardous waste, residues, and contaminated soils will be removed and managed in accordance with all applicable state and federal regulations. Upon formal notification to proceed with the closure of these structures, the hazardous wastes stored in these units will be removed within 90 days of receiving the final volume of hazardous waste. Table I-1[1] provides a general schedule for closure of a building.

I-1b (1) Partial Closure Activities

It is possible that one or more of the HWSUs/igloos could be converted to a non–Resource Conservation and Recovery Act (RCRA) use. In that case, the storage unit(s) being converted would be closed in accordance with the procedures described in Section I-1e (1) of this Part. The inventory of wastes in the storage unit(s) would either be moved to another area or managed in accordance with the procedures described in Section I-1a.

I-1b (2) Final Closure Activities

RCRA regulations require that a closure date be specified to assess the adequacy of financial assurance provisions. Federal facilities are exempt from these requirements. Accordingly, since closure of the HWSUs/igloos will depend on unknown future Army operational requirements, a closure date is not specified for the storage units addressed in this application. The final closure of all HWSUs/igloos is projected to be around 2030.

I-1c Maximum Waste Inventory

At time of closure, a historical records review of the type of hazardous waste managed within each individual unit will be conducted. From this review, a detailed sampling plan will be developed and submitted to KDEP for their approval.

Using known typical dimensions of the HWSUs/igloos and standard storage practices, the maximum waste inventory in any unit at the time of closure is 3,225 containerized, undrained M56 warhead assemblies (hereinafter warheads [WHs]) for a total of 4,193 gallons. The estimated life of each building is at least 100 years. The earliest expected year of closure for all the HWSUs/igloos is 2030. The compatibility of all wastes is considered during storage activities.

The structures are made of concrete and are built with a bearing strength necessary to withstand container management activities. The concrete flooring has not been sealed; therefore, generation of contaminated concrete debris during closure activities is possible. If this occurs, the debris will be managed in accordance with all applicable federal, state, and local regulations.

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[1] Tables are located at the end of this Part.

I-1d Schedule for Closure

The HWSUs/igloos will be closed in accordance with the schedule in Table I-1, once the decision for closure has been made and funding has been provided.

Currently, there are no plans for partial closure of these buildings. Estimated life of a building is limited to its structural integrity and the need for its service.

Any changes in hazardous waste management practices that could impact upon the closure of these HWSUs/igloos will initiate amendment to this Closure Plan. Modifications will be submitted to KDEP for review and approval.

I-1d (1) Time Allowed for Closure

Once a determination has been made that one or more HWSUs/igloos are no longer required to manage hazardous waste, closure activities will be started. A general schedule is provided for closure activities. Closure activities are projected to be completed within 360 days of the notification to KDEP of intent to close an HWSU/igloo in accordance with this Closure Plan. See Table I-1.

I-1d (1)a Extensions for Closure Time

Historically closure of HWSUs/igloos at other chemical storage sites has taken greater than 180 days to complete. Therefore, it is anticipated that a request for an extension to 180-day closure will be required. BGAD and PEO ACWA reserve the right to request a longer closure period for each HWSU/igloo. A petition demonstrating that the planned activities will take longer to complete shall be made to KDEP within 60 days of approval to close.

I-1e Decontamination, Removal, and Disposal of Inventory/Equipment

This section (including the associated subsections) describes how BGAD and PEO ACWA intend to decontaminate and dispose of closure-generated waste, as well as the equipment utilized in the process and the structures. It also describes when BGAD/PEO ACWA will view the structures and the surrounding area as clean closed.

The HWSU/igloo will first be emptied of the chemical munitions or components and associated wastes. The wastes will be disposed of according to federal, state, and local regulations.

For structures that stored chemical-agent-containing items, air monitoring will be the primary method of sampling to ensure cleanliness from a chemical agent perspective. Monitoring will be conducted to below the worker population limit (WPL) for all agent types (sarin [GB], VX, and/or H) that were ever stored in the HWSU/igloo. Any potentially contaminated portions of the structure may be individually tented (to further isolate and concentrate vapors) and monitored. If the level of contamination is greater than 0.00003 milligrams per cubic meter (mg/m^3) GB, 0.000001 mg/m^3 VX, or 0.0004 mg/m^3 H, the floor will be decontaminated with appropriate solution. Water will be the first and primary decontaminant used. (See Section I-1e (1)a.) Should analytic results indicate that further decontamination is necessary, commercial products will be used. BGAD and PEO ACWA reserve the right to test and employ other commercially available decontaminants should more vigorous decontamination be needed. The air will then be re-tested. If the level is still above the desired concentration, the floor will be decontaminated a second time allowing for a larger contact period (up to 48-hours) and the walls will also be washed with decontaminating solution. The air will be tested again for the respective agent. Sampling for polychlorinated biphenyls (PCBs) and explosives will be conducted only in units that stored PCB or explosive wastes (i.e., rockets or rocket motors with M441 shipping and firing tubes). If necessary, the entire structure can be gridded and tented to show localized contamination that may remain. Rinsate from washings will be analyzed to determine agent concentration as well as PCBs and explosives. After initial cleaning of the structures, wipe samples may be employed to determine residual contamination. Any concrete that is scabbled due to agent contamination will be sampled and analyzed for chemical agent.

If the levels are below the desired concentrations, the HWSU/igloo is considered clean and may be used for other purposes, as desired.

If the air concentrations still fail to meet the required limits, two options are available:

1. Continue the decontamination process until the concentration in the air falls below the desired level. This is a viable alternative if a significant decrease in air concentration was seen after the second decontamination step.

2. Remove the top 1/4 to 1 inch of concrete from the hot areas of the unit's floor. Repeat air monitoring and/or concrete removal (scrabbling) until acceptable air concentrations are obtained.

It is not anticipated (from previous experience) that any of the HWSUs/igloos will not be able to be suitably decontaminated.

The decontaminating solution would be collected and tested for the presence of agent and hazardous waste characteristics. Since the decontaminating solution cleans equipment by the chemical destruction of the agents, it is highly unlikely that any agent could exist in the solution itself. However, if any agent were found, additional decontaminating chemicals would be added until destruction was complete.

The solutions would then be treated and/or disposed of according to federal, state, and local regulations.

All personal protective equipment (PPE) and sampling/monitoring equipment used during closure activities will be tested for possible contamination. Any contaminated items will be decontaminated with the appropriate solutions.

Records will be maintained documenting that all activities were conducted in accordance with the approved Closure Plan. At a minimum, the following records will be maintained and a summary of the pertinent information will be incorporated and submitted in the Final Closure Certification Report.

- Field notes taken during closure-related activities
- A description of any minor deviations from the Closure Plan and justification for those deviations
- Laboratory data and/or field data, including quality assurance/quality control data for all samples

The Closure Certification Report will provide detailed information demonstrating that closure activities were conducted in accordance with the approved Closure Plan. It will be submitted to KDEP concurrent with the final closure certification (which will be incorporated in the report).

I-1e (1) Closure of HWSUs/Igloos

Closure of HWSUs/igloos begins by determining the nature and extent of contamination. Records will be available as to the storage of the wastes in each of the HWSUs/igloos. Concurrent with waste removal operations, reviews of historical storage records will be conducted to verify that no known spills have occurred in these structures.

Prior to beginning decontamination, but after wastes have been removed, personnel will visually inspect each HWSU/igloo to identify cracks and other openings through which wastes or decontamination media (i.e., rinsewater) could be released into the environment. If cracks exist, they will be sealed or repaired prior to decontaminating the units to prevent releases during these activities. Sampling below the subsurface of the storage units may be necessary depending upon visual inspection and records review.

The visual inspection will be accomplished and noted using a visual inspection log. Releases and potential releases and their locations will be annotated as well as responses to any such problems. The log will be used to finalize selection of sampling points, and as a method to inform KDEP of any potential releases.

I-1e (1)a Decontamination of Structures and Equipment

Trained chemical workers wearing appropriate PPE will conduct decontamination procedures.

<u>Sweeping Foundation</u>

The inside of the HWSU/igloo will be vacuumed using an industrial wet/dry vacuum equipped with a high efficiency particulate air (HEPA) filter. Materials collected during this activity will be placed into a drum marked “Hazardous Waste, Vacuum Sweepings.” Some areas may require scraping or similar removal method prior to vacuuming. Unless the sweepings are known to be mixed with, be derived from, or contain a listed hazardous waste, the sweepings will not be segregated. It is anticipated that the sweepings will consist of dry powder granule material. Sweepings that do not meet a listing or a hazardous characteristic of toxicity will not be subject to 401 KAR Chapter 39 and instead will be characterized as solid waste and managed in accordance with 401 KAR 47.

Once the building has been cleaned of all residual material, air monitoring will be conducted as discussed previously in Section I-1e. If the initial air monitoring indicates agent levels above acceptable levels, the building will be decontaminated as described in the following sections.

<u>Washing Inside Structure</u>

Based on supporting data and the Environmental Protection Agency's (EPA's) best engineering judgment, water washes are applicable for removing contaminants from all categories of debris surfaces, including contaminants that are not water soluble. Considering the physical characteristics of the concrete (e.g., surface texture, hardness, and brittleness), BGAD and PEO ACWA intend to utilize water washes to effectively remove contaminants from the structures.

Personnel will ensure the water-wash operation incorporates steps that remove contaminants and minimize the amount of water required. If no release of listed hazardous wastes has been documented, rinsewater is not anticipated to be contaminated with (i.e., "containing") a listed hazardous waste and will not need to be managed separately from other rinsewaters in accordance with generator provisions.

The steps are as follows:

- Block the drains and place barriers at the door to prevent the escape of any rinsewater.
- Utilize an inside-out, top-down approach for the water wash until all of the concrete in the structure has been directly sprayed.
- Continue until all of the concrete in the structures has been water washed a second time.
- Squeegee the standing water toward the structures inner containment trench for collection and sampling.

Accumulated rinsewaters, which are expected to be non-hazardous, will be removed from the area using an industrial wet/dry vacuum and containerized.

Before initiating the use of the vacuum and between subsequent removals of accumulated rinsewaters, personnel will flush the unit (vacuum and hose assembly) with an appropriate amount of clean water (dependent on the capacity of the vacuum and hose assembly) to ensure cross-contamination does not occur. Equipment rinsate blanks will be taken. Flush water will be accumulated in a separate 55-gallon drum and tested only if some of the accumulated rinsewater is determined to qualify as hazardous waste.

Decontaminating Loading/Unloading Ramp

The loading/unloading ramp does not come in direct contact with containerized hazardous wastes. Historical records will be checked and if there has been no release on the loading/unloading ramp, sampling of the ramp is not anticipated. However, if staining on the ramp suggests that contaminants could be present, the ramp will be decontaminated and sampled.

Decontaminating Equipment

While completing closure, personnel will ensure that sampling equipment (e.g., industrial wet/dry vacuum, hand auger) is decontaminated to prevent cross-contamination.

Upon completing decontamination activities, the industrial wet/dry vacuum will be flushed with three volumes of a non-phosphate detergent/tap water rinsate solution. The squeegee will be washed with a non-phosphate detergent solution and rinsed with tap water. Provided the accumulated rinsate does not exhibit a hazardous waste characteristic, it will be mixed/bulked with the non-hazardous regulated water-wash rinsewater and managed accordingly.

I-1e (1)b Management of Waste Generated During Decontamination

In the process of closure, any equipment, structures, residues, and soils intended for recycling or disposal will be evaluated and managed in accordance with standards applicable to generators of hazardous waste.

Rinsewater Management

Based on the following equations, it is estimated that the use of a water wash will result in the generation of 109 gallons of rinsewater (minimum) to 11,331 gallons of rinsewater (maximum) per unit.

Area of base:

$$80 \text{ feet} \times 26.5 \text{ feet} = 2{,}120 \text{ ft}^2$$

Roofing and side walls:

$$12.75 \text{ feet} \times 3.141592\ [\pi] \times 80 \text{ feet} = 3{,}204 \text{ ft}^2$$

Total area:

$$2{,}120 \text{ ft}^2 + 3{,}204 \text{ ft}^2 = 5{,}324 \text{ ft}^2$$

Minimum gallons of rinsewater:

Water Flow Rate	×	Treatment Rate	×	Area	×	gal/L		
2.8 L/min	×	*min/36 ft^2*	×	*5,324 ft^2*	×	*1 gal/3.785 L*	=	*approximately 109 gal*

Maximum gallons of rinsewater:

Water Flow Rate	×	Treatment Rate	×	Area	×	gal/L		
290 L/min	*x*	*min/36 ft^2*	×	*5,324 ft^2*	×	*1 gal/3.785 L*	=	*approximately 11,331 gal*

If needed, the rinsewater will be containerized. Rinsewater collected from each unit will be managed separately until samples are obtained for analysis. Unless the rinsewater is known to be mixed with, be derived from, or contain a listed hazardous waste, the accumulation drum(s) will be marked with “Decontamination Rinsewater” and the source (e.g., building number). Upon completion of the decontamination procedure, a composite sample will be procured from the container(s). This strategy will allow the rinsewater from each HWSU/igloo to be treated as separate waste streams (one per storage unit). Personnel will document the strategy and specifics pertaining to the sampling in their field notes.

Representative samples will be sent to an approved laboratory. After sampling, personnel will seal the drum, mark the words “Awaiting Analysis Results,” and mark the date container samples were obtained. During the period BGAD/PEO ACWA is awaiting analytical results, the containerized waste will be stored in the HWSUs/igloos and managed in accordance with the generator accumulation provisions.

Upon receiving the analytical results, BGAD/PEO ACWA will characterize the rinsewater generated water-wash activities and dispose of the material. The water will be introduced into a federally owned treatment works. The appropriate water and wastewater personnel will be requested to review the analytical results. If they discern the rinsewater will not adversely impact the sewage wastewater treatment plant, the rinsewater will be transported and discharged into the sanitary system.

If personnel determine that a hazardous material has been released into or onto the foundation, drums used to store collected rinsewater will be managed in accordance with hazardous waste generator accumulation provisions. If a characteristic hazardous waste is known to be the source of contamination, personnel will evaluate contaminated rinsewater and PPE to determine whether either of them continues to exhibit a characteristic. If the rinsewater/PPE no longer exhibits any characteristic, the waste will be managed in accordance with KDEP solid waste management provisions.

Soil Management

BGAD has no reason to suspect surrounding soil is contaminated. Since the inception of hazardous waste container storage operations, containers have not been placed into or onto the land surrounding the location. If an area of concern is identified through historical records review, soil will be sampled in accordance with EPA-approved methods. However, if information indicates a hazardous substance has been released into or onto the surrounding soil, drums used to store excavated soil will be managed in accordance with hazardous waste requirements. In addition, any contaminated PPE will be drummed and managed as “hazardous waste.”

Debris Management

Because clean closure does not entail demolition, BGAD and PEO ACWA do not anticipate generating appreciable amounts of debris during closure. Management practices have been implemented that include proper storage and handling of the drums and engineering controls such as the incorporation of a drainage system that collects materials within the HWSU/igloo. However, BGAD and PEO ACWA recognize that the concrete has not been sealed, and penetration of potential contaminants is possible. Therefore, any debris generated in the sampling effort, or subsequent demolition of interior surfaces if necessary for decontamination, will be tested for hazardous characteristics and disposed of according to all applicable federal and state environmental regulations.

I-1e (1)c Determining the Need for Verifying the Success of Decontamination Efforts

Closure activities include a sampling and analysis component. At a minimum, sampling and analysis will be conducted to characterize the area and vertical extent of contamination at and/or released from the closing unit, as well as to confirm the effectiveness of decontamination activities. Personnel will conduct air monitoring to confirm attainment of target cleanup levels following decontamination activities. Sampling and analysis results will be compared against the closure performance standards discussed in Section I-1a to determine whether clean closure has been realized.

I-1e (1)d Sampling to Verify the Success of Decontamination Efforts

Upon completing decontamination, personnel will evaluate sample analysis results against the performance standards in the approved Closure Plan to determine whether decontamination has been realized. Debris (excluding concrete) subjected to an alternative treatment standard will be considered decontaminated and will not require testing, provided the technology-specific performance standard was met and the debris does not exhibit a characteristic of hazardous waste.

I-1e (2) Closure of Tank Systems

This section is not applicable.

I-1e (3) Closure of Waste Piles

This section is not applicable.

I-1e (4) Closure of Surface Impoundments

This section is not applicable.

I-1e (5) Closure of Incinerators

This section is not applicable.

I-1e (6) Closure of Landfills

This section is not applicable.

I-1e (7) Closure of Land Treatment Units

This section is not applicable.

I-1f Closure Certification

Within 60 days of the completion of final closure, BGAD/PEO ACWA will submit to the Director of KDEP, by registered mail, a certification signed by a principal executive officer and an independent, qualified, registered Professional Engineer (PE). The certification will state that the HWSUs/igloos have been closed in accordance with the specifications contained in the approved Closure Plan. The certification will specify the required documentation to be submitted to the Director. Documentation supporting the PE's certification shall be furnished to the state of Kentucky upon request. Since BGAD is a federal facility, it is not necessary that the PE be registered in Kentucky. However, the PE must not be directly involved with the unit closure and must be registered within the United States.

I-1g Amendment to the Plan

Personnel will notify KDEP and amend the Closure Plan if unexpected events occur during Closure Plan implementation that require a modification to the approved Closure Plan.

I-2 POST CLOSURE PLAN

Because of the nature of the hazardous waste management operations in the chemical HWSUs/igloos and the ability to thoroughly decontaminate the structures and/or remove their contents, there is no need for post-closure plans for these storage units. Should there be any changes in the BGAD hazardous waste management practices, the need for post-closure planning will be reviewed. With thorough decontamination, HWSUs/igloos would not need any post-closure care or monitoring.

I-3 NOTICE REQUIRED FOR DISPOSAL FACILITIES

This section is not applicable.

I-4 CLOSURE COST ESTIMATE

This section is not applicable.

I-5 FINANCIAL ASSURANCE MECHANISM FOR CLOSURE

This section is not applicable.

I-6 LIABILITY REQUIREMENT

This section is not applicable.

Table I-1. Closure Schedule for a Building Used to Store Chemical Munitions

Activity	Time Sequence (Days)	Total Elapsed Time (Days)
Notification of Intent to Close [a]	180	0
Removal of all Stored Wastes from HWSU/Igloo	0	180
Baseline Monitoring	30	210
Cleaning of HWSU/Igloo	90	300
Certification of Closure	60	360

Notes:

a It is anticipated that all munitions/components will have been removed from the building prior to notice of intent to close.

HWSU hazardous waste storage unit

PART J OTHER FEDERAL LAWS

Environmental issues pertinent to this permit are addressed under the provision of the National Environmental Policy Act, 40 Code of Federal Regulations (CFR) Parts 1500.4 (b), (f), and (i). Environmental issues associated with this permit include wetlands; federal or state threatened and endangered species; cultural resources; hazardous, toxic, or radiological waste; and explosive ordnance. The requirements of the following federal laws listed in this part must be met when they apply to the hazardous waste storage units (HWSUs)/igloos relative to this application.

J-1 WETLANDS

Several large wetland areas have been mapped at Blue Grass Army Depot (BGAD). Potential jurisdictional wetlands are present in narrow bands associated with the streams and lakes. The location of wetlands relative to the storage area of the Chemical Limited Area is shown in Figure B-5 (BGAD Flood Plains) of the Permit Renewal Application for Conventional Munition Related Items. The operations of the HWSUs/igloos identified in this permit will not impact/affect wetlands at BGAD.

J-2 WILD AND SCENIC RIVERS ACT

Wild or scenic rivers will not be affected by the operations of the HWSUs/igloos.

J-3 ENDANGERED SPECIES ACT

The Kentucky State Nature Preserves Commission survey performed from 1992–1994 identified Running Buffalo Clover and Spinulose Wood Fern as rare plant species found on the BGAD. During this survey, the areas in which these species were growing were mapped. The HWSUs/igloos relative to this application do not lie in these areas.

BGAD has not identified any endangered animal species on BGAD.

J-4 COASTAL ZONE MANAGEMENT ACT

The operation of the HWSUs/igloos relative to this application will not affect any coastal zone areas.

J-5 FISH AND WILDLIFE COORDINATION ACT

The operation of the storage facilities at BGAD does not result in the impoundment, diversion, control, or modification of any surface water bodies; therefore, this act is not applicable.

J-6 NATIONAL HISTORIC PRESERVATION ACT

Storage operations relative to this permit application will not affect cultural resources on BGAD. An archaeological overview, conducted at the Blue Grass Facility in 1984 by Woodward-Clyde Consultants, concluded that in light of the large number of archaeological sites recorded in the region, it is probable that unrecorded archaeological resources exist at the facility. No cultural resources on BGAD are currently listed or eligible for listing in the National Register of Historic Places (NRHP) (Cultural Resources Management Plan, January 1996).

J-7 HAZARDOUS, TOXIC, OR RADIOLOGICAL WASTE

The BGAD Hazardous Waste Management Program was inspected by the U.S. Environmental Protection Agency (USEPA) and the Kentucky Division of Waste Management in September 1996 and found to be in compliance. No radiological wastes are to be stored in the permitted facilities.

J-8 EXPLOSIVE ORDNANCE

The storage and maintenance operations will not adversely affect any explosive ordnance.

PART K WASTE MINIMIZATION [401 KAR 39:060 Section 5; 40 CFR 270.30]

Blue Grass Army Depot (BGAD) and Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA) are committed to environmental leadership and pollution prevention by reducing usage of hazardous materials and releases of pollutants into the environment to as near zero as possible.

The storage and transportation operations relative to this permit application will be conducted with waste minimization goals in mind. BGAD, PEO ACWA, and Blue Grass Chemical Activity (BGCA) are committed to excellence in environmental protection. Employees are stewards of the environment and responsible for the elimination, reduction, recycling, and proper disposal of waste. Source reduction and waste minimization are prime considerations in all phases of operations. Goals are to eliminate waste generation at the source whenever feasible without compromising quality. When waste generation occurs, they will employ practical measures to reduce its volume and toxicity. BGAD, PEO ACWA, and BGCA are committed to reducing overall risk and achieving pollution prevention goals.

BGAD has instituted a hazardous materials pharmacy (HAZMART) program as part of its waste minimization strategy to reduce the volume or toxicity of wastes generated to the lowest amount possible. The pharmacy offers single-point accountability over the requisitioning, receipt, repackaging, and issue of hazardous material. It is analogous to the control over prescription drugs. Control of hazardous material can eliminate unnecessary purchases, diminish handling hazards, and reduce hazardous waste disposal costs for unused, expired material. The pharmacy program includes studies for substitution of materials of a lesser hazard and toxicity.

HAZMART is just one aspect of waste minimization efforts at BGAD. Pollution prevention reduces the costs associated with hazardous material purchases and management, hazardous waste management and disposal, compliance efforts, personal protective equipment, and the health impacts resulting from exposure to hazardous substances. Pollution prevention is an opportunity to change the work process for greater safety and efficiency, using the latest environmental technologies. (See Permit Renewal Application for Conventional Munition Related Items, Part K [Waste Minimization]).

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PART L SIGNATURES [401 KAR 39:060 Section 5; 40 CFR 124 and 270]

I certify under penalty of law that this document (Module IX, dated December 2020) and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for known violations.

25 Feb 2021

Date

Candace M. Coyle, Ph.D.
Site Project Manager
Assembled Chemical Weapons Alternatives
Blue Grass Chemical Agent-Destruction Pilot Plant
Permit Operator

DORRIS.STEPHEN.DON.1102327272 Digitally signed by DORRIS.STEPHEN.DON.1102327272 Date: 2021.03.08 13:58:40 -05'00'

Date

Colonel Stephen D. Dorris
Commander
Blue Grass Army Depot
Permit Owner

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ATTACHMENT 1
COMPARISON OF TRANSPORT METHODS FOR WARHEADS (WHs) THAT HAVE BEEN DE-MATED FROM ROCKET MOTORS AND SEALED IN CANISTERS

Regardless of vehicle type, there are common procedures and regulations that govern movement of chemical materiel to include weather factors, speed limits, training, emergency response, and securing loads.

1. MOVEMENT USING FLATBED TRUCK

The risk of leaking during loading/unloading and transport is extremely low. The WH canister, along with the transportation skid, provides primary and secondary liquid containment and primary vapor containment:

- The WH canister plug protects against liquid and vapor agent release. The canister is designed with three O-rings. In addition, a mechanical seal via a crimp is formed against the center O-ring.

- Like an overpack, canisters are leak tested prior to introduction to the production line.

- The bottom of the transportation skid is designed to meet the criteria for secondary containment and can contain up to 12.3 gallons. The skid contains a maximum of 25 punched and drained or undrained WHs.

- Punched and drained WHs will be drained to an estimated 5% heel and will contain approximately 0.065 gallons of agent each. Therefore, the maximum amount of agent on a skid would be approximately 1.625 gallons of agent.

- Undrained WHs will not be punched. Therefore, the WH is still the primary container and canister is the secondary containment. The bottom of the skid would be the third means of containment. If the skid bottom were needed for secondary containment, it would still meet the requirements. An undrained WH contains a maximum of 1.3 gallons of chemical agent. Therefore, the maximum amount of agent on a skid is 32.5 gallons, and 10 percent of the maximum amount of agent on the skid is 3.25 gallons.

- It is extremely unlikely that liquid could leak from the canister. The drained WHs are punched in three places, two of which are approximately 3 inches from the bottom of the WH and the other near the top of the WH. The WH is then placed into a canister, and the canister is sealed and placed vertically on the skid. Any residual liquid in the WH would collect at the bottom of the WH, below the holes. In order for liquid to leak from the canister, a canister breach would have to occur below the holes at the bottom of the WH and the canister would have to fall in a position to allow the liquid at the bottom of the WH to leak.

- Storage configuration is vertical, keeping any remaining heel in bottom of the round. The canister is sealed at the top end, away from the agent.

Additional measures assure that liquid agent is not leaking during transport:

- Sealed canisters are monitored prior to leaving engineering controls.

The risk of explosion is extremely unlikely during loading/unloading or transport:

- The explosive hazard for a M55 chemical rocket assembly significantly decreases once the M57 rocket motor assembly is removed from the M56 rocket warhead assembly.
- The activation feature of the fuze requires a sustained (1-second) high acceleration to arm and 13 to 20 g of acceleration to activate. This cannot be achieved without the rocket motor assembly, which has been removed.
- The likelihood of puncture is low because the canisters are 0.120-inch steel.
- The skid is steel and provides additional protection of the WH canisters.
- Testing indicates the canister reduces fragmentation hazard, and there is no potential for sympathetic detonation of other WHs in the skid.
- There is no other realistic means of causing the explosives to actuate once in the canister.
- Loading/unloading poses a greater risk than transport, regardless of the transport vehicle. A smaller, 5,000-pound (or less) forklift will be used to load the skids onto a flatbed truck rather than a larger forklift to load an Enhanced Onsite Container (EONC) or Modified Ammunition Vehicle (MAV). Typically, a 10,000- to 16,000-pound forklift is used to load into an EONC or MAV. A smaller forklift has less kinetic energy than a larger forklift and is less likely to penetrate the canister. Using a smaller forklift results in a slight reduction in risk from a loading/unloading accident.
- There are fewer steps for loading skids on a flatbed than into an EONC or MAV. Two skids would be loaded onto a tray, and the tray in turn would be loaded into the EONC or MAV. There is no tray involved in loading skids onto the flatbed, resulting in a lower risk during flatbed loading, compared to EONC or MAV loading.

Movement by flatbed truck is allowed by Blue Grass Army Depot (BGAD) Resource Conservation and Recovery Act (RCRA) Permit:

- Flatbed trucks are routinely used for transport of leaking overpacked rockets or projectiles in single round containers (SRCs).
- Pallets of full mustard munitions are transported by forklift from the service magazine to the Static Detonation Chamber.

The risk to the surrounding community is extremely low even if a leak occurred during loading/unloading and transport:

- Modeling was conducted to determine risk to the community using three scenarios. The first scenario involved vapor leaking from 300 punched and drained WHs inside canisters with missing caps. Another scenario modeled was for two punched and drained WHs in canisters to be breached by a forklift causing a vapor leak. The third scenario was a forklift striking an undrained WH inside a canister, resulting in a hole through the canister and WH that allows liquid agent to spill into the secondary containment of the skid. Modeling for all three scenarios indicates that none of the hazard distances would reach the BGAD boundary. The modeling reports are provided as Appendices 1-1 and 1-2.

2. MOVEMENT USING EQUIPMENT SIMILAR TO PUEBLO CHEMICAL AGENT-DESTRUCTION PILOT PLANT (PCAPP)

PCAPP transports munitions in an overpack pallet (OPP) loaded in a MAV.

The OPP is a plastic tray with a plastic lid that would add some vapor containment during transport, though it is not airtight. A plastic shroud also adds some vapor containment. The OPP would add tertiary containment for liquid during transport (the WH canister and skid provide primary and secondary containment). The OPP would not provide additional protection from puncture due to an accident or a detonation.

The MAV is an enclosed cargo area equipped with a monitoring port and would add some vapor containment. However, the MAV is not airtight and does not have engineering controls for vapor containment. Additionally, the MAV does not provide any additional liquid containment. The MAV would not provide additional protection from puncture due to an accident or detonation.

The use of the OPP/MAV does not provide a significant decrease to risk versus use of the flatbed truck.

3. MOVEMENT USING EONC

The EONC was designed to:

- Protect the munition in the event of external fire, which is unlikely during transport.

- Protect munitions in case the EONC is dropped and punctured, which is unlikely during transport.

- Provide vapor/liquid containment with a seal confirmation conducted prior to transport.

- The use of EONCs was selected due to more than transportation risk; they provide additional protection when used for inside the Container Handling

Building, particularly if munitions may be stored for extended periods. The EONC offers protection in case of a building fire, and prevents propagation from one EONC to another in case of an accident involving rockets with the rocket motors still attached. The EONC's security features serve to prevent tampering and demonstrate Treaty compliance.

Due to the already low risk, the use of an EONC does not decrease risk compared to the flatbed truck.

4. DEVELOPMENT OF MAXIMUM CREDIBLE EVENTS (MCEs) AND APPLICATION TO WH MOVEMENT

As at other chemical disposal sites, munitions at Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) are only transported when the atmospheric dispersion calculations show that the Acute Exposure Guideline Level (AEGL)-3 plume for the MCE does not reach the BGAD site boundary. The specific MCE that applies depends on the munitions to be transported and the nature of the corresponding transport operations. The derivation of the MCEs and their application to transport operations are described in this section.

The methodology for determining the MCEs for munition movement was developed in the mid-1990s, relying on quantitative risk assessment (QRA) methods and results developed for managing risk at the chemical stockpile disposal sites. Since that time, the MCEs have been derived based on an MCE frequency of 1×10^{-4} per year (or events that would be expected to occur once every 10,000 years of operation). QRA methods are applied to each potential accident that could lead to an agent release and the accidents that meet the MCE probability threshold are considered for MCEs.

MCEs for transport of containerized warheads (either punched and drained or undrained) were determined by considering all upsets that could occur during movement from the BGCAPP Main Plant to storage, from the BGCAPP Main Plant directly to the Static Detonation Chambers (SDCs), or from storage to the SDCs. Each operation involves forklift movements to load and unload the transport vehicle, and transport of the warheads between locations. Of these, the forklift movements provide the greatest likelihood of an upset. Forklift upsets include impacts with the warhead skid/pallet or drops of the skid/pallet during loading or unloading. The probability of a forklift impact or drop has been estimated based on experience at the baseline chemical agent disposal facilities and at similar facilities in which hazardous containers are frequently moved by forklift. Separate analyses have been performed to determine the probability that the upset leads to a warhead leak or energetics explosion. For every operation involving movement of the containerized munitions, the overall probability of an upset leading to a leak or explosion is determined per skid/pallet moved.

The annual MCE probability of 1×10^{-4} per year is converted to a daily MCE probability by dividing by the planned number of days the operation will be conducted. The daily MCE probability is then divided by the probability of leak or explosion per skid/pallet to determine the number of skids/pallets that can be moved before the daily MCE probability is exceeded. If the number of skids/pallets to be moved on a given day exceeds the skid/pallet limit for the explosion MCE, then the explosion MCE must be used. If this skid/pallet limit is not exceeded, then the leak MCE is used.

The nature of the agent release that would occur as a result of the MCE depends on the munition and how it is palletized. For each such configuration, an assessment is made of the potential for more than one munition to leak or explode as a result of the upset. For the containerized warheads, testing has shown that explosion of one warhead will not cause explosion of adjacent warheads, so the MCE involves explosion of only one munition. Effects from that explosion are conservatively assumed to cause 14 munitions in the skid/pallet to leak. For a leak MCE, it is conservatively assumed that up to two munitions are punctured and leak (for example, as a result of both forklift tines simultaneously striking the warhead containers, or a dropped skid/pallet striking a rigid object that impacts two canisters simultaneously).

Each day, the BGAD Operations Center runs MCE calculations based on operations planned for that day. Current weather conditions are used—if the calculated AEGL-3 plume for the MCE extends beyond the site boundary, then movement operations cannot proceed as planned or the decision may be made to move fewer munitions. The MCE calculations are repeated later and, if weather conditions changed so that the AEGL-3 plume no longer goes offsite, then the originally planned transport operations can occur.

MCEs for punched and drained WHs and undrained WHs can be found in Appendices 1-3 and 1-4.

5. CONCLUSION

For flatbed transport, modeling indicated that none of the hazard distances would reach the BGAD boundary. Further, the use of OPP/MAV or an EONC is not necessary because the risks have been mitigated with the design of the WH, the canister, and the skid. Vapor or liquid leaks are unlikely due to the seal and factory testing. Puncture due to an accident, fire, or detonation is an unlikely occurrence. The design of the canister and skid adequately mitigate risk of puncture and fragmentation/sympathetic detonation in the unlikely event that a WH detonates. The risk of detonation during transport is significantly reduced because the WHs are separated from the rocket motor and the WH explosive train does not actuate without the rocket motor being actuated. Movement of munitions will be conducted when no credible off-post AEGL-3 scenario is possible based on modeling using atmospheric conditions.

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APPENDIX 1-1
HAZARD DISTANCE ESTIMATES FOR TWO EVAPORATION SCENARIOS INVOLVING DRAINED GB M55 ROCKET WARHEADS

Risk Management Analysis

Hazard Distance Estimates for Two Evaporation Scenarios Involving Drained GB M55 Rocket Warheads

Site: BGCAPP	Study Number: RM-20-001	Rev. 0

Calculations estimated AEGL and IDLH hazard distances for two GB vapor leak scenarios involving punched and drained M55 rocket warheads.

- Scenario A modeled hazard distances for up to 300 warheads inside canisters where the canister caps are missing.
- Scenario B modeled hazard distances for up to two warheads inside sealed canisters that are struck by a forklift tine, allowing GB vapors to leak.

Evaporation rates for Scenarios A and B were calculated using a void space evaporation model, which estimates evaporation from an open container with an air gap between the liquid and the top of the container. The evaporation rates were used to calculate the mass of GB evaporated in 60 minutes. The mass of GB evaporated was put into D2PC to determine hazard distances. None of the modeled hazard distances extended to the site boundary.

Final, Revision 0

February 2020

Prepared for
Program Executive Office,
Assembled Chemical Weapons Alternatives

Prepared by

leidos

Revision Log

Rev. #	Date	Summary
Final, Rev. 0	February 2020	

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1 INTRODUCTION

When GB-filled M55 rockets are processed at the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) Main Plant, the rocket motors are separated from the warheads and the warheads are removed from the shipping/firing tubes before the warheads are punched and drained. The punched and drained warheads retain a nominal 5 percent of the original fill after draining. Drained warheads are placed inside canisters and a plug is crimp-sealed in the canister opening to prevent leakage while the warheads are moved either to the Static Detonation Chamber (SDC) or to buffer storage. During movement, the nearest approach to the installation boundary is 1,600 meters.

This assessment considered two release scenarios involving punched and drained warheads containing 5 percent fill. A brief description of the scenarios follows.

- Scenario A: Evaporation of GB from warheads inside canisters. The canisters do not have their lids and the void space is 81.4 centimeters (cm) (32 inches).
- Scenario B: The warheads are inside sealed canisters; however, one or two canisters have a 2.54 cm (1 inch) diameter hole resulting from a forklift impact.

The modeled scenarios used assumptions to establish conservative hazard distances. Each scenario has conservative assumptions that deviate from what is expected during actual transport and handling. For example, a conservative assumption common to both scenarios is that the GB evaporates without inhibition from matrix effects or the size of the punched holes used to drain the GB. **Table 1** compares standard, expected procedures to the assumptions used in the modeled scenarios.

Section 2 defines the hazard levels and describes the evaporation and dissemination models used. Section 3 provides detailed descriptions of the modeled scenarios, including discussion of conservative assumptions, along with results of the calculations. Section 4 summarizes the results of modeling the evaporation scenarios.

Table 1. Standard Procedures vs. Leaker Scenarios

Standard Procedures	Leaker Scenario A	Leaker Scenario B
Warheads have been separated from motors.	No change from standard procedure	No change from standard procedure
Warheads have been drained; assume 5% of original fill remains in warhead.	No change from standard procedure	No change from standard procedure
GB remaining in the warheads is a mixture of wetted surface, liquid GB, and a viscus, semi-solid, or solid heel adhering to the sides of the agent well. GB in the heel will not evaporate as rapidly as liquid GB due to matrix effects.	Scenario assumes GB remaining in the warheads is liquid. There are no matrix effects on the evaporation rate.	Scenario assumes GB remaining in the warheads is liquid. There are no matrix effects on the evaporation rate.
Warheads have three holes used for draining.	Scenario assumes GB is free to evaporate inside canister.	Scenario assumes GB is free to evaporate inside canister.
Warhead is placed into transport/storage canister.	No change from standard procedure	No change from standard procedure
Canister opening is crimp-sealed with a cap that makes the canister liquid and vapor tight.	The cap of the canister is missing or fell off. This is a very conservative assumption because the cap has multiple gaskets and is crimped into place to prevent the cap from falling off. Testing at Redstone Arsenal demonstrated that an adjacent warhead detonation is also unlikely to remove it. Equipment sensors and visual inspection would identify if a cap failed to be placed before it left the Main Plant.	Canister cap is present but a 1-inch hole has been punched into the side of the canister by a forklift allowing GB vapors to escape.
Sealed canisters are monitored for leaks before placing on transport vehicle. If leakage is noted, the canister is set aside for further processing; known leaking canisters are not placed on the truck for movement to buffer storage.	Monitoring is irrelevant as leaking canisters are assumed to be present. This is a very conservative assumption because two headspace-monitoring events are used to verify it is vapor tight.	Warhead monitoring verified no leaking prior to placement on the truck. The scenario assumes an incident created leaking canisters after monitoring had been performed.

2 RISK ASSESSMENT METHODOLOGY

Scenarios A and B employ a void space evaporation model to calculate the mass of GB released in 60 minutes. The mass of vapor released in 60 minutes became an input to the D2PC dispersion model to calculate hazard distances. A duration of 60 minutes was used because that provides sufficient time for first responders to implement measures that will significantly reduce the evaporation rate from a leak.

The endpoint of the assessment was calculation of the hazard distances for three hazard levels: two that relate to emergency response and public safety and one related to worker safety. The emergency response hazard levels are 60-minute Acute Exposure Guideline Levels (AEGLs) published by the U.S. Environmental Protection Agency. The worker protection hazard level is the Immediately Dangerous to Life or Health (IDLH) level published by the National Institute for Occupational Safety and Health. The hazard levels, in order of increasing concentration, are described in the following:

- AEGL-2, 0.035 milligrams per cubic meter (mg/m^3): Exposures of 60-minute duration at or above AEGL-2 may result in irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- IDLH, 0.1 mg/m^3: Exposures of 30-minute duration at or above IDLH may immediately threaten life or cause irreversible or delayed adverse health effects, or would interfere with an individual’s ability to escape from the contaminated area.
- AEGL-3, 0.13 mg/m^3: Exposures of 60-minute duration at or above AEGL-3 may result in life-threatening health effects or death.

2.1 Void Space Evaporation Model

The void space model calculates evaporation from an open container including the effects of free space between the top of the liquid and the top of the container. The void space prevents wind passing over the container from directly affecting the evaporation rate at the surface of the liquid but allows vapors to be drawn out of the container.

Stefan developed the void space evaporation model in the late 1800s as discussed by Saez and Baygents (2015). **Equation (1)** shows the equation for the void space model.

$$E_{sv} = \frac{(6\times10^{-3})\,A\,d\,M_L P_a}{h\,R\,T} \ln\left(\frac{P_a}{P_a - P_v}\right) \quad (1)$$

where:

E_{sv} = evaporation rate (g/min)

A	=	surface area of container opening (m^2) = varies by scenario
d	=	diffusivity of GB (cm^2/s) = 0.0860
M_L	=	molecular weight of GB (g/mole) = 140.1
T	=	ambient temperature at surface of liquid (K) = 302.15
R	=	Universal Gas Constant (J/mole K) = 8.314
h	=	height of void space (meters) = varies by scenario
P_a	=	ambient pressure (Pa) = 101000
P_v	=	partial pressure of GB at scenario conditions (Pa) = 492

Table 2 lists additional inputs used in background calculations to calculate such parameters as the area of the container opening and diffusivity of the agent under the scenario conditions.

Table 2. Additional Inputs to Evaporation Model

Parameter	Input
Agent	GB
Molecular Weight	140.1
Density (g/cm^3)	1.09
Volume of agent [a] (mL)	222.60
Diameter of canister (cm)	12.7
Ambient air speed (m/s)	1
Air speed at liquid surface (m/s)	0
Ambient pressure (mm Hg)	760
Temperature of atmosphere in °C	29
Temperature of agent (°C)	29
Void space above liquid (cm)	Varies by scenario
Release duration (minutes)	480 [b]

Notes:

a Volume of agent corresponds to 5 percent fill
b Release duration was run out to 480 minutes to ensure identification of maximum evaporation rate.

The maximum evaporation rate calculated by the void space model is used to calculate the mass of GB evaporated in 60 minutes. D2PC uses the mass of GB evaporated to calculate hazard distances.

2.2 D2PC Dispersion Model

The D2PC model calculates hazard distances. D2PC is a personal computer based program developed by the Army for estimating downwind chemical agent hazard distances (Whitacre et al. 1987). **Table 3** lists input parameters and code abbreviations for the D2PC model. The wind speed of 1 meter per second (m/s) is conservative as it yields greater hazard distances than higher wind speeds.

Table 3. D2PC Parameter and Input Codes

D2PC Parameter		Input	
Definition	**Code**	**Definition**	**Code**
Location	LOC	Lexington Bluegrass	LBG
Season	SEA	Summer	SUM
Munition type	MUN	M55 Rocket [a]	M55
Agent type	AGN	Sarin	GB
Release type	REL	Semi-continuous [b]	SEM
Atmospheric stability type	STB	Pasquill Category D, neutral stability	D
Wind speed	WND	meters per second	1
Quantity and duration	Q() T()	milligrams minutes	Varies with scenario 60
Units used to define hazard levels	IMA	milligrams per cubic meter	1
Number of hazard level concentrations	NCI	Two AEGLs plus IDLH	3
On next line enter the hazard levels in ascending order		AEGL-2, IDLH, AEGL-3	0.035 0.1 0.13
Number of munitions	NMU	Number of warheads from 1 to 300 depending on scenario and iteration.	Section 3 identifies the numbers of warheads per iteration for scenario

Notes:

a Munition Type was entered as M55. This facilitated running multiple iterations of the model for various numbers of warheads simply by entering the number of warheads with the NMU code. D2PC would then calculate the quantity of GB based on the entry for Q(). The same answers would have been obtained if the non-munition code (NON) were used, but then each new iteration would have required entering a new Q() value.

b SEM models hazard distances at a constant evaporation rate for a finite time.

3 RELEASE SCENARIOS

The following sections describe the results for the two scenarios.

3.1 Scenario A

Scenario A assumes that the canister plug is missing (fell off or failed to be placed on the canister). This is a very conservative assumption because the plug has three gaskets that form a tight fit to the wall of the canister, and the plug is crimp-sealed to prevent the cap from falling off. Testing at Redstone Arsenal demonstrated that even an adjacent warhead detonation is unlikely to remove the cap. Equipment sensors, agent monitoring, and visual inspection would identify if caps were not placed on the canisters before they left the Main Plant. Scenario A also assumes that nothing inside the canister or warhead interferes with the ability of GB vapors to reach the opening at the top of the canister.

The main features of Scenario A include:

1. Warheads contain 242,634 milligrams (mg) of GB, 5 percent of the original fill.
2. The GB is liquid and evaporates without matrix effects.
3. The GB is free to evaporate inside the canister with no constraints caused by the warhead or the packing materials.
4. There is 81.4 cm (32 inches) of headspace above the GB level.
5. Canisters are in packaged warhead skids of 25 per skid, with 12 skids per truck.
6. The truck does not have an enclosure or cover that would impede evaporation.
7. Warheads are upright so there is no liquid spill.
8. Only a vapor release is modeled.

Table 4 contains inputs to the void space evaporation model. The maximum evaporation rate calculated by the evaporation model is 0.221 milligrams per minute (mg/min), which equals 13.26 mg in 60 minutes. A temperature of 29°C was used as the temperature of the GB because the warheads are coming from either an air-conditioned building or an igloo, both of which would be at lower temperatures than might be considered bounding for a summertime release (SAIC 2012). A void space of 81.4 cm was used because it was assumed that the GB was approximately 7.5 cm from the bottom of the canister. The canister is 88.9 cm (35 inches) long, but a spring at the bottom of the canister plus the bottom parts of the warhead would elevate the GB by approximately 7.5 cm, resulting in a headspace of 81.4 cm.

Table 4. Inputs to Void Space Evaporation Model for Scenario A

Parameter	Input
Temperature of GB (°C)	29
Mass of GB in canister (mg)	242,634
Area of opening (cm^2)	126.7
Headspace (cm)	81.4
Air speed at liquid surface (m/s)	0.0
Air speed above container opening (m/s)	1

Table 5 lists D2PC inputs for Scenario A. The model was run 15 times for numbers of munitions ranging from 1 to 300. The limit of 300 warheads is the assumed maximum number of warheads moved in a single event.

Table 5. D2PC Inputs for Scenario A

Parameter	Input
LOC	LBG
SEA	SUM
MUN	M55
AGN	GB
REL	SEM
STB	D
WND (m/s)	1
Q()(MG), TQ()(MIN)	13.26, 60
IMA	1
NCI (60-minute AEGLs plus IDLH)	3 0.035 0.1 0.13
NMU	15 trials from 1 to 300 leakers

Table 6 shows Scenario A hazard distances for the various hazard levels. The maximum hazard distance is 48 meters for AEGL-2 and 23 meters for AEGL-3 (the most serious hazard) based on the assumption that all 300 canisters on the truck are missing their lids. This is a worst-case scenario because it assumes that the lids are not on the canisters. The conservative nature of the scenario is noted by the fact that during actual operations, sensors, video monitors, and chemical agent monitoring would detect if a canister lid were not correctly in place. Carrying the scenario model out to 300 problematic containers provides an additional layer of conservatism.

Table 6. D2PC Results for Scenario A

Number of Leakers	Distance to Hazard Level (meters)		
	AEGL-2	IDLH	AEGL-3
1	2	1	<1
5	5	3	2
10	7	4	3
25	12	6	6
50	17	10	8
75	22	12	10
100	26	14	12
125	29	16	14
150	32	18	15
175	35	19	17
200	38	21	18
225	41	22	19
250	43	24	21
275	46	25	22
300 [a]	48	26	23

Notes:

a 300 leakers (12 packaged warhead skids) is the assumed maximum number of canisters on one flatbed truck.

3.2 Scenario B

Scenario B involves vapor leakage from sealed canisters struck by a forklift tine, resulting in a hole in the canister and warhead that would allow GB vapors to escape. The scenario assumes that either one or two canisters were struck with sufficient force to create a hole in the canister and warhead. This is assumption is conservative because actual operations involve trained forklift operators skilled at moving pallets. In addition, there has never been a forklift impact of sufficient force to puncture either a munition at any of the chemical stockpile sites. Therefore, the assumption of one or two damaged canisters is considered conservative.

Leakage is modeled from a 2.54 cm (1-inch) diameter hole that is 2.54 cm (1-inch) above the level of the GB inside the warhead. To ensure a maximum leak rate is modeled, Scenario B assumes nothing inside the canister or warhead interferes with the evaporation of the GB or the ability of the GB vapors to reach the hole.

The main features of Scenario B include:

1. Warheads contain 242,634 milligrams (mg) of GB.
2. GB is liquid and evaporates without matrix effects.
3. GB is free to evaporate inside the canister with no constraints caused by the warhead or the packing materials.
4. There is 2.54 cm (1 inch) of headspace between the assumed GB level and the hole.
5. Canisters are in packaged warhead skids of 25 per skid, with 12 skids per truck.
6. The truck does not have an enclosure or cover that would impede evaporation.
7. Warheads are upright so there is no liquid spill.
8. Only a vapor release is modeled.

Table 7 lists inputs to the void space evaporation model. The maximum evaporation rate is 0.283 mg/min and the mass of GB evaporating in 60 minutes is 16.98 mg. As with Scenario A, a GB temperature of 29°C was used because the canisters are coming either from an air-conditioned building or from an igloo, both of which would be below the ambient temperature of a hot summer day.

Table 7. Inputs to Void Space Evaporation Model for Scenario B

Parameter	Input
Temperature of GB (°C)	29
Mass of GB in canister (mg)	242,634
Area of opening (cm^2)	5.1
Headspace (cm)	2.54
Air speed at liquid surface (m/s)	0.0
Air speed above container opening (m/s)	1

Table 8 contains D2PC inputs. Scenario B was only run for two iterations, one involving a single leaking canister and one involving two leaking canisters. Runs with greater numbers of leaking canisters were not considered because it is unreasonable to assume the forklift could strike with sufficient force to damage more than two canisters.

Table 8. D2PC Inputs for Scenario B

Parameter	Input
LOC	LBG
SEA	SUM
MUN	M55
AGN	GB
REL	SEM
STB	D
WND (m/s)	1
Q()(MG), TQ()(MIN)	16.98, 60
IMA	1
NCI (60-minute AEGLs plus IDLH)	3 0.035 0.1 0.13
NMU	Two trials: 1 leaker and 2 leakers

Table 9 lists D2PC results. The hazard distance to the outer limit of AEGL-2 is 2 meters for a single canister and 3 meters for two canisters. The distance to the outer limit of AEGL-3 (the most serious hazard) is 1 meter for one or two canisters.

Table 9. D2PC Results for Scenario B

Number of Leakers	Distance to Hazard Level (meters)		
	AEGL-2	IDLH	AEGL-3
1	2	1	1
2	3	2	1

4 SUMMARY

This assessment calculated hazard distances for two conservative release scenarios involving movement of punched and drained M55 rocket warheads. Scenario A involved vapor leakage from an open warhead canister. Scenario B involved vapor leakage from a sealed canister that had a hole in it from a forklift impact.

Hazard distances calculated were for 60-minute AEGLs and IDLH.

The scenarios consider releases that might occur during movement of the warheads from the BGCAPP Main Plant either to the SDC or to buffer storage as well as movement from buffer storage to the SDC. The nearest approach to the installation boundary during any part of the movement operation is 1,600 meters. Scenarios A and B result in hazard distances that are far short of reaching the installation boundary. The AEGL-2 hazard distance for Scenario A involving 300 warheads is only 48 meters. The AEGL-2 hazard distance for Scenario B is 3 meters.

5 REFERENCES

SAIC, *Public and Worker Risk Due to a Leaking Munition at the Blue Grass Chemical Activity*, RM-10-001, Rev. 1, 2012.

Whitacre, C. G., J. H. Griner, M. M. Myirski, and D. W. Sloop, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, U.S. Army Chemical Research Development & Engineering Center, CRDEC-TR-87021, 1987.

APPENDIX A. ABBREVIATIONS

AEGL	Acute Exposure Guideline Level
BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
cm	centimeter(s)
cm^2	square centimeter(s)
cm^2/s	square centimeter(s) per second
g/cm^3	gram(s) per cubic centimeter
g/min	gram(s) per minute
g/mole	gram(s) per mole
GB	Sarin (nerve agent)
IDLH	Immediately Dangerous to Life or Health
J/mole	joule(s) per mole
K	Kelvin
km (m/s)	kilometer (meters per second)
m	meter(s)
m/s	meter(s) per second
m^2	square meter(s)
mg	milligram(s)
mg/m^3	milligram(s) per cubic meter
mg/min	milligram(s) per minute
mL	milliliter(s)
mm Hg	millimeter(s) of mercury
Pa	pascal(s)
SDC	Static Detonation Chamber

APPENDIX 1-2
HAZARD DISTANCE ESTIMATES FOR EVAPORATION FROM UNDRAINED GB M55 ROCKET WARHEAD

Risk Management Analysis

QRA Quantus

Hazard Distance Estimates for Evaporation from Undrained GB M55 Rocket Warhead

Site: BGCAPP	Study Number: RM-20-002	Rev. 0

Calculations estimated AEGL and IDLH hazard distances for a GB liquid leak scenario involving an undrained M55 rocket warhead inside a sealed canister struck by a forklift tine resulting in a hole through the canister and the warhead allowing liquid GB to leak into the spill pan.

Evaporation rate was calculated using the ALOHA® model to calculate evaporation rate and D2PC to calculate hazard distances. The calculated hazard distances do not exceed the distance to the site boundary.

Final, Revision 0

February 2020

Prepared for
Program Executive Office,
Assembled Chemical Weapons Alternatives

Prepared by

leidos

Revision Log

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0	February 2020	

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1 INTRODUCTION

When GB-filled M55 rockets are processed at the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) Main Plant, the rocket motors are separated from the warheads and the warheads are removed from the shipping/firing tubes. The Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA) is evaluating the treatment of M55 rocket warheads in the Static Detonation Chamber (SDC) without first draining the warheads. Part of that consideration is movement of warheads inside canisters from the BGCAPP Main Plant to the SDC or to buffer storage. This paper describes modeling of the hazard distances that might result if, during movement, one of the canisters containing a GB-filled warhead were struck by a forklift tine with sufficient force to create a hole in both the canister and the warhead, allowing liquid GB to leak from the canister.

A brief description of the scenario follows.

- An undrained warhead inside a sealed canister that has a hole through both the canister and warhead as the result of a forklift impact. The hole results in 80 percent of the GB leaking into the spill pan at the bottom of the packaged warhead skid.

The scenario used assumptions to establish conservative hazard distances. The calculated hazard distances were compared to the nearest distance to the site boundary, about 1,600 meters (m).

Section 2 defines the hazard levels and describes the evaporation and dissemination models used. Section 3 provides detailed description of the modeled scenario, including discussion of conservative assumptions, along with results of the calculations. Section 4 summarizes the modeling results.

2 RISK ASSESSMENT METHODOLOGY

The scenario used the ALOHA® evaporation model because the spill pan is large enough that it more closely resembles an unconfined spill than it does a confined spill. The sides of the spill pan are only 2 inches high; therefore, wind blowing across the spill pan will have a direct effect on evaporation from the surface of the liquid in the spill pan. Hazard distances were calculated by D2PC (described in Section 2.2).

The endpoint of the assessment was calculation of the hazard distances for three hazard levels. Two hazard levels are 60-minute Acute Exposure Guideline Levels (AEGLs) published by the U.S. Environmental Protection Agency and pertain to spill response and public protection. The third hazard level is the Immediately Dangerous to Life or Health (IDLH) level published by the National Institute for Occupational Safety and Health and pertains to worker protection.

The hazard levels, in order of increasing concentration, are described in the following:

- AEGL-2, 0.035 milligrams per cubic meter (mg/m^3): Exposures of 60-minute duration at or above AEGL-2 may result in irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- IDLH, 0.1 mg/m^3: Exposures of 30-minute duration at or above IDLH may immediately threaten life or cause irreversible or delayed adverse health effects, or would interfere with an individual's ability to escape from the contaminated area.
- AEGL-3, 0.13 mg/m^3: Exposures of 60-minute duration at or above AEGL-3 may result in life-threatening health effects or death.

2.1 ALOHA Model

The U.S. Environmental Protection Agency ALOHA model (EPA 2007) calculates evaporation from a spill that is open to the direct effects of wind. **Equation (1)** is the equation used by ALOHA to estimate the evaporation rate.

$$E = 60{,}000{,}000 \times A \times D \times MW \times P_{GB} / 8{,}314 / T \quad (1)$$

where:

E = evaporation rate (mg/min) = calculation result
60,000,000 = combined units conversion factors
A = area of spill (m^2)
D = diffusivity of GB (km (m/s))
MW = molecular weight of GB
P_{GB} = partial pressure of GB at temperature T (Pa)
8,314 = universal gas constant (J/kg·K)
T = temperature (K)

The calculated evaporation rate allows calculation of the mass of GB evaporating in 60 minutes, which, in turn, is used in D2PC to calculate hazard distances.

2.2 D2PC Dispersion Model

The D2PC model calculates hazard distances. D2PC is a personal computer based program developed by the U.S. Army for estimating downwind chemical agent hazard distances (Whitacre et al. 1987). **Table 1** lists input parameters and code abbreviations for the D2PC model. The wind speed of 1 meter per second (m/s) is conservative as it yields greater hazard distances than higher wind speeds do.

Table 1. D2PC Parameter and Input Codes

D2PC Parameter		Input	
Definition	**Code**	**Definition**	**Code**
Location	LOC	Lexington Bluegrass	LBG
Season	SEA	Summer	SUM
Munition type	MUN	M55 Rocket	M55
Agent type	AGN	Sarin	GB
Release type	REL	Semi-continuous [a]	SEM
Atmospheric stability type	STB	Pasquill Category select A to F	Specific to scenario
Wind speed	WND	Enter wind speed in meters per second	Specific to scenario
Quantity and Duration	Q() T()	Enter milligrams of agent spilled Enter duration of evaporation in minutes	Specific to scenario Specific to scenario
Units used to define hazard levels	IMA	milligrams per cubic meter	1
Number of hazard level concentrations	NCI	Two AEGLs plus IDLH	3
On next line enter the hazard levels in ascending order		AEGL-2, IDLH, AEGL-3	0.035 0.1 0.13

Notes:

[a] SEM models hazard distances at a constant evaporation rate for a specific duration.

3 RELEASE SCENARIO

The scenario models a liquid leak from an undrained GB-filled warhead. The model assumes the warhead is inside a sealed canister that was struck by a forklift with sufficient force to penetrate both the canister and the warhead, resulting in liquid GB leaking out of the canister into the spill pan.

The scenario assumes that the pallet of warheads is not covered or otherwise contained to prevent evaporation and dispersion of the GB in the spill pan. A release duration of 60 minutes was used as a conservative estimate of how long it would take personnel to notice the leak and take response measures to drastically reduce the evaporation of GB. This is a conservative duration because the locations were the spill might happen would all have spill response kits on site as well as personnel trained in how to use them.

The scenario assumes only one canister and warhead were punctured. This is a liquid leak scenario—as long as the leak fills the bottom of the spill pan and does not completely evaporate in 60 minutes, multiple leakers pose no greater hazard than a single leaker does because the surface area of the pool of GB remains the same.

The scenario considers leakage from only one canister because it is unlikely that a trained forklift driver experienced in movement of pallets containing chemical agent warheads would strike the pallet with such force as to cause holes in the warheads. In the history of the Chemical Demilitarization Program, there has never been a forklift strike of chemical agent munitions of sufficient force to cause a chemical age leak. Therefore, it was considered unreasonable to model a scenario involving more than a single leaking canister.

The scenario assumes the rockets have been removed from the shipping and firing tubes and the rocket motors have been separated from the warheads, but that the warheads were not drained. The warheads are packaged in canisters (the same canisters used to transport punched and drained warheads). The scenario estimates hazard distances due to evaporation of GB from the spill pan.

Based on the design of the warhead skid, the wall of the spill pan protects the bottom 2 inches of the canister from punctures. Above the top of the spill pan, there is an 8-inch space to the bottom of the first skid canister holder. This space is where an errant forklift tine is most likely to strike one of the canisters. Therefore, the scenario assumes the leak is 6 inches above the base of the canister, which is equivalent to 4 inches above the base of the warhead (a spring at the bottom of the canister elevates the warhead by approximately 2 inches).

3.1 Estimate How Much GB Leaks Out of Canister

Not all of the GB will leak out because the hole is 6 inches above bottom of the canister. This space can hold approximately 20 percent of the GB in the warhead. Therefore, hazard distances are based on 80 percent of the GB leaking into the spill pan.

3.2 Spill Dimensions

Per the Rocket Warhead Containerization System 90% Design Review (Crown 2019), the spill pan is nominally 42x42 inches (1.0668x1.0668 m) giving an area of 1,764 square inches (1.1381 square meters [m^2]). However, a portion of the spill pan is taken up by the 25 canisters on the pallet. Each canister has a diameter of approximately 5.0 inches (0.127 m), meaning that the 25 canisters occupy an area of 0.31669 m^2. In addition, two of the corners of the pallet have chamfers. Each chamfer is a right triangle with sides of 5.46 inches (0.138684 m). Together, the two chamfers take up 192.33 square centimeters (0.019233 m^2). Therefore, the effective surface area of the spill is 0.8021 m^2 (1.1381 m^2 – 0.3167 m^2 – 0.0192 m^2 = 0.8021 m^2). ALOHA assumes a circular spill. A circle with an area of 0.8021368 m^2 has a diameter of 1.0106 m, as calculated in **Equation (2)**.

$$Diameter = 2 \times \sqrt{\frac{Area}{\pi}} \tag{2}$$

$$Diameter = 2 \times \sqrt{\frac{0.802136\ \text{m}^2}{3.145926}}$$

$$Diameter = 1.0106\ \text{m}$$

The mass of GB leaked into the spill pan is assumed to be 80 percent of the contents of the warhead. Based on IEM WebPuff data, an M55 rocket warhead has 4,853,434.4 milligrams (mg) of GB; therefore, the spill contains 3,882,747.52 mg of GB. At a density of 1,090 milligrams per milliliter (mg/mL), the volume of the spill is 3,562.15 milliliters (mL).

Table 2 shows inputs and results for the ALOHA evaporation model. The key inputs are the length of the spill, the temperature, and the volume of GB present. The warheads have been inside either an air-conditioned building or an igloo and are most likely are at a lower temperature than the outdoors air on a hot summer day (SAIC 2012). However, once the leak occurs, the pool formed is so shallow (approximately 0.4 centimeters) that it is assumed the GB warms to the surrounding temperature within the 60-minute duration of the model. Therefore, 32°C was used as a bounding summer temperature for both the GB and the surrounding air.

Table 2. ALOHA Evaporation Rate Calculation

Parameter	Input		
Temperature of GB (°C)	32		
Volume of GB in spilled (mL)	3,562.15		
Density of GB (mg/mL)	1,090		
Diameter of spill (m)	1.0106		
Air speed at liquid surface (m/s) – 3 iterations	1	2	5
Ambient pressure (mm Hg)	760		
Ambient temperature (°C)	32		
Air density (g/cm^3)	1.16E-03		
Air viscosity (g/cm s)	1.86E-04		
Mu/rho (cm^2/s)	1.61E-01		
Diffusivity of GB (km (m/s)	3.15E-03		
Partial pressure of GB (Pa)	590		
Results			
Steady GB evaporation rate (mg/min) – 3 iterations	4,947.52	8,482.46	17,299.39
Mass of GB evaporated in 60 minutes (mg) – 3 iterations	296,851.08	508,947.61	1,037,963.24

Three iterations were run, one at a wind speed of 1 m/s, one at 2 m/s, and one at 5 m/s. Results of the ALOHA model range from a maximum evaporation rate of 4,984.57 mg/min for a wind of 1 m/s to 17,428.95 mg/min for a wind speed of 5 m/s. The mass of GB evaporated in 60 minutes ranged from 299,074.34 mg for a 1 m/s wind to 1,045,737.02 mg for a 5 m/s wind.

Table 3 shows D2PC inputs. A release type of SEM was used. SEM calculates hazard distances based on a constant evaporation rate (results of the ALOHA model) over a specified period of time (60 minutes).

The model was run for each three wind speeds used in the ALOHA model. Each iteration had a different wind speed and a different mass of GB. Each iteration was run using a temperature of 32°C.

Table 3. D2PC Inputs

Parameter	Input		
LOC	LBG		
SEA	SUM		
MUN	M55		
AGN	GB		
REL	SEM		
STB	D		
WND – three iterations	1	2	5
TMP	32		
Q() –three iterations T()	296,851.08 60	508,947.61 60	1,037,963.24 60
IMA	1		
NCI (60-minute AEGLs plus IDLH)	3 0.035 0.1 0.13		

Table 4 shows D2PC results. The run using a wind speed of 1 m/s yielded the longest hazard distances, with AEGL-2 extending 567 m from the spill site and AEGL-3 (the most hazardous AEGL) extending 268 m. The reason the higher wind speeds produce shorter hazard distances even though the mass of GB in the plume is greater is due to increased turbulence and spreading of the plume at the higher wind speeds.

Table 4. D2PC Results

Hazard Level		Distance (meters)		
		WND 1 m/s	WND 2 m/s	WND 5 m/s
60-minute AEGL-2	(0.035 mg/m^3)	567	519	462
IDLH	(0.1 mg/m^3)	311	285	254
60-minute AEGL-3	(0.13 mg/m^3)	268	245	218

4 SUMMARY

This assessment calculated hazard distances for a scenario involving movement of undrained M55 rocket warheads. The scenario assumes that a forklift tine strikes one of the canisters with sufficient force to penetrate both the canister and the warhead, resulting in a leak of liquid GB into the spill pan.

Hazard distances calculated were for 60-minute AEGLs and IDLH.

The scenario considers releases that might occur during movement of the warheads from the BGCAPP Main Plant either to the SDC or to buffer storage as well as movement from buffer storage to the SDC. The nearest approach to the installation boundary is 1,600 m. None of the hazard distances came near the installation boundary. The longest hazard distance was for AEGL-2 with a 1 m/s wind, which results in a hazard distance of 567 m.

5 REFERENCES

Crown Packaging Corp., *Rocket Warhead Containerization System – 90% Design Review*, Final Submittal, 4 December 2019.

IEM, WebPuff® v.5.4/BGCA

SAIC, *Public and Worker Risk Due to a Leaking Munition at the Blue Grass Chemical Activity*, RM-10-001, Rev. 1, 2012.

U.S. Environmental Protection Agency (EPA), *The CAMEO® Software System ALOHA® User's Manual*, February 2007.

Whitacre, C. G., J. H. Griner, M. M. Myirski, and D. W. Sloop, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, U.S. Army Chemical Research Development & Engineering Center, CRDEC-TR-87021, 1987.

APPENDIX A. ABBREVIATIONS

AEGL	Acute Exposure Guideline Level
ALOHA®	Areal Locations of Hazardous Atmospheres
BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
cm^2/s	square centimeter(s) per second
g	gram(s)
g/cm^3	gram(s) per cubic centimeter
g/cm s	grams per centimeter-second
GB	Sarin (nerve agent)
IDLH	Immediately Dangerous to Life or Health
J/kg·K	joule(s) per kilogram kelvin
K	kelvin
km (m/s)	kilometer (meters per second)
m	meter(s)
m/s	meter(s) per second
m^2	square meter(s)
mg	milligram(s)
mg/m^3	milligram(s) per cubic meter
mg/min	milligram(s) per minute
mg/mL	milligram(s) per milliliter
mL	milliliter(s)
mm Hg	millimeter(s) of mercury
Pa	pascal(s)
PEO ACWA	Program Executive Office, Assembled Chemical Weapons Alternatives
SDC	Static Detonation Chamber

APPENDIX 1-3
DEVELOPMENT OF MAXIMUM CREDIBLE EVENTS FOR MOVEMENT OF PUNCHED AND DRAINED PALLETIZED M55 ROCKET WARHEADS AT BGCAPP

Risk Management Analysis

Development of Maximum Credible Events for Movement of Punched and Drained Palletized M55 Rocket Warheads at BGCAPP

Site: BGCAPP	Study Number: RM-20-009	Final

This report presents an analysis to define maximum credible events (MCEs), based on a leak and/or explosion occurring during forklift handling and vehicle transport, for movement of punched and drained palletized M55 rocket warheads. Movements may be from the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) Main Plant unpack area (UPA) to an interim storage igloo or Static Detonation Chamber (SDC) facility, or from an igloo to the SDC facility. MCEs are defined based on the number of pallet movements to be performed on a given day. MCEs were developed for 5-days-per-week and 7-days-per-week operations.

Final

October 2020

Prepared for
Program Executive Office, Assembled Chemical Weapons Alternatives

Prepared by

leidos

Revision Log

Rev. #	Date	Summary
Draft	August 2020	Initial submittal
Second Draft	September 2020	Incorporated government comments
Final	October 2020	Incorporated government comments

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1 INTRODUCTION

The U.S. Army is currently in the process of destroying its stockpile of chemical weapons at the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) near Richmond, Kentucky. Recent changes to operations include processing punched and drained sarin (GB) and O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate (VX) M55 rocket warheads in the Static Detonation Chamber (SDC), as opposed to processing them in the Main Plant. The punched and drained warheads are enclosed in steel canisters, placed in metal skids (pallets), and transported either to interim storage in igloos or to the SDC facility.[1] If the warheads were placed into interim storage, an additional transport operation moves them from the igloo to the SDC facility for processing in the SDCs.

The Army has historically used maximum credible events (MCEs) as a way to characterize the hazard associated with operations involving chemical munitions. By definition, MCEs are events with a *reasonable* likelihood of occurrence. In keeping with the guidance developed for the System Safety Management Plan (PMCD 1991), a reasonable probability of occurrence is defined in this report as greater than or equal to 0.0001 per year. (In other words, an MCE is the most severe event that would occur once every 10,000 years of operation). This annual MCE probability is converted to a daily MCE probability by dividing by the maximum number of days per year that an operation would be performed.

1.1 Objective

The objective of this study is to define the MCEs for movement of punched and drained palletized M55 rocket warheads in terms of the number of pallet movements to be performed per day. This is based on the probabilities of forklift or transport vehicle accidents resulting in a leak and/or an explosion.

1.2 Previous Studies

This study uses the methodology and data presented in the following two prior studies:

- Christman, D., *Probabilities of Leaks and Energetic Initiations Due to Drops and Collisions*, Science Applications International Corporation (SAIC) Calculation Note SAF-452-94-0048, Revision 6, Abingdon, Maryland, 2002 (hereinafter SAIC Calc Note)

[1] The SDC facility refers to the SDC 1200 building, the SDC 2000 building, or the associated SDC service magazines.

- SAIC, *Development of Maximum Credible Events to be Used During Stockpile Management Operations,* RM-12-003, Rev. 0, October 2013 (hereinafter Stockpile Management MCEs)

1.3 Approach

The mechanistic analysis calculation approach using Monte Carlo[2] simulations, as presented in the SAIC Calc Note, is utilized for determining the conditional probability of a leak or an explosion occurring due to the following events:

- Forklift tines impact pallet/munitions during movement operations
- Forklift drops pallet during movement operations
- Transport accident (vehicle crash)

The probabilities of the initiating accidents were developed in the Stockpile Management MCEs. The calculated conditional probabilities in combination with the accident probabilities are used to calculate the probabilities of a leak and an explosion during a move. Based on the daily MCE probability and the calculated probabilities of a leak and an explosion, the number of pallets that could be moved per day while staying below the daily MCE probability is calculated for each case.

2 ASSUMPTIONS AND SCOPE

The following assumptions were used in the development of the MCEs. The application of the MCEs is limited to the scenarios described in this report.

a. The movement of pallets from the Main Plant unpack area (UPA) to the igloo assumes one forklift operation (non-swing-mast forklift) at the UPA, vehicle transport[3] of 1 mile to the igloo (or to the SDC facility), and two forklift operations (a non-swing-mast and swing-mast forklift) at the igloo. Forklift operations at the SDC facility assume one non-swing-mast forklift for unloading from the vehicle and one swing-mast forklift for delivery inside the SDC facility. Movements inside the BGCAPP Main Plant or between the SDC service magazine and SDC building are on-site movements and are not within the scope of this analysis.

[2] The values of some of the parameters in the mechanistic models are not certain. The variation of input parameters is judged to be due to random factors. Monte Carlo simulation addresses the uncertainties in the probability distributions by randomly sampling from the distributions of the model parameters.

[3] Transport accidents are a negligible contributor to the risk, so the assumptions on transport distance and speed are not important to the calculated results.

b. The analysis assumes a conservative value of 6 feet[4] for evaluation of forklift drops.

c. The analysis assumes an upper bounding value of 35 miles per hour for vehicle speed during transport.

d. In keeping with the development of typical values, the probabilities used for leakage and explosion are the mean values of the uncertainty distributions developed for previously published quantitative risk assessments for chemical demilitarization facilities.

e. The development of frequencies and probabilities used in this analysis is in accordance with other assumptions listed in the source documents (SAIC Calc Note and Stockpile Management MCEs).

f. A daily MCE probability is determined for each operation based on the annual MCE probability discussed in Section 1 and the anticipated annual number of days in which the operation will be conducted. The analysis considers operations occurring 24 hours per day, 5 days per week, 52 weeks per year (i.e., 260 days of operation per year). Appendix C presents a separate case that considers operations occurring 24 hours per day, 7 days per week, 52 weeks per year (i.e., 365 days per year). The calculation of the daily MCE probability is discussed in Section 5.

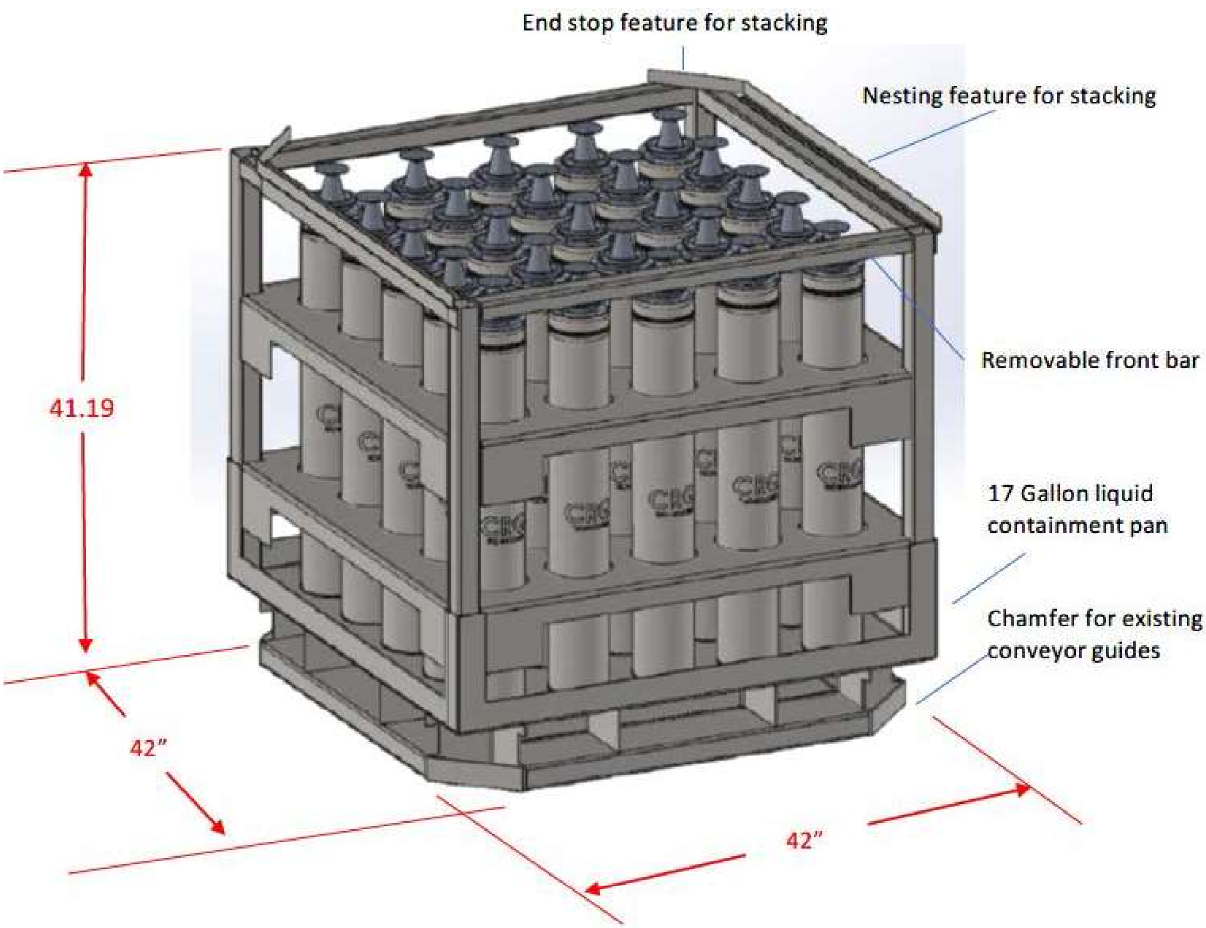
g. If separation of the rocket motor from the warhead is not possible, the reject rocket is overpacked in a single round container (SRC) and set aside for subsequent return to the stockpile. MCEs were previously established for handling and delivery of full rockets (Stockpile Management MCEs) and, therefore, those same MCEs would apply for these rejects.

h. If a warhead is not punched and drained (due to punch/drain failures or problematic munitions lots, the undrained warhead is canned and set aside for subsequent palletization in the same manner as the punched and drained warhead. MCEs are defined for these undrained warheads in a separate report. It should be noted that the additional weight of the undrained agent would result in a slightly greater impact, thereby slightly reducing the number of pallet movements per day.

4 Based on the conservative estimate of the maximum center of mass of the pallet.

3 DESCRIPTION OF PALLET MOVEMENTS

In the Main Plant, rockets—packaged inside shipping and firing tubes (SFTs)—are conveyed into the Explosive Containment Vestibule. The SFT is cut, and the portion of the SFT that covered the warhead is removed and sent to the Motor Packing Room. A second cut is made to separate the exposed warhead section from the rocket motor. The motor, still inside its portion of the SFT, is also sent to the Motor Packing Room. The warhead is transferred to the Explosion Containment Room for punching and draining. The punched and drained warhead, which still contains the M34 and M36 bursters and fuzes, is placed into a steel canister. The canister is sealed and transferred to the Energetics Batch Hydrolyzer Room for palletizing. A pallet holds 25 warheads in canisters, as shown in Figure 1. The pallets are transferred to the UPA. This section describes the pallet movements considered in this study.



Source: Crown Packaging 2019

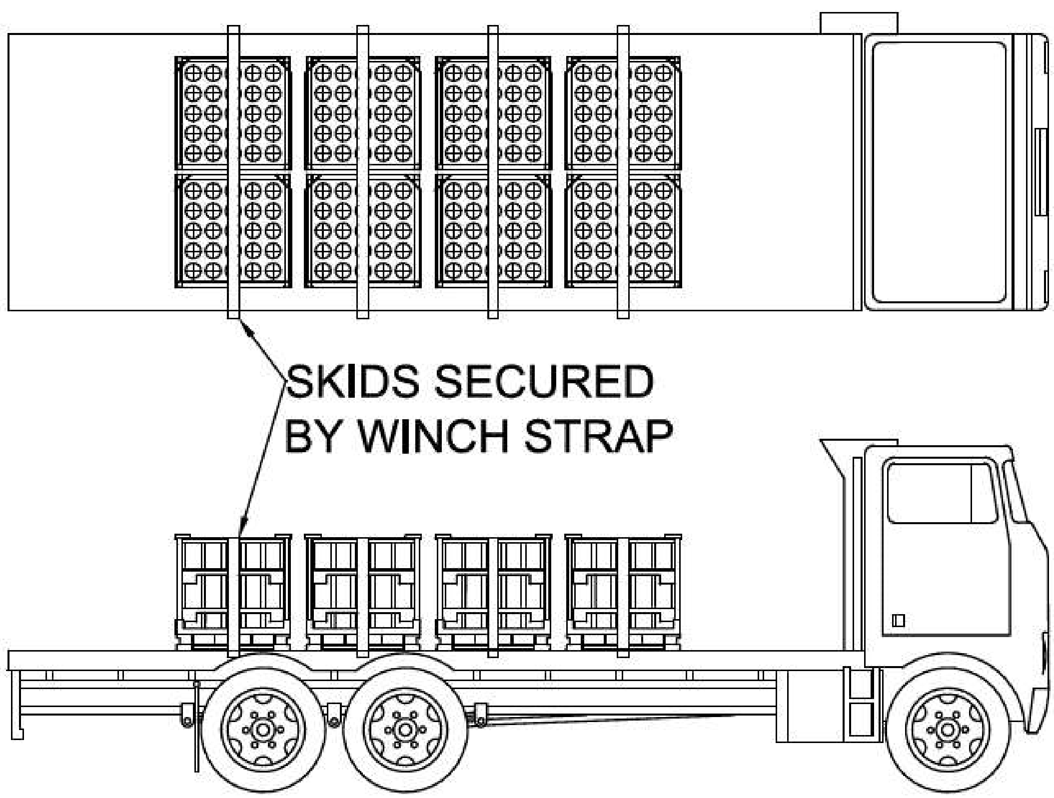
Figure 1. Pallet Configuration

3.1 Forklift Operation at the UPA

A non-swing-mast forklift moves the pallets from the UPA and loads them, one at a time, onto the transport vehicle. Forklift operations include picking up a pallet, moving it to the vehicle, and loading it onto the vehicle. The forklift accidents that could occur during this operation include forklift impacts and drops.

3.2 Vehicle Transport

A maximum of eight pallets are loaded and secured onto the transport vehicle in the configuration shown in Figure 2. After the vehicle is fully loaded, it moves approximately 1 mile from the UPA to the storage igloo, from the UPA to the SDC facility, or from the igloo to the SDC facility. Transport accidents can result from collisions with other vehicles or with structures en route.



Adapted from BGAD/ACWA 2020

Figure 2. Typical Transport Vehicle Skid Configuration

3.3 Forklift Operations at the Igloo

A non-swing-mast forklift unloads/loads pallets from/to the transport vehicle, and a swing-mast forklift delivers pallets to/from the igloo. Forklift operations include unloading a pallet from the vehicle with a non-swing-mast forklift, placing it on the apron, picking up the pallet with a swing-mast forklift, moving the pallet to the interior of the igloo, and placing the pallet in its designated position (or in reverse order if the movement is from the igloo to the SDC facility). The forklift accidents that could occur during this operation include forklift impacts and drops.

3.4 Forklift Operations at the SDC Facility

A non-swing-mast forklift unloads pallets from the transport vehicle, and a swing-mast forklift delivers pallets inside the SDC facility. Forklift operations include unloading a pallet from the vehicle with a non-swing-mast forklift, placing it in the exterior unloading area, picking up the pallet with a swing-mast forklift, moving the pallet to the interior of the SDC facility, and placing the pallet in the designated position. The forklift accidents that could occur during this operation include forklift impacts and drops.

4 ASSIGNMENT OF PROBABILITIES

The accident scenarios described in Section 3 are modeled graphically using an event tree. The event tree includes branches for the initiating event and the mode of the initial agent release. Probabilities are assigned to the branches of the event tree, and the probabilities for each path through the tree are then multiplied together to calculate the overall probability of the accident sequence. The event tree for movement from the UPA to the igloo or from the UPA to the SDC facility is presented in Figure 3. The event tree for movement from the igloo to the SDC facility is presented in Figure 4.

Given a drop or impact, the warhead may: (1) sustain no significant damage, (2) leak agent, or (3) explode. Probabilities for a leak or an explosion are displayed using the event tree. The shaded boxes across the top of the event tree are the *basic events* considered in the tree. Each branch of the tree represents a potential accident progression. Each branch has a label above the line for the nature of the event and includes a conditional probability (see Sections 4.2 and 4.3) below the line. These are referred to as conditional probabilities because they depend on the nature of the preceding events in the tree. For example, the probability of a leak due to the first forklift drop is 8.73×10^{-2}. In other words, approximately 1 out of every 11 such drops (1/0.0873) will result in a leak. The number to the right of each branch is the probability of the branch per pallet (referred to as the *frequency* of the event).

Pallets Handled	Initiating Event	Initial Release Mode	Outcome	Frequency (per pallet)
Pallets Handled 1	Forklift Impact 1 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 1 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09
	Transport Accident 2.38E-08	No Release	No Release	
		Leak 4.69E-05	Leak	1.12E-12
		Explosion 1.53E-06	Explosion	3.64E-14
	Forklift Impact 2 1.20E-05	No Release	No Release	
		Leak <1.0E-10	Leak	<1.2E-15
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 2 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09
	Forklift Impact 3 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 3 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09

Figure 3. Event Tree for M55 Rocket Warhead Movement from UPA to Igloo or SDC Facility

Pallets Handled	Initiating Event	Initial Release Mode	Outcome	Frequency (per pallet)
Pallets Handled 1	Forklift Impact 1 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 1 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09
	Forklift Impact 2 1.20E-05	No Release	No Release	
		Leak <1.0E-10	Leak	<1.2E-15
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 2 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09
	Transport Accident 2.38E-08	No Release	No Release	
		Leak 4.69E-05	Leak	1.12E-12
		Explosion 1.53E-06	Explosion	3.64E-14
	Forklift Impact 3 1.20E-05	No Release	No Release	
		Leak <1.0E-10	Leak	<1.2E-15
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 3 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09
	Forklift Impact 4 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 4 1.20E-05	No Release	No Release	
		Leak 8.73E-02	Leak	1.05E-06
		Explosion 1.94E-04	Explosion	2.33E-09

Figure 4. Event Tree for M55 Rocket Warhead Movement from Igloo to SDC Facility

4.1 Initiating Accident Probabilities

The probability of a forklift upset is assumed to be the same for all forklift operations, whether they occur inside or outside the igloo or involve a drop or an impact. A probability value of 1.2×10^{-5} is used for a forklift impact/drop, based on historical data for typical forklift operations, as described in the Stockpile Management MCEs.

Accidents could also occur when the pallets of warheads are being transported to the igloo. Because the frequency of transportation accidents is based on the distance traveled, an assumption was made regarding the distance between the UPA to the igloo. The analysis assumed a worst-case travel distance of 1 mile, which results in a conservative estimate of the accident frequency. The accident rate of 1.9×10^{-7} per mile, as referenced in the Stockpile Management MCEs, is multiplied by an assumed travel distance of 1 mile to get an overall accident frequency of 1.9×10^{-7} per trip. Assuming there are eight pallets on the transport vehicle, this would correspond to an accident frequency of 2.38×10^{-8} accidents per trip per pallet ($1.9 \times 10^{-7}/8 = 2.38 \times 10^{-8}$).

4.2 Conditional Probabilities of a Leak

An agent leak could be initiated by a puncture of the agent cavity caused by the munition casing failure due to impact with the ground or a rigid structure), forklift impact, or a transport accident. The models used for the impact analysis resulting in leaks are described in detail in the SAIC Calc Note and, therefore, are not elaborated in this study.

4.3 Conditional Probabilities of an Explosion

The explosive components of the warhead could be initiated either by shear energy in the explosive components when the warhead strikes the floor or another object, or by friction between hard surfaces with explosive material in direct contact where it can be initiated by the heat of friction. The burster well, M34 burster, and M36 burster are considered in the analysis. The explosive materials in the fuze are in very small quantities and, even if initiated, would not propagate with the safe-and-arm mechanism in the out-of-line position.

The models used for impact initiation due to shear energy and initiation due to friction are described in detail in the SAIC Calc Note, and, therefore, are not elaborated in this study. Input parameters for the models that differ from the SAIC Calc Note spreadsheet inputs are summarized in Table 1. The differences are based on the following:

- The SAIC Calc Note examines a full M55 rocket in its shipping tube while this study considers just the warhead without the shipping tube.
- The SAIC Calc Note assesses an SRC overpack for the full rocket while this study considers a specially designed canister.

- Full rockets are stored horizontally in wooden pallets while warheads are stored vertically in steel skid pallets.
- Geometry factors are different based on the different dimensions of the canister.
- The mass of the non-swing-mast forklift is lower than the forklift considered in the SAIC Calc Note.

A conservative forklift drop height of 6 feet was used in the modeling. Similarly, a reasonably bounding transport accident speed of 35 miles per hour was used in the modeling.

Table 1. Model Input Values that Differ from Original Assessment

Component	Original Value	New Input Value [a]	New Input Value Notes
Munition mass	57 pounds (for a full rocket)	12.53 lb [b]	M_{WH5} = punched and drained warhead (11.994 lb) + 5% agent heel (0.535 lb)
Pallet of munitions mass	1,340 lb	1,813.25 lb	Munitions (M_{WH5} × 25 munitions) + M_{Pal} (1,500 lb pallet)
Munition + canister mass	121.5 lb	33.87 lb [b]	M_{WH+Can} = M_{WH5} + canister (21.34 lb)
Total loaded pallet mass	1,822 lb	2,346.75 lb	M_{Pal} + (M_{WH+Can} × 25 munitions)
Canister wall thickness	0.065 inches	0.12 inches	
Canister outer diameter	5.5 inches	5 inches	
Canister length	84.75 inches	31.66 inches	
Shipping tube wall thickness	0.1 inches	0.001 inches	To represent no shipping tube
Geometry factors [c]			
Warhead in canister	0.317	0.792	
M34 burster	0.0082	0.211	
M36 burster	0.068	0.023	

Notes:

a Source: Crown Packaging Corporation, *Rocket Warhead Containerization System (RWCS),* 90% Design Review, December 4, 2019.

b Email dated 3 Sep 2020, from T. Williams, BGCAPP Field Office, with Attachment “Disclosure Impacts (Rev. A) 20200902.xlsx”

c Impacts to a munition or component are influenced by the geometry factor. The geometry factors are derived based on the ratio of the surface area of the canister to the surface area of the component.

lb pounds

The mechanistic models were run, and the uncertainty analysis was conducted using Monte Carlo simulations. The resulting conditional probabilities of leak and explosion for each of the initiating events were determined. Table 2 summarizes the results.

Table 2. Calculated Conditional Probability Results for Leak and Explosion

Scenario	Conditional Probability for Leak	Conditional Probability for Explosion
Forklift Impact		
Swing-mast forklift (inside igloo and SDC facility)	0	0
Non-swing-mast forklift (outside igloo and SDC facility)	$<1.0 \times 10^{-10}$	0
Non-swing-mast forklift (at UPA)	0	0
Forklift Drop		
6 feet	8.73×10^{-2}	1.94×10^{-4}
Transport Accident		
35 miles per hour	4.69×10^{-5}	1.53×10^{-6}

Notes:

SDC Static Detonation Chamber
UPA unpack area

5 DETERMINATION OF MCEs

To calculate the MCEs, the frequency of a leak or explosion is first determined using the event tree discussed in Section 4. Then the number of pallets that can be processed in a single day without exceeding the daily MCE probability criterion is calculated for munition leaks and explosions.

The daily MCE probability is established based on the maximum expected number of days per year that the operation would be performed. For warhead transport operations, this is assumed to be 24 hours per day, 5 days per week, 52 weeks per year. Since these activities would not be conducted on the weekend, the resulting estimate of 260 days per year represents an upper bound. As noted in Section 1, a reasonable probability of occurrence is defined in this report as greater than or equal to 0.0001 per year. The daily MCE probability is determined by dividing the annual MCE by the number of days per year that warhead transport operations would occur ($0.0001/260 = 3.85 \times 10^{-7}$).

To determine the total probability of a leak or explosion during the operation, the event tree probabilities (see Figures 3 and 4) of leak or explosion are summed. The total leak probability is 3.14×10^{-6} per pallet and the total explosion probability is 6.98×10^{-9} per pallet for transport from the UPA to the igloo or to the SDC facility. For transport from the igloo to the SDC facility, the total leak and explosion probabilities are 4.19×10^{-6} and 9.31×10^{-9} per pallet, respectively. The MCE calculations are summarized in Table 3. The meaning of each table column is described in the following:

- **Munition** lists the munition to which the MCE applies.
- **Munitions per Pallet** lists the number of munitions in a pallet.
- **Leak Probability per Pallet** lists the total leak probability per pallet. This is the sum of all leak probabilities for forklift impact and drop accidents modeled in the event tree.
- **Explosion Probability per Pallet** lists the total explosion probability per pallet. This is the sum of all explosion probabilities for forklift impact, forklift drop, and transport accident modeled in the event tree.
- **Maximum Pallets per Day to Stay below Leak MCE** calculates the maximum allowable pallet movements that can be performed in a day without exceeding the daily MCE probability for munition leaks. This number is calculated by dividing the daily MCE probability by the total Probability per Pallet value.
- **Maximum Pallets per Day to Stay below Explosion MCE** calculates the maximum allowable pallet movements that can be performed in a day without exceeding the daily MCE probability for munition explosions. This number is calculated by dividing the daily MCE probability by total Explosion Probability per Pallet value.

Table 3. Maximum Number of Pallets per Day for Leaks and Explosions [a]

Route	Leak Probability per Pallet	Explosion Probability per Pallet	Maximum Pallets per Day to Stay below Leak MCE	Maximum Pallets per Day to Stay below Explosion MCE
UPA to Igloo or SDC	3.14×10^{-6}	6.98×10^{-9}	<1	55
Igloo to SDC	4.19×10^{-6}	9.31×10^{-9}	<1	41

Notes:

a Daily MCE probability = 3.85×10^{-7} (annual probability/260 days)

MCE maximum credible event
SDC Static Detonation Chamber
UPA Unpack Area

6 IMPACT OF LEAK OR DETONATION

An upper bound for leakers due to forklift impact or drop is likely to be two. This is based on each forklift tine striking a canister, or a dropped pallet striking a rigid object that impacts two canisters simultaneously.

Based on the demonstration test conducted (Doss 2020), the MCE for the punched and drained M55 rocket warheads is one round in uncontainerized or containerized configuration (no propagation to other warheads). Based on a warhead—located in the center of an outside row of the pallet—exploding (see Figure 5), this analysis assumes there would be 14 leakers.

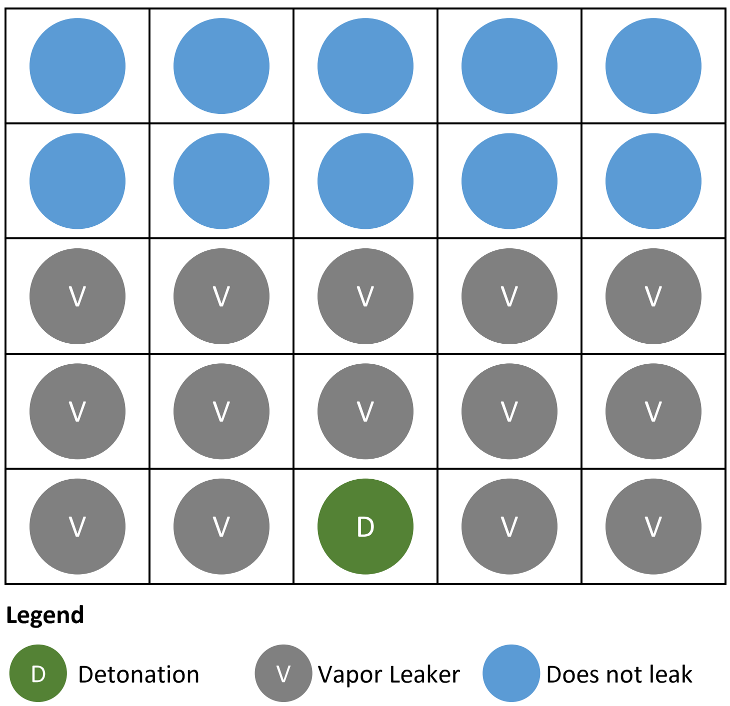


Figure 5. Detonation Impact

7 ANALYSIS OF MOVEMENTS

As described in Section 3, movement of the pallets from the UPA to the igloo or to the SDC facility will involve three forklift operations per pallet. Movement from the igloo to the SDC facility will involve four forklift operations per pallet. Since forklift operations (specifically forklift drops) are the principal driver of the risk, this analysis is based on the total number of forklift operations that can be performed to stay below the explosion MCE limit.

Total forklift operations per day = Number of pallets per day × forklift operations per pallet

Total forklift operations per day = 55 × 3 = 165 (assuming base case is from UPA to igloo)

Table 4 presents various combinations of movements that can be performed per day without exceeding 165 total forklift operations.

Table 4. Maximum Pallets per Day for Various Combination of Movements

Case	UPA to Igloo or SDC Facility (3 forklift operations)	Igloo to SDC Facility (4 forklift operations)	Total Forklift Operations
1	55	0	165
2	41	10	163
3	31	18	165
4	23	24	165
5	13	31	163
6	0	41	164

Notes:

SDC Static Detonation Chamber
UPA unpack area

8 SUMMARY/CONCLUSIONS

This report presents an analysis to define MCEs, based on a leak and/or explosion occurring during forklift handling and vehicle transport, for movement of punched and drained palletized M55 rocket warheads. Movements may be from the BGCAPP Main Plant UPA to an interim storage igloo or SDC facility, or from an igloo to the SDC facility. MCEs are defined based on the number of pallet movements to be performed on a given day.

For movement of 1 to 55 pallets per day from the Main Plant UPA to an igloo or SDC facility, the leak MCE would apply. For movement of 56 or more pallets, the explosion MCE would apply.

For movement of 1 to 41 pallets per day from an igloo to the SDC facility, the leak MCE would apply. For movement of 42 or more pallets, the explosion MCE would apply.

APPENDIX A. ABBREVIATIONS

BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
GB	sarin
MCE	maximum credible event
SAIC	Science Applications International Corporation
SDC	Static Detonation Chamber
SFT	shipping and firing tube
SRC	single round container
UPA	unpack area
VX	O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate

APPENDIX B. REFERENCES

BGAD/ACWA (Blue Grass Army Depot/Assembled Chemical Weapons Alternatives). 2020. *Resource Conservation and Recovery Act (RCRA) Hazardous Waste Storage and Treatment Permit Application, Transportation and Storage of Nerve Agent-Related Items from Blue Grass Chemical Agent Destruction Pilot Plant (BGCAPP)*. Revision 1. July.

Christman, D., 2002. *Probabilities of Leaks and Energetic Initiations Due to Drops and Collisions.* SAIC Calculation Note SAF-452-94-0048, Revision 6. SAIC, Abingdon, Maryland.

Crown Packaging Corporation. 2019. *Rocket Warhead Containerization System (RWCS).* 90% Design Review. December.

Doss, A. W. 2020. Department of the Army Memo. Subject: *Summary and Recommendations for Bluegrass Chemical Agent Destruction Pilot Plant (BGCAPP) 115 mm M55 Rocket Warhead Testing.*, U.S. Army Corps of Engineers, Engineering and Support Center, Huntsville. 24 January.

PMCD (Program Manager for Chemical Demilitarization). 1991. *System Safety Management Plan for the Chemical Stockpile Disposal Program.* Aberdeen Proving Ground, MD. April.

SAIC (Science Applications International Corporation). 2013. *Development of Maximum Credible Events to be Used During Stockpile Management Operations.* RM-12-003, Rev. 0. October.

APPENDIX C. RESULTS FOR 7-DAYS-PER-WEEK OPERATIONS

C.1 Maximum Credible Event Results

Table C-1 summarizes the maximum number of pallets per day for leaks and explosions, based on 365 days of operation per year.

Table C-1. Maximum Number of Pallets per Day for Leaks and Explosions [a]

Route	Leak Probability per Pallet	Explosion Probability per Pallet	Leak Maximum Pallets per Day to Stay Below MCE	Explosion Maximum Pallets per Day to Stay Below MCE
UPA to Igloo or SDC	3.14×10^{-6}	6.98×10^{-9}	<1	39
Igloo to SDC	4.19×10^{-6}	9.31×10^{-9}	<1	29

Notes:

a Daily MCE probability = 2.74×10^{-7} (annual probability/365 days)

MCE maximum credible event
SDC Static Detonation Chamber
UPA unpack area

C.2 Analysis of Movements

Total forklift operations per day = number of pallets per day × forklift operations per pallet

Total forklift operations per day = 39 × 3 = 117 (assuming base case is from unpack area to igloo)

Table C-2 presents various combinations of movements that can be performed per day without exceeding 117 total forklift operations.

Table C-2. Maximum Pallets per Day for Various Combination of Movements

Case	UPA to Igloo or to SDC Facility (3 forklift operations)	Igloo to SDC Facility (4 forklift operations)	Total Forklift Operations
1	39	0	117
2	28	8	116
3	20	14	116
4	15	18	117
5	8	23	116
6	0	29	116

Notes:

SDC Static Detonation Chamber
UPA unpack area

APPENDIX 1-4
DEVELOPMENT OF MAXIMUM CREDIBLE EVENTS FOR MOVEMENT OF UNDRAINED, PALLETIZED M55 ROCKET WARHEADS AT BGCAPP

Risk Management Analysis

Development of Maximum Credible Events for Movement of Undrained, Palletized M55 Rocket Warheads at BGCAPP

Site: BGCAPP	Study Number: RM-20-012

This report presents an analysis to define maximum credible events (MCEs), based on a leak and/or explosion occurring during forklift handling and vehicle transport, for movement of undrained, palletized M55 rocket warheads. Movements may be from the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) Main Plant unpack area (UPA) to an interim storage igloo or Static Detonation Chamber (SDC) facility, or from an igloo to the SDC facility. MCEs are defined based on the number of pallet movements to be performed on a given day. MCEs were developed for 5-days-per-week and 7-days-per-week operations.

Final

October 2020

Prepared for

Program Executive Office, Assembled Chemical Weapons Alternatives

Prepared by

leidos

Revision Log

Rev. #	Date	Summary
Draft	September 2020	Initial submittal
Final	October 2020	Incorporated government comments

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1 INTRODUCTION

The U.S. Army is currently in the process of destroying its stockpile of chemical weapons at the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) near Richmond, Kentucky. Recent changes to operations include processing punched and drained sarin (GB) and O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate (VX) M55 rocket warheads in the Static Detonation Chamber (SDC), as opposed to processing them in the Main Plant. The punched and drained warheads are enclosed in steel canisters, placed in metal skids (pallets), and transported either to interim storage in igloos or to the SDC facility.[1] 1200 or SDC 2000 facility (hereinafter "SDC facility"). If the warheads were placed into interim storage, an additional transport operation moves them from the igloo to the SDC facility for processing in the SDCs. In the event of unsuccessful punching/draining or problematic rejects, the undrained warhead is canned and set aside for subsequent palletization in the same manner as the punched and drained warhead, as described in this report.

The Army has historically used maximum credible events (MCEs) as a way to characterize the hazard associated with operations involving chemical munitions. By definition, MCEs are events with a *reasonable* likelihood of occurrence. In keeping with the guidance developed for the System Safety Management Plan (PMCD 1991), a reasonable probability of occurrence is defined in this report as greater than or equal to 0.0001 per year. (In other words, an MCE is the most severe event that would occur once every 10,000 years of operation). This annual MCE probability is converted to a daily MCE probability by dividing by the maximum number of days per year that an operation would be performed.

1.1 Objective

The objective of this study is to define the MCEs for movement of undrained, palletized M55 rocket warheads in terms of the number of pallet movements to be performed per day. This is based on the probabilities of forklift or transport vehicle accidents resulting in a leak and/or an explosion.

[1] The SDC facility refers to the SDC 1200 building, the SDC 2000 building, or the associated SDC service magazines.

1.2 Previous Studies

This study uses the methodology and data presented in the following two prior studies:

- Christman, D., *Probabilities of Leaks and Energetic Initiations Due to Drops and Collisions*, Science Applications International Corporation (SAIC) Calculation Note SAF-452-94-0048, Revision 6, Abingdon, Maryland, 2002 (hereinafter SAIC Calc Note)

- SAIC, *Development of Maximum Credible Events to be Used During Stockpile Management Operations,* RM-12-003, Rev. 0, October 2013 (hereinafter Stockpile Management MCEs)

1.3 Approach

The mechanistic analysis calculation approach using Monte Carlo[2] simulations, as presented in the SAIC Calc Note, is utilized for determining the conditional probability of a leak or an explosion occurring due to the following events:

- Forklift tines impact pallet/munitions during movement operations
- Forklift drops pallet during movement operations
- Transport accident (vehicle crash)

The probabilities of the initiating accidents were developed in the Stockpile Management MCEs. The calculated conditional probabilities in combination with the accident probabilities are used to calculate the probabilities of a leak and an explosion during a move. Based on the daily MCE probability and the calculated probabilities of a leak and an explosion, the number of pallets that could be moved per day while staying below the daily MCE probability is calculated for each case.

2 ASSUMPTIONS AND SCOPE

The following assumptions were used in the development of the MCEs. The application of the MCEs is limited to the scenarios described in this report.

a. The movement of pallets from the Main Plant unpack area (UPA) to the igloo assumes one forklift operation (non-swing-mast forklift) at the UPA, vehicle transport[3] of 1 mile

[2] The values of some of the parameters in the mechanistic models are not certain. The variation of input parameters is judged to be due to random factors. Monte Carlo simulation addresses the uncertainties in the probability distributions by randomly sampling from the distributions of the model parameters.

[3] Transport accidents are a negligible contributor to the risk, so the assumptions on transport distance and speed are not important to the calculated results.

to the igloo (or to the SDC facility), and two forklift operations (a non-swing-mast and swing-mast forklift) at the igloo. Forklift operations at the SDC facility assume one non-swing-mast forklift for unloading from the vehicle and one swing-mast forklift for delivery inside the SDC facility. Movements inside the BGCAPP Main Plant or between the SDC service magazine and SDC building are on-site movements and are not within the scope of this analysis.

b. The analysis assumes a conservative value of 6 feet[4] for evaluation of forklift drops.

c. The analysis assumes an upper bounding value of 35 miles per hour for vehicle speed during transport.

d. In keeping with the development of typical values, the probabilities used for leakage and explosion are the mean values of the uncertainty distributions developed for previously published quantitative risk assessments for chemical demilitarization facilities.

e. The development of frequencies and probabilities used in this analysis is in accordance with other assumptions listed in the source documents (SAIC Calc Note and Stockpile Management MCEs).

f. A daily MCE probability is determined for each operation based on the annual MCE probability discussed in Section 1 and the anticipated annual number of days in which the operation will be conducted. The analysis considers operations occurring 24 hours per day, 5 days per week, 52 weeks per year (i.e., 260 days of operation per year). Appendix C presents a separate case that considers operations occurring 24 hours per day, 7 days per week, 52 weeks per year (i.e., 365 days per year). The calculation of the daily MCE probability is discussed in Section 5.

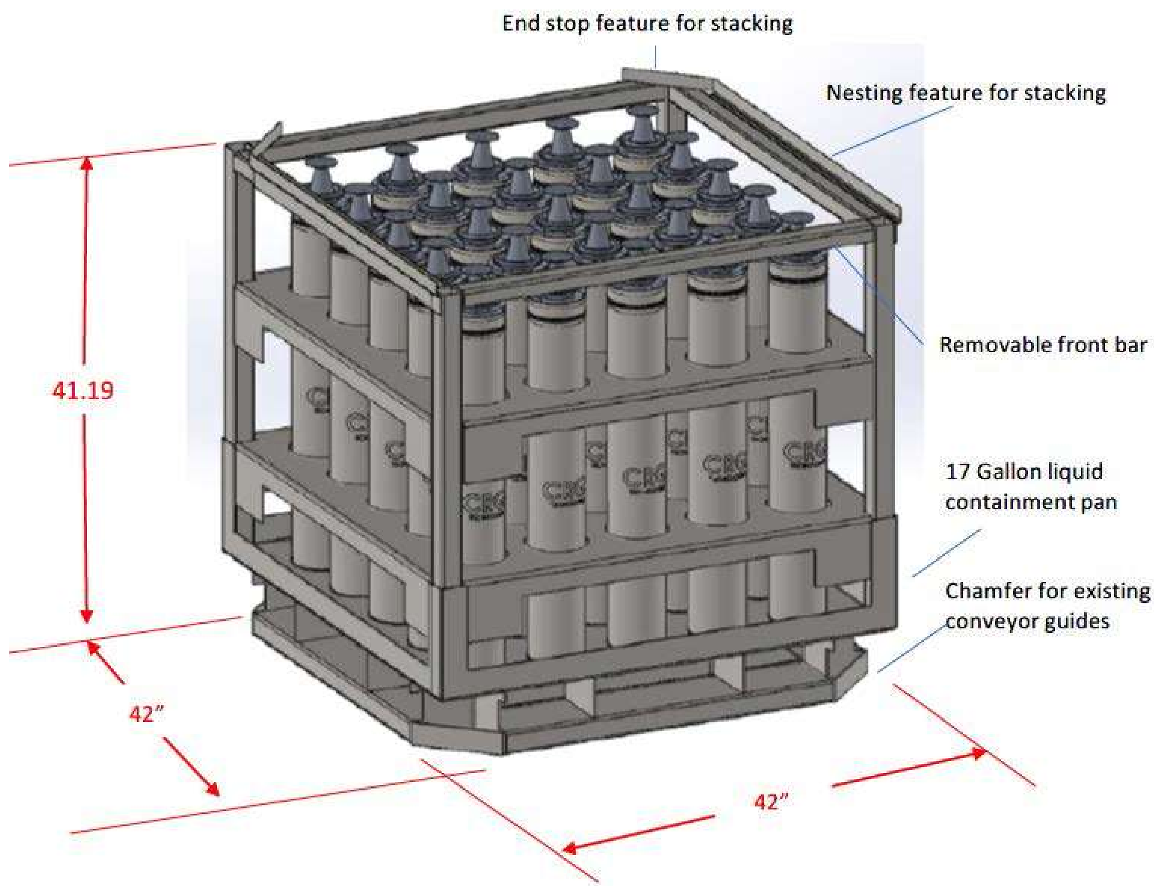
g. If separation of the rocket motor from the warhead is not possible, the reject rocket is overpacked in a single round container (SRC) and set aside for subsequent return to the stockpile. MCEs were previously established for handling and delivery of full rockets (Stockpile Management MCEs) and, therefore, those same MCEs would apply for these rejects.

h. MCEs for pallets of punched and drained rocket warheads in canisters are defined in a separate report. It should be noted that the reduced weight of the warhead (due to drained agent) would result in a slightly reduced impact, thereby slightly increasing the number of pallet movements per day.

[4] Based on the conservative estimate of the maximum center of mass of the pallet.

3 DESCRIPTION OF PALLET MOVEMENTS

In the Main Plant, rockets—packaged inside shipping and firing tubes (SFTs)—are conveyed into the Explosive Containment Vestibule. The SFT is cut, and the portion of the SFT that covered the warhead is removed and sent to the Motor Packing Room. A second cut is made to separate the exposed warhead section from the rocket motor. The motor, still inside its portion of the SFT, is also sent to the Motor Packing Room. The warhead is transferred to the Explosion Containment Room for punching and draining. If the punching and draining operation is unsuccessful, the reject warhead is set aside. In the case of known problematic munition lots, the punching and draining process may be bypassed. The undrained warheads, which still contain the M34 and M36 bursters and fuzes, are placed into steel canisters. The canisters are sealed and transferred to the Energetics Batch Hydrolyzer Room for palletizing. A pallet holds 25 warheads in canisters, as shown in Figure 1. The pallets are transferred to the UPA. This section describes the pallet movements considered in this study.



Source: Crown Packaging 2019

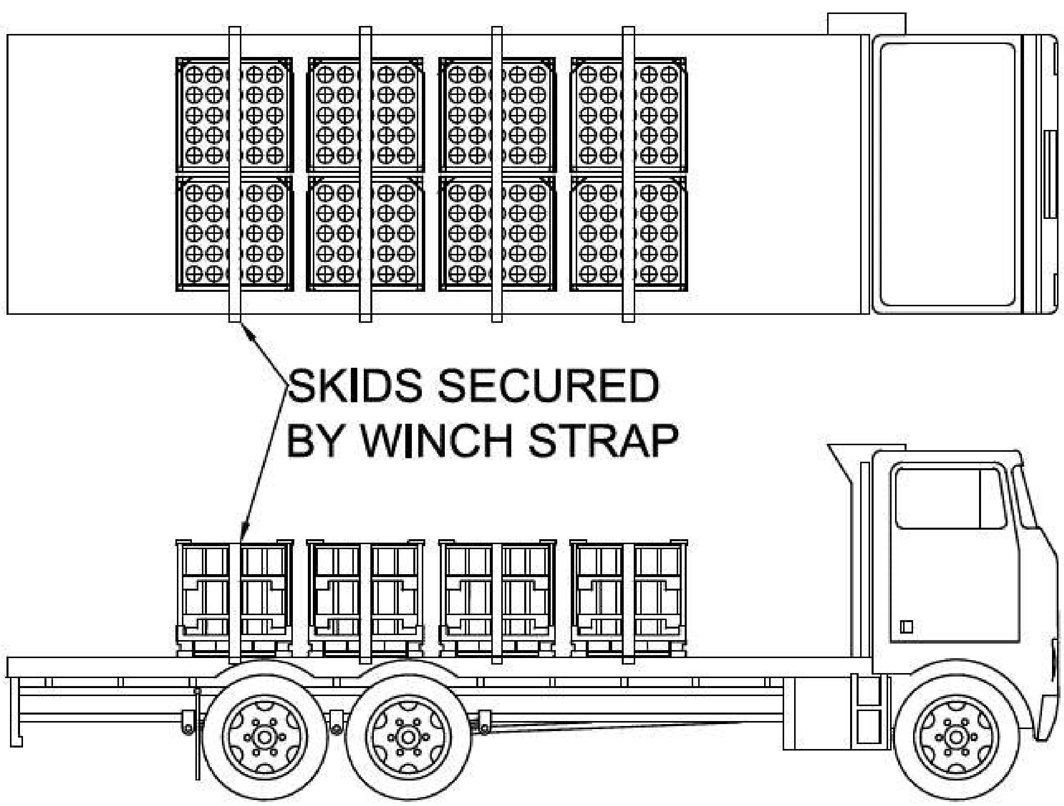
Figure 1. Pallet Configuration

3.1 Forklift Operation at the UPA

A non-swing-mast forklift moves the pallets from the UPA and loads them, one at a time, onto the transport vehicle. Forklift operations include picking up a pallet, moving it to the vehicle, and loading it onto the vehicle. The forklift accidents that could occur during this operation include forklift impacts and drops.

3.2 Vehicle Transport

A maximum of eight pallets are loaded and secured onto the transport vehicle in the configuration shown in Figure 2. After the vehicle is fully loaded, it moves approximately 1 mile from the UPA to the storage igloo, from the UPA to the SDC facility, or from the igloo to the SDC facility. Transport accidents can result from collisions with other vehicles or with structures en route.



Adapted from BGAD/ACWA 2020

Figure 2. Typical Transport Vehicle Skid Configuration

3.3 Forklift Operations at the Igloo

A non-swing-mast forklift unloads/loads pallets from/to the transport vehicle, and a swing-mast forklift delivers pallets to/from the igloo. Forklift operations include unloading a pallet from the vehicle with a non-swing-mast forklift, placing it on the apron, picking up the pallet with a swing-mast forklift, moving the pallet to the interior of the igloo, and placing the pallet in its designated position (or in reverse order if the movement is from the igloo to the SDC facility). The forklift accidents that could occur during this operation include forklift impacts and drops.

3.4 Forklift Operations at the SDC Facility

A non-swing-mast forklift unloads pallets from the transport vehicle, and a swing-mast forklift delivers pallets inside the SDC facility. Forklift operations include unloading a pallet from the vehicle with a non-swing-mast forklift, placing it in the exterior unloading area, picking up the pallet with a swing-mast forklift, moving the pallet to the interior of the SDC facility, and placing the pallet in the designated position. The forklift accidents that could occur during this operation include forklift impacts and drops.

4 ASSIGNMENT OF PROBABILITIES

The accident scenarios described in Section 3 are modeled graphically using an event tree. The event tree includes branches for the initiating event and the mode of the initial agent release. Probabilities are assigned to the branches of the event tree, and the probabilities for each path through the tree are then multiplied together to calculate the overall probability of the accident sequence. The event tree for movement from the UPA to the igloo or from the UPA to the SDC facility is presented in Figure 3. The event tree for movement from the igloo to the SDC facility is presented in Figure 4.

Given a drop or impact, the warhead may: (1) sustain no significant damage, (2) leak agent, or (3) explode. Probabilities for a leak or an explosion are displayed using the event tree. The shaded boxes across the top of the event tree are the *basic events* considered in the tree. Each branch of the tree represents a potential accident progression. Each branch has a label above the line for the nature of the event and includes a conditional probability (see Sections 4.2 and 4.3) below the line. These are referred to as conditional probabilities because they depend on the nature of the preceding events in the tree. For example, the probability of a leak due to the first forklift drop is 9.11×10^{-2}. In other words, approximately 1 out of every 11 such drops (1/0.0911) will result in a leak. The number to the right of each branch is the probability of the branch per pallet (referred to as the *frequency* of the event).

Pallets Handled	Initiating Event	Initial Release Mode	Outcome	Frequency (per pallet)
Pallets Handled 1	Forklift Impact 1 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 1 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09
	Transport Acciden 2.38E-08	No Release	No Release	
		Leak 1.04E-04	Leak	2.48E-12
		Explosion 3.36E-06	Explosion	8.00E-14
	Forklift Impact 2 1.20E-05	No Release	No Release	
		Leak <1.0E-10	Leak	<1.2E-15
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 2 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09
	Forklift Impact 3 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 3 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09

Figure 3. Event Tree for M55 Rocket Warhead Movement from UPA to Igloo or SDC Facility

Pallets Handled	Initiating Event	Initial Release Mode	Outcome	Frequency (per pallet)
Pallets Handled 1	Forklift Impact 1 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 1 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09
	Forklift Impact 2 1.20E-05	No Release	No Release	
		Leak <1.0E-10	Leak	<1.2E-15
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 2 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09
	Transport Accident 2.38E-08	No Release	No Release	
		Leak 1.04E-04	Leak	2.48E-12
		Explosion 3.36E-06	Explosion	8.00E-14
	Forklift Impact3 1.20E-05	No Release	No Release	
		Leak <1.0E-10	Leak	<1.2E-15
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 3 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09
	Forklift Impact 4 1.20E-05	No Release	No Release	
		Leak 0.00E+00	No Leak	
		Explosion 0.00E+00	No Explosion	
	Forklift Drop 4 1.20E-05	No Release	No Release	
		Leak 9.11E-02	Leak	1.09E-06
		Explosion 2.20E-04	Explosion	2.64E-09

Figure 4. Event Tree for M55 Rocket Warhead Movement from Igloo to SDC Facility

4.1 Initiating Accident Probabilities

The probability of a forklift upset is assumed to be the same for all forklift operations, whether they occur inside or outside the igloo or involve a drop or an impact. A probability value of 1.2×10^{-5} is used for a forklift impact/drop, based on historical data for typical forklift operations, as described in the Stockpile Management MCEs.

Accidents could also occur when the pallets of warheads are being transported to the igloo. Because the frequency of transportation accidents is based on the distance traveled, an assumption was made regarding the distance between the UPA to the igloo. The analysis assumed a worst-case travel distance of 1 mile, which results in a conservative estimate of the accident frequency. The accident rate of 1.9×10^{-7} per mile, as referenced in the Stockpile Management MCEs, is multiplied by an assumed travel distance of 1 mile to get an overall accident frequency of 1.9×10^{-7} per trip. Assuming there are eight pallets on the transport vehicle, this would correspond to an accident frequency of 2.38×10^{-8} accidents per trip per pallet ($1.9 \times 10^{-7}/8 = 2.38 \times 10^{-8}$).

4.2 Conditional Probabilities of a Leak

An agent leak could be initiated by a puncture of the agent cavity caused by the munition casing failure due to impact with the ground or a rigid structure), forklift impact, or a transport accident. The models used for the impact analysis resulting in leaks are described in detail in the SAIC Calc Note and, therefore, are not elaborated in this study.

4.3 Conditional Probabilities of an Explosion

The explosive components of the warhead could be initiated either by shear energy in the explosive components when the warhead strikes the floor or another object, or by friction between hard surfaces with explosive material in direct contact where it can be initiated by the heat of friction. The burster well, M34 burster, and M36 burster are considered in the analysis. The explosive materials in the fuze are in very small quantities and, even if initiated, would not propagate with the safe-and-arm mechanism in the out-of-line position.

The models used for impact initiation due to shear energy and initiation due to friction are described in detail in the SAIC Calc Note, and, therefore, are not elaborated in this study. Input parameters for the models that differ from the SAIC Calc Note spreadsheet inputs are summarized in Table 1. The differences are based on the following:

- The SAIC Calc Note examines a full M55 rocket in its shipping tube while this study considers just the warhead without the shipping tube.
- The SAIC Calc Note assesses an SRC overpack for the full rocket while this study considers a specially designed canister.

- Full rockets are stored horizontally in wooden pallets while warheads are stored vertically in steel skid pallets.
- Geometry factors are different based on the different dimensions of the canister.
- The mass of the non-swing-mast forklift is lower than the forklift considered in the SAIC Calc Note.

A conservative forklift drop height of 6 feet was used in the modeling. Similarly, a reasonably bounding transport accident speed of 35 miles per hour was used in the modeling.

Table 1. Model Input Values that Differ from Original Assessment

Component	Original Value	New Input Value [a]	New Input Value Notes
Munition mass	57 pounds (for a full rocket)	22.69 lb [b]	M_{WH} = empty warhead (11.994 lb) + undrained agent (10.7 lb)
Pallet of munitions mass	1,340 lb	2,067.25 lb	Munitions (M_{WH} × 25 munitions) + M_{Pal} (1,500 lb pallet)
Munition + canister mass	121.5 lb	44.03 lb [b]	M_{WH+Can} = M_{WH} + canister (21.34 lb)
Total loaded pallet mass	1,822 lb	2,600.75 lb	M_{Pal} + (M_{WH+Can} × 25 munitions)
Canister wall thickness	0.065 inches	0.12 inches	
Canister outer diameter	5.5 inches	5 inches	
Canister length	84.75 inches	31.66 inches	
Shipping tube wall thickness	0.1 inches	0.001 inches	To represent no shipping tube
Geometry factors [c]			
Warhead in canister	0.317	0.792	
M34 burster	0.0082	0.211	
M36 burster	0.068	0.023	

Notes:

a Source: Crown Packaging Corporation, *Rocket Warhead Containerization System (RWCS),* 90% Design Review, December 4, 2019.
b Email dated 3 Sep 2020, from T. Williams, BGCAPP Field Office, with Attachment "Disclosure Impacts (Rev. A) 20200902.xlsx"
c Impacts to a munition or component are influenced by the geometry factor. The geometry factors are derived based on the ratio of the surface area of the canister to the surface area of the component.

lb pounds

The mechanistic models were run, and the uncertainty analysis was conducted using Monte Carlo simulations. The resulting conditional probabilities of leak and explosion for each of the initiating events were determined. Table 2 summarizes the results.

Table 2. Calculated Conditional Probability Results for Leak and Explosion

Scenario	Conditional Probability for Leak	Conditional Probability for Explosion
Forklift Impact		
Swing-mast forklift (inside igloo and SDC facility)	0	0
Non-swing-mast forklift (outside igloo, SDC facility)	$<1.0 \times 10^{-10}$	0
Non-swing-mast forklift (at UPA)	0	0
Forklift Drop		
6 feet	9.11×10^{-2}	2.2×10^{-4}
Transport Accident		
35 miles per hour	1.04×10^{-4}	3.36×10^{-6}

Notes:

SDC Static Detonation Chamber
UPA unpack area

5 DETERMINATION OF MCEs

To calculate the MCEs, the frequency of a leak or explosion is first determined using the event tree discussed in Section 4. Then the number of pallets that can be processed in a single day without exceeding the daily MCE probability criterion is calculated for munition leaks and explosions.

The daily MCE probability is established based on the maximum expected number of days per year that the operation would be performed. For warhead transport operations, this is assumed to be 24 hours per day, 5 days per week, 52 weeks per year. Since these activities would not be conducted on the weekend, the resulting estimate of 260 days per year represents an upper bound. As noted in Section 1, a reasonable probability of occurrence is defined in this report as greater than or equal to 0.0001 per year. The daily MCE probability is determined by dividing the annual MCE by the number of days per year that warhead transport operations would occur ($0.0001/260 = 3.85 \times 10^{-7}$).

To determine the total probability of a leak or explosion during the operation, the event tree probabilities (see Figures 3 and 4) of leak or explosion are summed. The total leak probability is 3.28×10^{-6} per pallet and the total explosion probability is 7.92×10^{-9} per pallet for transport from the UPA to the igloo or to the SDC facility. For transport from the igloo to the SDC facility, the total leak and explosion probabilities are 4.37×10^{-6} and 1.06×10^{-8} per pallet, respectively. The MCE calculations are summarized in Table 3. The meaning of each table column is described in the following:

- **Munition** lists the munition to which the MCE applies.
- **Munitions per Pallet** lists the number of munitions in a pallet.
- **Leak Probability per Pallet** lists the total leak probability per pallet. This is the sum of all leak probabilities for forklift impact and drop accidents modeled in the event tree.
- **Explosion Probability per Pallet** lists the total explosion probability per pallet. This is the sum of all explosion probabilities for forklift impact, forklift drop, and transport accident modeled in the event tree.
- **Maximum Pallets per Day to Stay below Leak MCE** calculates the maximum allowable pallet movements that can be performed in a day without exceeding the daily MCE probability for munition leaks. This number is calculated by dividing the daily MCE probability by the total Probability per Pallet value.
- **Maximum Pallets per Day to Stay below Explosion MCE** calculates the maximum allowable pallet movements that can be performed in a day without exceeding the daily MCE probability for munition explosions. This number is calculated by dividing the daily MCE probability by total Explosion Probability per Pallet value.

Table 3. Maximum Number of Pallets per Day for Leaks and Explosions [a]

Route	Leak Probability per Pallet	Explosion Probability per Pallet	Maximum Pallets per Day to Stay below Leak MCE	Maximum Pallets per Day to Stay below Explosion MCE
UPA to Igloo or SDC	3.28×10^{-6}	7.92×10^{-9}	<1	48
Igloo to SDC	4.37×10^{-6}	1.06×10^{-8}	<1	36

Notes:

a Daily MCE probability = 3.85×10^{-7} (annual probability/260 days)

MCE maximum credible event
SDC Static Detonation Chamber
UPA Unpack Area

6 IMPACT OF LEAK OR DETONATION

An upper bound for leakers due to forklift impact or drop is likely to be two. This is based on each forklift tine striking a canister, or a dropped pallet striking a rigid object that impacts two canisters simultaneously.

Based on the demonstration test conducted (Doss 2020), the MCE for the punched and drained M55 rocket warheads[5] is one round in uncontainerized or containerized configuration (no propagation to other warheads). Based on a warhead—located in the center of an outside row of the pallet—exploding (see Figure 5), this analysis assumes there would be 14 leakers.

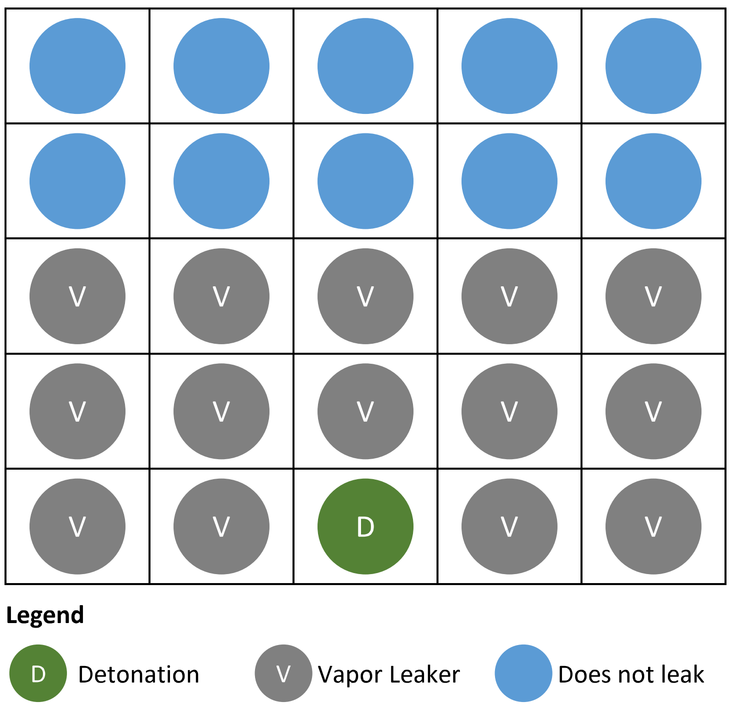


Figure 5. Detonation Impact

[5] The pressure on the outer body of the undrained warhead will be the same as for the punched and drained warheads used in the demonstration test. The pressure on the burster could be minimally less due to the presence of the agent, which will absorb some shock. The burster may face minimally smaller forces; therefore, use of the demonstration test results is conservative.

7 ANALYSIS OF MOVEMENTS

As described in Section 3, movement of the pallets from the UPA to the igloo or to the SDC facility will involve three forklift operations per pallet. Movement from the igloo to the SDC facility will involve four forklift operations per pallet. Since forklift operations (specifically forklift drops) are the principal driver of the risk, this analysis is based on the total number of forklift operations that can be performed to stay below the explosion MCE limit.

Total forklift operations per day = Number of pallets per day × forklift operations per pallet

Total forklift operations per day = 48 × 3 = 144 (assuming base case is from UPA to igloo)

Table 4 presents various combinations of movements that can be performed per day without exceeding 144 total forklift operations.

Table 4. Maximum Pallets per Day for Various Combination of Movements

Case	UPA to Igloo or SDC Facility (3 forklift operations)	Igloo to SDC Facility (4 forklift operations)	Total Forklift Operations
1	48	0	144
2	40	6	144
3	32	12	144
4	24	18	144
5	12	27	144
6	0	36	144

Notes:

SDC Static Detonation Chamber
UPA unpack area

8 SUMMARY/CONCLUSIONS

This report presents an analysis to define MCEs, based on a leak and/or explosion occurring during forklift handling and vehicle transport, for movement of undrained, palletized M55 rocket warheads. Movements may be from the BGCAPP Main Plant UPA to an interim storage igloo or SDC facility, or from an igloo to the SDC facility. MCEs are defined based on the number of pallet movements to be performed on a given day.

For movement of 1 to 48 pallets per day from the Main Plant UPA to an igloo or SDC facility, the leak MCE would apply. For movement of 49 or more pallets, the explosion MCE would apply.

For movement of 1 to 36 pallets per day from an igloo to the SDC facility, the leak MCE would apply. For movement of 37 or more pallets, the explosion MCE would apply.

APPENDIX A. ABBREVIATIONS

BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
GB	sarin
MCE	maximum credible event
SAIC	Science Applications International Corporation
SDC	Static Detonation Chamber
SFT	shipping and firing tube
SRC	single round container
UPA	unpack area
VX	O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate

APPENDIX B. REFERENCES

BGAD/ACWA (Blue Grass Army Depot/Assembled Chemical Weapons Alternatives). 2020. *Resource Conservation and Recovery Act (RCRA) Hazardous Waste Storage and Treatment Permit Application, Transportation and Storage of Nerve Agent-Related Items from Blue Grass Chemical Agent Destruction Pilot Plant (BGCAPP)*. Revision 1. July.

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APPENDIX C. RESULTS FOR 7-DAYS-PER-WEEK OPERATIONS

C.1 Maximum Credible Event Results

Table C-1 summarizes the maximum number of pallets per day for leaks and explosions, based on 365 days of operation per year.

Table C-1. Maximum Number of Pallets per Day for Leaks and Explosions [a]

Route	Leak Probability per Pallet	Explosion Probability per Pallet	Leak Maximum Pallets per Day to Stay Below MCE	Explosion Maximum Pallets per Day to Stay Below MCE
UPA to Igloo or SDC	3.28×10^{-6}	7.92×10^{-9}	<1	34
Igloo to SDC	4.37×10^{-6}	1.06×10^{-8}	<1	25

Notes:

a Daily MCE probability = 2.74×10^{-7} (annual probability/365 days)

MCE maximum credible event
SDC Static Detonation Chamber
UPA unpack area

C.2 Analysis of Movements

Total forklift operations per day = number of pallets per day × forklift operations per pallet

Total forklift operations per day = 34 × 3 = 102 (assuming base case is from unpack area to igloo)

Table C-2 presents various combinations of movements that can be performed per day without exceeding 102 total forklift operations.

Table C-2. Maximum Pallets per Day for Various Combination of Movements

Case	UPA to Igloo or to SDC Facility (3 forklift operations)	Igloo to SDC Facility (4 forklift operations)	Total Forklift Operations
1	34	0	102
2	27	5	101
3	20	10	100
4	12	16	100
5	8	19	100
6	0	25	100

Notes:

SDC Static Detonation Chamber
UPA unpack area