

Preliminary Compilation of Possible Alternative Remedies (March 10, 2015)

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	A	B	C	D	E
Thermal Destruction	CH2M HILL/ Dynasafe/ EXPAL Thermal Treatment-Tunnel Furnace	Clean Harbor Environmental High Efficiency Thermal Oxidation	US Demil Decineration	ATON Microwave incineration and oxidation	CO2AL Exothermic anoxic molten alloy process
Technology type	Thermal Treatment/ Tunnel Furnace	Thermal Oxidation	Decineration	Microwave incineration and oxidation	Molten Alloy Bath
1 Vendor	CH2M Hill	Clean Harbors	U S Demil	ATON	CO2AL
2 Subcontractor	EXPAL	ECC			
3 Need more information from vendor?	Yes	Yes	Yes	Yes	Yes
4 Continuous or batch process	Continuous	Continuous	Continuous	Batch?	Continuous
5 Is it an established technology?	Yes	Yes	Nitrocellulose	Yes	Experimental
6 Is it a proven technology for M6?	No	Yes	No	No	No
7 Company's experience in handling such propellants	Yes	Yes	Yes; deployed in Utah	Gases	None
8 Is technology certified/approved by DDESB?	Not known	Not known	Not known	Not in the US	No
9 Front-end handling experience	Yes	Yes			No
10 Pre-treatment	No				No
11 Setup/installation time	6-9 months; have to fabricate unit	4-8 months	Three units ready; 10-12 weeks	12 months	2-4 months
12 Capacity/throughput	Up to 450 lbs/hr/furnace; 10 months with two furnaces	2,000 lb/hr; 8 months disposal	Three units; 12-18 months	Not known	44 lb batch max
13 Amount of waste (solids or wastewater) excessive or manageable [can it be handled by local facilities (like POTW)]	Acceptable; waste ash disposal	Gases; emissions system; particulates disposal	No waste		Excessive solids
14 Utility requirements (water/gas/electricity)	electric, gas, water needed	Electrical		Not known	
15 Environmental concerns	Emissions/ APCE; Cat converter and baghouse	Emissions/APCE Baghouse	Emissions/APCE	Emissions untreated as presented.	Waste disposal
16 Vendor has relevant Experience	Yes	Yes			No explosive experience
17 Comment	Acceptable capacity	Acceptable capacity; Requires proprietary material handling	Acceptable capacity; not a RCRA process	Lab testing to be done first; sand is added for treatment	0.5 lb aluminum needed for each lb if M6; pilot testing only

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	A	B	C
Combustion	Eldorado Equipment Contained Burn Indoors	Eldorado Equipment Rotary kiln explosive waste incinerator	Ammunition Peculiar Equipment Rotary Kiln Deactivation Furnace
Technology type	Contained Burn	Rotary Kiln Incinerator	Deactivation Furnace (APE 1236)
1 Vendor	Eldorado Engineering	Eldorado Engineering	
2 Subcontractor			
3 Need more information from vendor?	Yes	Yes	Yes
4 Continuous or batch process	Batch/Continuous	Continuous	
5 Is it an established technology?	Yes	Yes	
6 Is it a proven technology for M6?	Proven for similar propellants	Yes (Belgium)	
7 Company's experience in handling such propellants	Yes	Yes	
8 Is technology certified/approved by DDESB?	Yes	Yes	
9 Front-end handling experience	Yes	Yes	
10 Pre-treatment	No	No	
11 Setup/installation time	Built on site (5-6 months)	Built on site (6-12 months build time)	The Army's Program Executive Office - Ammunition (PEO Ammo) indicated the APE (Ammunition Peculiar Equipment) 1236 is not a mobile system. It would take significant construction to emplace a new system (6 – 12 months), and possibly longer to deconstruct a system, move and emplace it at a new location.
12 Capacity/throughput	Estimated 250-370 days to treat M6 based on capacity of 880 lbs/burn cycle, 2-3 burn cycles/hr, 24/7 operations	Scaleable with multiple units - 2.6M lbs/year max per unit Assuming 300 lbs/hr operating 24/7, 150-300 lbs/hour, theoretical max 500 lbs/hr, 24/7 operations	Up to 600 lbs/hour for certain propellants p explosives, and pyrotechnics (PEP) (Bulk High Explosives – Comp B, TNT, Tetryl, Octyl, Black Powder, etc.; Bulk Single & double based propellants and composites; Bulk Pyrotechnics - signal flares, illuminating candles.) The type material determines the actual feed rate. On average the feed rate approximates 250 lbs/hour. The weight of the material processed is not limited to the net explosives weight (i.e., it includes other materials, such as metal parts.) A heavily modified kiln, which is not the current APE 1236 system configuration, could potentially maintain a feed rate of 400 lbs/hour hour maximum (3.2M lbs maximum per year).
13 Amount of waste (solids or wastewater) excessive or manageable (can it be handled by local facilities (like POTW))	Small quantities of pariculate matter Non Hazardous Collected in drums for off site disposal	Small quantities of pariculate matter Non Hazardous Collected in drums for off site disposal	
14 Utility requirements (water/gas/electricity)	Electrical power required	Electrical power required	
15 Environmental concerns	Lower Emissions than open burn. Equiped with pollution control system to treat emmissions. Verified via stack test monitoirng. Demonstrated for M6 below European standards	Equiped with pollution control system to treat emmissions. Verified via stack test monitoirng. Demonstrated for M6 below European standards	A heavily modified kiln, which is not the current APE 1236 system configuration, could potentially maintain a feed rate of 400 lbs/hour hour maximum (3.2M lbs maximum per year).
16 Vendor has relevant Experience	Yes	Yes	
17 Comment	Established technology; M6 expereince	Will burn M6; throughput seems limited for one unit	Designed for conventional end-item munitions.

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	A	B	C	D	E	F	G
	DA VINCH Shock Induced Chemistry	OZM Horizontal Detonation Chambers	Dynasafe Hot Detonation Chambers	Industrial Waste Processor and Caffee Road Thermal Decontamination	Explosives Destruction Systems	Tactical Missile Demilitarization	Donovan Chambers
Detonation							
Technology type	Shock Induced Chemistry	Detonation Chamber	Hot Detonation Chamber	Industrial Waste Processor	Explosives Destruction	Explosives Destruction	Explosive Detonation
1 Vendor	Kobelco	OZM	Dynasafe				
2 Subcontractor							
3 Need more information from vendor?	Yes	Yes	Yes	Yes			
4 Continuous or batch process	Batch?	Batch					
5 Is it an established technology?	Seems to be mainly for chemical munitions		Designed for thermal decomposition/controlled deflagration and burning reactions of high explosives and propellants.				
6 Is it a proven technology for M6?	Did not give an example of pure M6				Not suitable for destruction of M6 or other bulk propellants.		Not suitable for destruction of M6 or other bulk propellants.
7 Company's experience in handling such propellants	Did not give an example of pure Propellants. Did not mention who would be managing the propellants from bunker to unit						
8 Is technology certified/approved by DDESB?	Not known						
9 Front-end handling experience							
10 Pre-treatment							
11 Setup/installation time	Multiple units; one year fabrication						
12 Capacity/throughput	165 lbs/hr, assuming 20 hrs per day due the need to clean it every 10 shots, it will take over 13 years with one unit	Over 50,000 operational hours Over 6,250 operation days based on 8 hr/day Over 17 operational years based on 365 days/year	Has very limited throughput - the maximum detonable quantity allowed inside at any one time is 5.29 lbs of TNT equivalent material (approximately 11 pounds of M-6). The SDC cannot process extremely large amounts of propellant (M6). For example, the Anniston SDC could process (rough estimate) 325,000 pounds of propellant annually.	Net Explosive Weight (NEW) for the IWP is 2 to 10 lbs NEW for the CRTDA is 1 lb.	The containment vessel is designed to handle munitions containing a TNT equivalent of explosives as: Phase 1 = 1.5 lbs and Phase 2 (Retrofit) = 9 lbs	Disposal of up to 10,000 lbs. of ammunition per day through demilitarization, burning, or processing through a deactivation furnace.	System intended for emergency use and not a production environment.
13 Amount of waste (solids or wastewater) excessive or manageable (can it be handled by local facilities (like POTW))	Gas would be tested and recycled until clean.						
14 Utility requirements (water/gas/electricity)	Didn't hear anything on this						
15 Environmental concerns	Residual solid will be tested and disposed appropriately	Real-Time air monitoring should be conducted.	Gases are largely destroyed by explosive effects and pyrolysis in the main chamber. Remaining pyrolysis products and gasses from the explosives are further treated to remove pollutants. Emission factors for this technology were not available at least in literature reviewed for M6. Ambient and direct plume monitoring would be recommended.	Emission factors for this technology were not available at least in literature reviewed for M6. Ambient and direct plume monitoring would be recommended		Emission factors for this technology were not available at least in literature reviewed for M6. Ambient and direct plume monitoring would be recommended	Emission factors for this technology were not available at least in literature reviewed for M6. Ambient and direct plume monitoring would be recommended
16 Vendor has relevant Experience			Yes				
17 Comment	Not suitable for bulk propellants (Army).	Not suitable for bulk propellants (Army).	Not suitable for bulk propellants (Army).	Not suitable for bulk propellants (Army).	Not suitable for bulk propellants (Army).	Not suitable for bulk propellants (Army).	Not suitable for bulk propellants (Army).

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	Hydrolysis ACTODEMIL/ARCTECH Actodemil Non Thermal Humic Acid Catalyzed Hydrolysis	General Atomics SCWO	Munirem Neutralization	Bluegrass Chemical Agent Pilot Plant	FDHS
Technology type	Humic Acid Catalyzed Hydrolysis	Water Based Chemical Treatment	Chemical Treatment	Chemical Agent Pilot Plant	
1 Vendor	Arctech	General Atomics	MuniRem	Bluegrass	Field Deployable Hydrolysis System
2 Subcontractor	OHI				
3 Need more information from vendor?	Yes	Yes	Yes	Yes	Yes
4 Continuous or batch process	Batch	Batch	Batch		
5 Is it an established technology?	Yes	Sounded like they had done test programs for the Army and not full-scale operation.	Yes (tested on small amount of propellants)		Not suitable for M6
6 Is it a proven technology for M6?	Yes	Didn't sound like they had done it specifically for M6	No		
7 Company's experience in handling such propellants	Yes	Did not mention who would be managing the propellants from bunker to unit	Yes		
8 Is technology certified/approved by DDES?	Yes? Not documented	Not known	Not known		
9 Front-end handling experience		No			
10 Pre-treatment		Yes. Prepare slurry	Not required per vendor		
11 Setup/installation time	11 units	13-15 months	Vendor states quick		Army: Can be up and running within 10 days of arriving on a site.
12 Capacity/throughput	11 months (80,000 lb/day)	Multiple units that ranged from 3 gpm to 10 gpm. Mentioned completion in 13 - 15 months. They did not mention how long it would take to get equipment there. Although one is already at Camp Minden	Not known	Timeframe can not be determined based on limited vendor information. Would need system capacity information to estimate.	
13 Amount of waste (solids or wastewater) excessive or manageable [can it be handled by local facilities (like POTW)]	Fertilizer as byproduct. Large quantities of effluent	Will have to deal with excess water	1M lb residue; 2-3M gallon wastewater to be treated at POTW		
14 Utility requirements (water/gas/electricity)	1 M gal water, electrical	Didn't hear anything on this	Not known		
15 Environmental concerns	None	Liquid effluent will be tested prior to discharge	Large tank farm; Uncontrolled reaction of large tanks?		
16 Vendor has relevant Experience	M6 at MCAAP & HWAD		Mainly for nitrocellulose propellants		
17 Comment	Need 50 acres land; fertilizer disposal; 1 M gal of water.	Grind M6 in water to prepare slurry; acceptable capacity; lot fresh water will be required; also large quantity wastewater generated.		Chemical agent pilot plant; small scale	Army - FDHS is not configured to handle flammable liquids or explosive mixtures. Additionally, M6 propellant is made up of relatively insoluble solids; therefore, is unsuitable for a process which relies on being able to mix the intended destruction material with an aqueous liquid.

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	A
Miscellaneous Technologies/Options	EXPAL
Technology type	Export/Recycle
1 Vendor	EXPAL
2 Subcontractor	
3 Need more information from vendor?	Yes
4 Continuous or batch process	
5 Is it an established technology?	
6 Is it a proven technology for M6?	
7 Company's experience in handling such propellants	
8 Is technology certified/approved by DDESB?	
9 Front-end handling experience	
10 Pre-treatment	
11 Setup/installation time	Export
12 Capacity/throughput	24 -33 months. 12 months to transfer propellant into water tight drums 9 months to get DOT approval (concurrent with packaging or prior to starting work) 12 months for recycling
13 Amount of waste (solids or wastewater) excessive or manageable [can it be handled by local facilities (like POTW)]	
14 Utility requirements (water/gas/electricity)	
15 Environmental concerns	Undetermined. Ambient real-time monitoring should be conducted during stabilization and transport. Detonation during stabilization would be a potential hazard that may not be able to be monitored.
16 Vendor has relevant Experience	
17 Comment	<ul style="list-style-type: none"> • Can the M6 be safely transferred into drums for stabilization? • Has DOT been contracted on potential for transportation authorization? • What other regulations will need to be evaluated prior to shipping out of the country? <p style="text-align: right;">Export to Europe; many unknowns</p>