| Capability | Location | Technology Type | Description | | Capacity/Throughput | Status | DDESB Approved |
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| Open Burn (OB) | Various Locations ??? | Destruction | OB has been used to treat energetic wastes by self-sustained combustion, which is ignited by an external source (such as a flame, heat, or detonation wave that does not result in an explosion) (U.S. Environmental Protection Agencey (USEPA), June 1997).<br><br>In the past, OB was frequently conducted on the ground surface or in burn trenches. Current best management practice for OB involves the use of burn pans to contain the energetic waste prior to treatment as well as the residue and ash from the burn. Burn pans typically range in size from 3 to 5 ft. wide by 5 to 20 ft. long and are 1 to 2 ft. deep (USEPA, June 1997). Based on field tests conducted by the U.S. Army, the OB ash/residue from the treatment of bulk propellants is approximately a factor of 10-3 of the original energetic waste mass (U.S. Army, January 1992).<br><br>Because of safety hazards, as well as site specific feasibility factors for alternative treatment technologies, there are certain circumstances and energetic wastes that necessitate the use of OB treatment. | | Typical energetic wastes treated by OB include bulk propellants and energetic material items which are not reliably detonable and/or can be burned without causing an explosion. Occasionally, OB has been used for the treatment of solvents that contain energetic constituents or other energetic-contaminated wastes. Each location has a Resource Conservation and Recovery Act (RCRA) permit which limits the amount of OB which can be performed on a daily and or annual basis. Additional State or local restrictions may exist. | Demonstrated | |
| Contained Burn | ??? | Destruction | Energetic wastes are burned in a blast-reinforced chamber. The combustion gases are contained, treated, and released. | | Regulated by RCRA Permit. | Demonstrated Not in Service | |
| Contained Burn Chamber (CBC) Explosive Service International (ESI) Unit | Camp Minden, LA | Destruction | The Contained Burn System (CBS) is an integrated thermal treatment system designed to demilitarize energetic materials in a safe and environmentally sound manner. The Thermal Treatment Chamber (TTC) processes the energetic material. The Afterburner (AB) System treats the TTC effluent gases. Then the Pollution Abatement System (PAS) removes particulate and Nitrogen Oxide (NOx) from the exhaust stream before it is released into the atmosphere. | | Throughput – 55 thousand lbs. in 24 hours (880 lbs. per pan) of M6 neat propellant | Demonstrated on M6 Propellant only | |
| Bulk Energetics Demil System (BEDS) | Hawthorne Army Depot (HWAD), NV and Radford Army Ammunition Plant (RFAAP), VA | Destruction | Process of disposing bulk propellants and explosives via water slurry feed into a refractory lined rotary kiln incinerator with an afterburner. System includes a pollution abatement system (PAS).. | | Propellants (Single, Double and Triple Based) from cartridges, propelling charges, & bulk propellant from conventional weapons. | Demonstrated (Not currently operational) | |
| Ammonia Perchlorate (AP) Rocket Motor Confined Burn Process | Letterkenny Munition Center, PA | Destruction | Closed disposal process for AP composite grain rocket motors. | | AP composite grain rocket motors up to 680 Lbs. Net Explosive Weight (NEW) or rocket motos segments 505lbs up to 805 lbs. | Demonstrated at Low Rate Initial Production Runs. | |
| Open Detonation (OD) | Various Locations | Destruction | OD has been used to treat waste explosives and certain munition items typically has been conducted directly on the ground surface, in open pits or trenches, or via buried charges (i.e., subsurface detonations). Use of pits, trenches and subsurface detonations reduces the fragmentation hazard associated with the treatment of munition items, as well as minimizing noise.<br><br>Open pits typically range from 10 ft. to 30 ft. in diameter and from 5 ft. to 15 ft. deep (depending on the explosive weight to be treated). Trenches vary in size depending on the quantity to be tested and are usually 4 to 8 ft. wide by 6 to 15 ft. long (USEPA, June 1997). Subsurface detonations usually involve burial of charges with a 2 ft. to 10 ft. soil cover.<br><br>Because of safety hazards, as well as site specific feasibility factors for alternative treatment technologies, there are certain circumstances and energetic wastes that necessitate the use of OD treatment. | | The maximum quantities to be OD treated are measured in terms of NEW the total weight of explosives in the munition. An explosive charge (donor charge) is used to initiate the detonation and increase treatment effectiveness. The donor charge is an explosive being used for its intended purpose, and therefore it is not RCRA regulated but should be accounted for in the characterization and impact assessment of OD operations. Military installations often use Composition C-4 (90 percent Rapid Detonating Explosive (RDX) and 10 percent plasticizer, such as polyisobutylene) as an explosive donor charge for OD operations. The quantity of donor charge used is frequently equal to the NEW of the munitions to be treated but may vary depending on the type of waste energetics/munitions treated (USEPA, June 1997). Each location has a RCRA permit which limits the amount of OD which can be performed on a daily and or annual basis. Additional State or local restrictions may exist. | Demonstrated | |
| Controlled Detonation Chamber (CDC) (also referred to a Donovan Chambers)<br><br>Transportable Controlled Detonation Chambers- (Models T-10, T-25, T-30 and T-60)<br><br>(T60C is approved for use for destruction of certain chemical munitions) | CH2M Hill/Demil International | Destruction | Systems are self-contained and mobile. Have been used to destroyed conventional munitions and explosive components.<br><br>Demonstrated the ability to destroy 105mm HE munitions. (Ref 4) | | Varies based on type munition and CDC used.<br><br>Example: T-10 used at Fort Hunter Liggett, Mare Island, Seal Beach, and Camp Roberts, CA. 28,858 munitions and explosives of concern and code H munitions destroyed in 15 days. Typical throughput is 25 munitions per day.<br><br>T-10 - 13 pounds Trinitrotoluene (TNT) equivalency (up to 81mm mortar)<br>T-25 – 16.7 lbs. TNT equivalency (up to 4.2 in mortar or 4.5 in rocket)<br>T-30 – 40 lb. TNT equivalency (up to 155 mm projectile)<br>T-60 - 40 lb. TNT equivalency (up to 155 mm projectile<br><br>DDESB approved for use at Schofield Barracks, HI, for the destruction of certain chemical munitions.<br><br>System intended for emergency use and not a production environment. CDCs are rate limited and the published max NEW rating includes the donor | Demonstrated | YES |

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| Stationary Contained Detonation | Crane Army Ammunition Activity CAAA, IN | Destruction/Resource, Recovery, and Recycling (R3) | Energetic material (explosives or propellants) is loaded into a gas tight, sealed detonation unit either by hand or robot. Heat is applied to the material until auto-ignition occurs. Expanding gasses are vented and cooled within an expansion tank to reduce pressure before being filtered through an air pollution control unit for discharge to the atmosphere. | | This technology has been evaluated with respect to the types and quantities of explosive waste currently being treated by OD at the Naval Surface Warfare Center Dahlgren -Division (NSWCDD). Not currently in use. | Demonstrated | |
| Static Detonation Chamber (SDC) 1200 CM | Anniston Army Depot (ANAD), AL | Destruction/R3 | The complete SDC system contains a munitions handling and loading system and a detonation chamber with ~~pollution abatement system (~~PAS~~)~~ and a metal scrap disposal system.<br><br>Munitions are dropped into the heated, thick-walled detonation chamber (also called destruction chamber) and rest on a bed of hot metal scrap from previous processed munitions. The heating of the explosives in the munitions and/or pressure generated from the heated liquid agent contents eventually causes the munitions to rupture and add to the scrap bed, which is periodically reduced by a chamber tipping procedure. | | The SDC utilizes batch throughput - the maximum detonable quantity allowed inside at any one time is 5.29 lbs. of TNT equivalent material of Hazard Class (HC) 1.1 Material. Higher limit exists for 1.2 HC material. | Demonstrated on limited munition items | |
| Static Fire | Various Locations | Destruction/R3 | Static Fires is used to treat rocket and missile motors and other munition items conducive to the process. Munitions are placed in mounting stands or silos and secured. The items are then ignited using an electrical charge.<br><br>Because of safety hazards, as well as site specific feasibility factors for alternative treatment technologies, there are certain circumstances and energetic wastes that necessitate the use of Static Fire treatment. | | Typically used for large rocket and missile motors. | Demonstrated | |
| Decineration | US Demil | Destruction/R3 | A non-incinerative, thermal process that occurs at ambient pressure and moderate temperature of approximately 400-900° F in an externally electrically heated rotary tube without contact between heating source and munitions components. When energetic is applied to the surface it begins to decompose via the breaking of various molecular bonds. | | Capable of processing Small Arms Ammunition, Propellant Actuated Device (PAD)/Cartridge Activated Devices (CAD), Bulk Explosive (RDX), various other items requiring preprocessing. Throughput determined by feed stream. NEW limit not known. | Demonstrated<br>(on limited munition items) | |
| Ammunition Peculiar Equipment (APE)-1236 Rotary Kiln Incinerator (Deactivation Furnace) | CAAA, IN, Tooele Army Depot (TEAD), UT, McAlester Army Ammunition Plant (MCAAP), OK, HWAD, NV | Destruction/R3 | APE 1236M2 consists of the following: deactivation retort, afterburner, cyclone, ceramic baghouse, draft fan, control panel, gas sampling system, and connecting ducting. It also includes: automatic feed system, feed and discharge conveyors, fuel oil and propane storage tanks, oil pump, and final exhaust stack. | | Feed rates up to 600 lbs./hour with an average feed rate of approximately 240 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.) The APE 1236 will accommodate demilitarization of small arms ammunition, primers, fuzes, and boosters. They can be used to flash 75MM through 120MM projectiles after washout of explosive charge; and to deactivate drained chemical bombs, rockets, grenades and other miscellaneous items.<br>Maximum acceptable dimensions of material which can be fed into the furnace is approximately 5" diameter by 18" length. Feed rate limited by safety and environmental considerations. | Demonstrated | |
| Field Deployable Hydrolysis System (FDHS) | Edgewood, MD | Destruction | The FDHS is a transportable, high throughput neutralization system designed to convert chemical warfare materiel into compounds not usable as weapons.<br><br>TheFDHS is a self-sufficient system that includes power generators and a laboratory that is fully capable out of the box, needing only consumable materials such as water, reagents and fuel to operate. It can be set-up within 10 days and is equipped with redundant critical systems that ensure maximum system availability. Once onsite a crew of 15 trained personnel, including subject matter expert (SME) support, is needed each shift for 24/7 operational capability.<br><br>Designed to destroy chemical warfare agents in bulk. Possible liquid waste stream. | | FDHS is not configured to handle flammable liquids or explosive mixtures. Process flows using the appropriate chemistry achieve 99.9 percent destruction.<br><br>The titanium reactor has a 2,200-gallon capacity and throughput varies from five to 25 metric tons per day, depending on the material being treated. To increase throughput rates, multiple units can be co-located onsite. | Demonstrated | |
| Stationary Base Hydrolysis Oxidation | TEAD, UT , RFAAP, VA | Destruction | Energetic wastes are mixed with a strong base and heated to 90-150° C. This causes the waste to be decomposed into a water soluble product.<br><br>If the solid particles are filetered out, potential to use as a pre-treatment for super critical water oxidation (unproven). | | Technology used on CAD/PAD devices with aluminum bodies at TEAD.<br><br>Batch feed up to 122 pounds staggered every 30 minutes.<br><br>The base used for the reaction must be periodically replaced and neutralized for disposal. | Demonstrated | |
| Industrial Waste Processor (IWP) and Caffee Road Thermal Decontamination Area (CRTDA) | Indian Head, MD | Destruction | Processes explosives contaminated materials from an initial "trace explosives "to a final "releasable to the public" condition. | | NEW for the IWP is 2 lbs. Hazard Division (HD) (HD 1.1) or 10 lbs. (HD 1.3) NEW for the CRTDA is 1 lb. (HD 1.1) or 1 lbs. (HD 1.3). | Demonstrated | |

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| Explosives Destruction System (EDS) Phase 1 and Phase 2 (Retrofit) Units | Various locations<br><br>Phase 2 (Pueblo Chemical Depot). | Destruction | The U.S. Army Chemical Materials Agency's (CMA) Non-Stockpile Chemical Material Project (NSCMP) designed the EDS with Sandia National Laboratories to provide on-site treatment of chemical warfare material. Designed for chemical munitions destruction by external (implosion) detonation<br><br>EDS is capable of treating chemical munitions with a variety of different fills (e.g., treat Mustard, Phosgene, G-series agents, VX, Lewisite, Cyanogen Chloride, Hydrogen Cyanide, and Chloropicrin.) | | The containment vessels is designed to handle munitions containing a TNT-equivalent of explosives as listed below:<br>Phase 1 = 1.5 lbs.<br>Phase 2 = 4.8 lb.<br>Phase 2 (Retrofit) = 9 lbs.<br>Phase 1 can processes three items at once including: 4.2-inch mortars, 75 mm artillery shells, live projectiles and bomblets.<br>Phase 2 and Phase 2 (Retrofit) can processes six munitions at one time, including: 4.2-inch mortars, 75 mm artillery shells, 105 mm projectiles, 155 mm projectiles and 8-inch projectiles.<br><br>Successfully completed missions at Aberdeen Proving Ground (APG), MD., Spring Valley, Washington, D.C., Dover Air Force Base, DE., Former Camp Sibert, AL., Pine Bluff Arsenal, AK., Rocky Mountain Arsenal, CO., and Redstone Arsenal, AL. Testing for the EDS was conducted at Porton Down, United Kingdom and APG. | Demonstrated | |
| ICM R3 Process (M42/M46 Submunitions) | HWAD, NV | Disassembly/R3 | Fully automated method for recovering Comp A-5 and copper cones from M42/M46 submunitions using a mechanical milling approach. Metal cases containing explosive residues and remaining fuze treated thru rotary kiln. | | M42 and M46 Submunitions Contain 28 grams nominal Composition A-5 explosive. Feed rate not finalized. | Prototype Demonstrated (Total system not completed for production) | |
| M77 Grenade Thermal Treatment Closed Disposal Process (TTCDP) | ANAD, AL | Destruction/R3 | Multistage process where M77 Grenades are processed from Multiple Launch Rocket System (MLRS) rockets. Grenades fuzes are sheared off and processed in the Munitions Destruction System (MDS) which indirectly heats the fuzes inside an armored chamber. Copper cone are removed from the grenades and recycled. The grenades are then inverted and the explosive ignited via electric heated coils that are moved into the grenades. Off-gasses are processed through a High Efficiency Particulate Air (HEPA) filter system. | | M77 Grenades containing 28 grams nominal of composition A-5 at a maximum rate of 2400 grenades per hour. M77 grenades are downloaded from MLRS M26 rockets. | Demonstrated | |
| Cryofracture | MCAAP, OK<br>CAAA, IN | Destruction | Submerge munitions into a liquid nitrogen cryobath, then cooled in the cryobath until a suitable temperature is met. Once pulled from the cryobath the munition is placed in a hydraulic press which will fracture (access) the munition items exposing the energetic. The energetic material is processed through a rotary kiln system for incineration. | | Artillery Denial Artillery Munitions (ADAM) Submunitions, contained approximately 28 grams comp A-5, can be processed at a rate of 6 mines/ minute. | Demonstrated (Process currently undergoing system upgrades) | |
| APE 2271 Super Pull Apart Machine (SPAM) | TEAD, UT | Disassembly/Destruction | APE 2271 consists of the following: An in-feed station, a pull-apart station, a projectile conveyance system, a powder hopper, a primer function station and a cartridge case conveyance system. The powder hopper can be attached to a separate propellant powder collection system. The Primer function station is vented to a wet scrubber system which exhausts to the outside. | | Capable of processing 20MM through 40MM Grenade.<br><br>Propellant downloaded from cartridges is subsequently demil'd using other capabilities, mostly OB.<br><br>Any projectiles containing depleted uranium (DU) are provided to a qualified contractor for storage. | Demonstrated | |
| Tactical Missile Demilitarization (TMD) | Letterkenny Army Depot (LEAD), PA | Disassembly | System used to section and destroy large tactical missiles ;<br>Recover high value energetics from propellant and warhead feedstocks | | Disposal of up to 10,000 lbs. of ammunition per day through demilitarization, burning, or processing through a deactivation furnace. | Demonstrated | |
| Munition Disassembly | Various Locations | Disassembly | Many munition items require disassembly prior to treatment of the explosive components. Manual and automated operations are used to mechanically separate and/or cut the munition items. Disassembly reduces material requiring OB/OD while increasing the R3 potential. Disassembly operations increase risk to personnel through additional handling. | | Varies based on requirements of the specific munition item. | Demonstrated | |
| Molten Salt Oxidation (MSO) | Republic of Korea (ROK) | Waste Stream Treatment/Destruction | A bed of molten salt, usually a mixture of sodium carbonate and potassium carbonate, oxidizes organic material at ~850 degrees C. Volatile organic compounds in the waste feed material are broken up into their constituents; Chlorine, sulfur, phosphorous, etc., and are converted into inorganic salts and retained within the salt bed. Inorganic compounds and heavy metals sink into the melt and accumulate at the bottom where they remain in-situ. The Pollution Control System (PCS) removes entrained salt in the exhaust stream and treats the exhaust stream to achieve acceptable levels of Oxides Of Nitrogen (NOX), Carbon Monoxide (CO), Carbon Dioxide (CO2), and other Korea Environmental Preservation Association (KEPA) regulated gases. The PCS utilizes a salt trap and bag house filters to remove the entrained salt. An ammonia-injected catalytic converter reduces NOX and CO levels. A bank of Horiba gas analyzers monitors the stack gases from the PCS. | | The ROK MSO system processed TNT contaminated carbon slurry and other melt-out waste streams at a rate of 14 kg/hr. A slurry consists of 25% TNT contaminated carbon by weight.<br><br>The ROK MSO suffered from reliability issues surrounding corrosion of the inlet piping at or below the salt level in the reactor. Operation was halted after extended downtimes. | Demonstrated (Process requires further refinement before being used again in a production setting.) | |

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| Hot Gas Decontamination (HGD) Facility | HWAD, NV | Waste Stream Treatment | HGD has been recognized as an effective method to remove surface contamination of volatile organic energetic material. The technique has been shown to be effective for nondestructive decontaminating of production equipment and other items that would be completely destroyed using the conventional decontamination methods of flashing.<br><br>HGD operates by exposing munitions or equipment (located in a decontamination chamber) that are contaminated with explosive residue to a flow of hot gas, at a temperature as low as 500° F, to volatize and/or thermally degrade the explosives. The vapors of the explosive compounds are then directed to a thermal oxidizer where they are destroyed under controlled conditions. The explosives are mineralized, that is, converted to low molecular weight inorganic compounds, predominately carbon dioxide and water. A small amount of NOX are produced from the nitrogen content of the explosives themselves but oxidizer conditions are controlled to minimize NOX formation from combustion air. | | The explosives limit for the decontamination chamber itself is 5 lbs. NEW of HD 1.1. This limit is based solely on available distance, not on the most probable NEW expected at the decontamination chamber. | Demonstrated | |
| Super Critical Water Oxidation (SCWO) Industrial SCWO (iSCWO) | SCWO currently at ROK is scheduled to be decommissioned.<br><br>iSCWO planned for Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) | Waste Stream Treatment | A liquid/slurry feed stream is brought to conditions above its thermodynamic critical point of 374°C (705°F) and 3,206 psi (pounds per square inch), allowing complete oxidation of organic materials.<br><br>CO2, Dihydrogen Monoxide (water) (H2O), and salts, with NOX, Sulfur Dioxide (SOX), and particulate concentrations at or below detection limits, all without any post-treatment. | | ROK SCWO has a throughput of 1.2 Gallons Per Minute (GPM) with water being returned to the boiler for reuse in melt-out operations.<br><br>iSCWO systems have a 3 GPM throughput with water being exhausted after treatment.<br><br>A 10 GPM iSCWO was developed for Blue Grass Army Depot (BGAD) for processing propellant. Program was canceled after loss of funding. Slurry grind was required to process propellant. | Demonstrated | |
| Munirem Energetic Neutralization | Munirem | Explosive Residue or Waste Stream Treatment | Technology utilizing reduction chemistry to chemically neutralize and degrade explosives and chemical warfare materials (CWM), while also stabilizing metals as the insoluble metal sulfides. | | Disposal of up to 10,000 lbs. of ammunition per day through demilitarization, burning, or processing through a deactivation furnace. | Demonstrated (for explosive residue treatment only) | |
| APE 1400 White Phosphorous (WP) - Phosphoric Acid Conversion Plant | CAAA, IN | R3 | The APE 1400 acid conversion plant consists of two systems, the feed system and the acid plant system.<br><br>The two systems consist of a 115-ton punch, a converted APE 1236 furnace, hydrator, initial demister-separator, two negative pressure draft fans, a final demister, water cooling tower, acid cooling heat exchanger, acid filtering unit, acid storage tanks, rail and tanker truck acid loading stations, and an emergency generator in the event of power failure.<br><br>Downloaded munitions (fuzes, detonators and explosives removed) are punched in the 115 ton hydraulic press to expose the WP/RP and then sent through the converted APE 1236 rotating kiln furnace for burning. The resultant smoke is drawn out of the furnace by a negative-pressure closed loop ducting system and routed into the acid plant system for conversion to phosphoric acid. | | The white phosphorus plant converts obsolete and reject white phosphorus and red phosphorus (RP) from chemical munitions to phosphoric acid and reclaims the empty shells and acid for resale.<br><br>Throughput is dependent on munition item. Currently operational. | Demonstrated | |
| Yellow D/Ammonium Picrate Chemical Conversion Plant | CAAA, IN | R3 | Process uses high pressure water to remove Ammonium Picrate explosive fills which is then chemically converted into Picric Acid for commercial sale. | | 3,000lbs of ammonium picrate converted in 24 hour period. | Demonstrated | |
| APE 1412 Small Arms Ammunition Spent Brass Sorter | Various Locations | R3 | The APE 1412 SBS is used to provide rapid sorting of mixed small caliber ammunition cases from live ammunition. It is capable of separating cases by type, as well, and is designed to work with cases ranging in size from 9mm to .50-caliber. The system checks for both the absence of a projectile and a struck primer for identifying a spent case. Major components consist of a Mixed Bulk Ammunition Container, a Feed System, a Computerized Ammunition Detection System, and a Sorting System that sorts ammunition and sends them to a series of bins, arranged by caliber and type. | | The APE 1412 is designed to work with cases ranging in size from 9mm to .50-caliber. This includes 9mm, .357 magnum, .40 caliber, .45 caliber, 5.56mm, .300 caliber, 7.62mm, .338 caliber, AK-47 round cases (7.62 x 39), and .50 caliber. | Demonstrated | |
| APE 1401M2 Autoclave Meltout | MCAAP, OK<br>HWAD, NV<br>ROK | R3 | The APE 1401M1 Autoclave Meltout System removes and recovers melt-able main charge explosives from various munitions by steam heating the exterior of a group of ammunition items that are mounted on a projectile carousel placed inside an autoclave. As the explosive inside the ammunition heats up it melts, the explosive drains out and is collected in a melt kettle. The normal cycle time is 60 minutes. | | 100-200 pounds explosive per hour per autoclave, process is optimized for TNT removal, but can remove other meltable explosives, such as Composition B with pilot testing. | Demonstrated | |
| High Pressure Water Washout | HWAD, NV | R3 | Upgrade low-pressure washout facility to utilize higher-pressure water and hence lower overall water consumption. | | Washout energetic fills from three inch, five inch and six inch 105/106MM, 120MM, 165MM and 81MM projectile rounds. Process demonstrated for 5 inch projectile removal of Comp A-3 only. | Demonstrated | |
| Munitions Residue Inspection System (MRIS) | HWAD, NV | R3 | Uses machine vision and unique software to fully automate visual inspection process for inspection of residual explosives in demilitarized munitions. | | 81MM and 105MM have been tested. | Demonstrated | |
| APE 2048 Metal Parts Flashing Furnace | TEAD-, UT<br>BGAD, KY<br>ROK | R3 | The APE 2048 Flashing Furnace System is used to flash explosives from metal so that the metal can be sold to the general public. It can be used as part of a "R3" facility to decontaminate processed munitions. It is not used to flash explosively contaminated waste. | | 105mm Cartridges to 750 lb. bombs; can only decontaminate metal parts which have a light contamination of energetic waste, not for thermal treatment of explosives/energetics. | Demonstrated | |
| Energetics Recovery / Reuse | Various Locations | R3 | Bulk recovery of explosives for reuse. Explosives are typically recovered for use as donor material for OD operations. Reuse in commercial applications has proven challenging due to ebb and flow of demand verses large supply of stocks and safety issues associated with loss of propellant lot identity during processing. | | Various munition items and throughputs. | Demonstrated | |

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| Commercial Conversion or Commercial Resale | | R3 | Chemical conversion of recovered explosives and propellants to form other products. Commercial resale involves the sale of obsolete U.S. munitions to foreign governments. | | This alternative only occurs when the scale of recovery can be performed safely, the final products are commercially viable, and there is a receiving customer. Explosives used in mining and quarry are generally "ANFO like" materials (ammonium nitrate and fuel oil) and the use of a nonconventional blast explosive must be approved by the state's Fire Marshall. This only occurs when there is a continuous source of a material, the product is ensured to be safe for the environment (which rules out perchlorate containing propellant and recovered products that contain traces of heavy metals), and there are industries willing to use the product. Since Dahlgren does not process enough material for commercial interests, and since the waste stream at NSWC Dahlgren generated in local research and development programs is mixed and unpredictable and only amounts to around a total NEW of 30,000 pounds a year, a program for commercial recovery is not viable. | Demonstrated (Supply outpaces Commercial Demand leading to stockpiling and safety risk) | |

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| Capability | Location | Technology Type | Description | Capacity/Throughput | Status | DDESB Approved |
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| Acid Digestion | TEAD | Chemical Conversion | Acid hydrolysis of steel CADs/PADs.<br>Phase I of three phases of the Acid Hydrolysis of munitions project was started in FY08. Project Management drafted a schedule, work breakdown structure (WBS) and established a working earned value management (EVM) report. Phase I activities included a design basis study on the corrosion effects of acid on different types of metals. The study included literature reviews using several types of public, commercial, and government databases. A Design Basis Document was drafted that identifies the design objectives and requirements for the acid hydrolysis process. Equipment was designed and built for the performance of corrosion tests with various metal specimens in acid solutions at General Atomics (GA). Equipment was also designed and built for corrosion beaker testing of live munitions at TEAD in Phase II. | Throughput Rate Testing with stainless steel (SS) and carbon steel (CS) coupons was conducted. CS coupon test showed that after two hours the reaction was not complete and the off-gas was still brown in color. SS coupon test initially experienced temperature issues from the exothermic reaction. The test was scaled back to one coupon versus six and after two hours elapsed time the coupon showed no obvious sign of corrosion. | Not Demonstrated (Feasibility study showed poor results) | |
| Adams Sulfur Oxidation | | Destruction | Patented method that relies on the reactivity of elemental sulfur vapor to destroy organic materials at temperatures of 500 to 600 °C. Liquid agent and sulfur vapor are fed to a reactor that is maintained at a constant temperature. The gas leaving the reactor contains nitrogen and unreacted sulfur vapor along with products of the reaction such as carbon disulfide, hydrogen sulfide, carbonyl sulfide, disulfur dichloride, thiophosgene, and hydrochloric acid. | This process was identified as a possible treatment method for disposing of chemical agents (in bulk containers and in munitions) within the U.S. stockpile. It has been evaluated using Nitrocellulose, Nitroglycerin-based propellant M30, fuze containing lead azide, Comp B, and malathion (surrogate for chemical agent GB), and PCBs. | Not Demonstrated | |
| Charged Particle Beam | | Destruction | Energetic charged (electron and proton) particle beams can penetrate significant distances into dense media and deposit significant fractions of their energy in the form of secondary electrons, gamma rays, x-rays, and neutrons. Such energy deposition can lead to heating, melting, material dispersal and thermal shock. The electron beams can be used to detonate high explosives. | It has been shown experimentally that under proper conditions both sensitive and insensitive high explosives can be detonated by electronic beams. However, the technology to efficiently deliver electron beams of sufficient energy and current in the field has not been demonstrated. Research is ongoing at Lawrence Livermore National Laboratory. This technology has not been demonstrated in the field and has therefore been dismissed from further evaluation. | Not Demonstrated | |
| Electrochemical Oxidation | | Destruction | An electrochemical cell is used to destroy organic waste. Organic liquids are oxidized either directly be metal ions or by other oxidizing compounds produced from a reaction involving the metal ions. | This process has been proposed as a possible alternative for treating chemical warfare agent but is not applicable to metal parts, energetics, or dunnage. A substantial research and development program for the application of this technology would be required. This technology has not been demonstrated in the field and has therefore been dismissed from further evaluation. | Not Demonstrated | |
| Hypergolic Non-Detonative Neutralization | | Destruction | Amine compounds are reacted with bulk TNT, RDX, and Comp B, leading to a breakdown of the explosive materials without detonation, deflagration, or uncontrolled cook-off. | The high costs of degrading explosives by this method have discouraged further research and development of this technology. | Not Demonstrated | |
| Molten Metal | | Destruction | Metals such as copper, iron, or cobalt are used at high temperatures (3,000°F) to thermally decompose organic compounds. Inorganics are dissolved to form a slag that is insoluble in the liquid metal and rises to the top of the vessel where it can be removed (skimmed off the top). | The molten metal furnace and catalytic extraction process are essentially developed technologies as they are very similar to those used in steel production. However, the use of these technologies in the destruction of chemical agents, munitions, or propellants has not been tested or evaluated. This technology has not been demonstrated in the field and has therefore been dismissed from further evaluation. | Not Demonstrated | |
| Peroxydisulfate Oxidation | | Destruction | Peroxydisulfate salts can be used to oxidize organic compounds to CO2. | This technology has been proposed as a potential treatment method for wastes generated during chemical agent detoxification. However, this process has not been shown to be applicable to contaminated metal parts or energetics. This technology has not been demonstrated in the field and has therefore been dismissed from further evaluation. | Not Demonstrated | |
| Wet Air Oxidation | | Destruction | Organic materials in a dilute aqueous mixture are oxidized at elevated temperatures and pressures, detoxifying and converting residual organics to carbon dioxide. Waste products generated are residues of the propellant, high carbon oxygen demand (COD) and low biological oxygen demand (BOD) for further wastewater treatment. | Despite long residence times, refractory organic compounds remain. Application of this process to the treatment of energetics will require additional research and pilot plant studies. This technology has not been demonstrated in the field and has therefore been dismissed from further evaluation. | Not Demonstrated | |
| CryoPlasma Demil System (CPDS) | CAAA, IN | Destruction | Small-to-medium sized, fully-assembled munitions that contain significant quantities of energetic materials treated by cryofracturing the material then introducing the exposed energetic to a plasma arc thermal treatment process. | Maximum NEW: 0.75 lbs. every 15 seconds<br>Maximum total weight: 10 lbs. every 15 seconds<br>Maximum NEW per Press Cycle: 3.0 lbs. per minute | Not Demonstrated | |
| Tactical Demilitarization Development (TaDD) | HWAD | Destruction | Contained burn system capable of demilitarizing multiple types of small tactical rocket and missile motors. | Designed for Shillelagh missile motors that contain high levels of lead. | Not Demonstrated | |
| Plasma Arc Incineration (Plasma Ordanance Disposition System--PODS) | HWAD/CAAA | Destruction | Process developed for treatment of smokes and dyes. The process ueses electric current to heat gasses to 5000 – 15000C dissociating waste into atomic elements. The dissociated elements re-combine into environmentally safe products. Concept proven for municipal waste where organic waste is heated and converted into a gas which is fed into a plasma arc for refining to be used for electricity generation. Remaining solid waste is fed into another plasma arc to be melted and cooled into an inert slag. Has the potential to create volatile metals which must be sent to appropriate air scrubbers within an off-gas treatment. Effective at converting asbestos containing material into safe, inert solids. | This technology failed to be demonstrated as an effective technology for explosive hazardous waste. The demonstration project conducted at NSWC Crane ended without transitioning the technology to use. One of the problems was the electrodes continued to burn out in presence of he energy of the explosives. Estimation for capital costs ranged from $3 to $12 million dollars and the technology would fall under incinerator permit and would not be able to meet the National Emission Standards for Hazardous Air Pollutants (NESHAP Subpart EEEE emissions standards. The capability demonstration at Hawthorne resulted in repeated clogging of PODs system and pollution ababement system due to heavy particulate produced during HC smoke burning. | Not Demonstrated (Dismissed due to PAS clogging and reliability issues) | |
| Fluidized Bed Incineration | | Destruction | A fluidized bed is a dense, uniform suspension of solids (usually sand) maintained in a turbulent motion by upward moving air, behaving as a fluid. When fluidized, all particles are suspended and fully exposed to the gas stream increasing the surface area available for reaction. Combustible solids are dispersed rapidly and are held for a long enough time to achieve high combustion efficiencies. | Influent solid waste requires significant size reduction (shredding) and the removal of alkali metals. Solid waste feed particles in a bubbling fluidized bed combustor and a rotating fluidized bed combustor must be <10mm and <30mm respectively. Off-gases can be treated; however, effluent products can contain high amounts of mercury salts.<br>Requires long start-up time to bring the bed to the required temperature and the bed material must be regularly replenished. This technology requires pretreatment processes which may cause accidental detonation of the feed stream, introducing safety hazards and risks to personnel/equipment, and has therefore been dismissed from further evaluation. | Not Demonstrated (Dismissed due to safety hazards and risks to personnel/equipment.) | |

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| Liquid Ammonia Extraction (NH3 Washout) | | Destruction | High pressure anhydrous liquid ammonia is sprayed onto solid composite propellant, eroding and completing high particulate comminution of the propellant. The resulting slurry is filtered and gasified, precipitating the propellant. | | This process requires the propellant to be removed from the munition item and reduced to less than ½ inch prior to treatment. Due to the unstable nature of most items, manual removal of the propellant causes safety hazards to onsite personnel. This technology requires pretreatment processes which may cause accidental detonation of the feed stream, introducing safety hazards and risks to personnel/equipment, and has therefore been dismissed from further evaluation. | Not Demonstrated (Dismissed due to safety hazards and risks to personnel/equipment.) | |
| Demilitarization by Inductive Heating Meltout (DIHME) | HWAD, NV | Destruction | Design, develop, install, test and transition a pilot production system for the demilitarizing of 60-mm M49A4 and M49A2 mortars based on abrasive water jet cutting and dielectric meltout. | | Water jet cutting proved unfeasible and created secondary waste stream. Attempts made without cutting created issues with slugs of explosive and hot spots. | Not Demonstrated (Decommissioned) | |
| Co-Firing Boilers | | Destruction/R3 | Energetics are desensitized so that they can be co-fired with traditional fuels in commercial boilers for heat. | | Not a cost effective solution due to quick burning of energetics, and small feed stream. | Not Demonstrated (tests were not operated long enough to demonstrate reliability and long-term operation.) | |
| Flashless Powder | | R3 | Process for recovering and developing flashless powders for small arms ammunition from demilitarized field artillery charges. | | Project was ended before completion. Successfully produced flashless powder for .45 cal, 9mm and .40 Smith & Wesson (S&W). | Not Demonstrated | |
| Photocatalytic Conversion | Oklahoma State University | Waste Stream Treatment | Explosives and other energetic materials are catalytically converted to useful chemicals by metalloporphyrins using sunlight. | | | Not Demonstrated | |
| Surplus Energetics Reprocessing Pilot Plant | Commercial | R3 | Process of pressing reclaimed bulk explosives into boosters and other explosive charges for mining and other commercial industry use. | | Tested using PBXN-106 and Comp A-3. Commercial demand could not support large quantities produced. Further investigation would be required. | Not Demonstrated | |
| Actodemil/Humic Acid Processing<br><br>Propellant Conversion to Fertilizer (PCF) | | R3 | Process that uses Humic Acid solutions to reacts with propellants and other enegetics in a reaction vessel at 160 to 180º F. (Ref 1) Neutralized material available for disposal or further refinement into potential fertilzer product. | | Pre-designed units of 100, 200 or 500 pounds per batch. Batches take between 2 and 4 hours. Has been tested on M6 | Not Demonstrated (No longer being pursued due to process controll issues and heavy metal contamination of fertilizer end product.) | |
| Blasting Agent Manufacturing (BAM) | HWAD, NV | R3 | This technology converts large grain gun propellants to commercial blasting agents for the open-air mining industry. Conversion process involves mixing the bulk propellant with a binder/gelling agent and then manually dispensing mix into shot bags. | | Multiple types of gun propellants, no demonstrated commercial market. | Not Demonstrated (Abandoned for safety consideration, loss of lot identity) | |
| Microwave Meltout/Explosive Removal/Conversion | | R3 | The ability to use microwave energy to safely melt Tritonal. Microwave heating is an inherent safety problem because microwave heating is not temperature limiting and has the potential to create excessive temperatures. | | | Not Demonstrated (Abandoned for safety considerations) | |
| Pyrotechnic Recovery (Magnesium (MG) Recovery) | CAAA, IN | R3 | Development of a non-destructive demilitarization process, through which MG could be recovered in a form suitable for reuse in pyrotechnics manufacture. | | No military munitions market, recovers old MG which may be oxidized or the wrong type/grade. | Not Demonstrated (Decommissioned) | |
| Octogen, Homocyclonite (cyclotetramethylenetetranitramine) (HMX) Recovery & Requalification | LEAD, PA | R3 | Recover HMX from various explosives and requalify for use in new weapon systems. Testing performed by both Naval Surface Warfare Center (NSWC) Indian Head and Los Alamos National Laboratory (LANL) showed that the recovered HMX performs equally as well as formulations with virgin HMX in both Plastic Bonded Explosive (PBXN)-113 and PBXN-114 explosives. | | 600lb/batch. Not a cost effetive process, removes HMX which is of an obsolete type and grade. | Not Demonstrated (Lack of interest in recovered HMX) | |

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