CONTAINED BURN PROCESS DESCRIPTION AND APPLICATIONS

Contained Burning is a technology and method that is commonly thought of as "open burning indoors." Materials can be prepared and ignited similar to traditional open burning operations but the exhaust gasses are contained and cleaned prior to release. The design of the pollution control system to scrub the off gases is tailored to the chemistry of the materials being treated.

Technology Description

Contained burn and contained detonation systems have been developed, tested, and implemented at a number of different locations for different workload types as a closed disposal alternative to open burning and open detonation (OB/OD). The technological approach for contained burn typically involves a thermal treatment chamber (TTC) containment vessel or tank in which waste materials are burned. In some applications the wastes are placed inside the vessel and ignited as a batch; in other applications wastes are fed semi-continuously into the vessel where they are ignited. The vessel captures the combustion gases which are then exhausted through a pollution control system. Gases are usually filtered though high efficiency filters to remove particulates and can be ducted through wet or dry scrubbers—depending upon the chemical contaminants in the gases—before being vented through a conventional stack. Because there is no "controlled flame device" in the thermal treatment chamber, contained burn and contained detonation facilities can be permitted as RCRA Subpart X miscellaneous treatment units rather than as incinerators. Contained burn systems typically require significantly more equipment than OB/OD, but considerably less equipment than incineration.

Contained Burn System Components

The basic components of a contained burn system include a containment vessel, a feed system, an ignition source, a pollution control system, operating controls, and a draft fan and stack.

Containment Vessel

The containment vessel is typically a mild steel cylindrical tank, although other shapes are viable. If products of combustion are chemically aggressive, then other materials may be utilized.

For some applications, the tank is an ASME designed pressure vessel. These applications include those cases where it is desirable to contain all the combustion gases until they have cooled to a desired temperature, or until test sampling can be completed. The pressure rating is dependent upon the amount of Propellant, Energetics, and Pyrotechnics, (PEP) to be burned versus the tank size, as well as the temperature requirements for the gases. These applications run as batch operations, and valve trains and control logic are used to achieve gas capture, and to meter the exhaust gas at the proper flow rate and temperature conditions to the pollution control system. A key advantage for this type of system is that the pollution control equipment for batch operations can be relatively small and thus economical.

In other applications, the vessel does not need to be pressure rated. In these cases, feed may be batch, continuous, or semi-continuous, and a draft fan in the system continuously draws the

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products of combustion through the pollution control system. This arrangement provides for a negative operating pressure throughout operations so that a pressure rated tank with gas tight seals is not required. In order to reduce gas temperatures to levels appropriate for pollution control systems, the addition of a gas cooler or the introduction of cooling air prior to the pollution control system is usually required.

The containment vessel is sized to provide sufficient air for complete combustion of the waste materials, and is designed to withstand the process operating conditions regarding pressure, temperature, and chemical compatibility. The vessel is also designed with regards to safety to ensure that personnel and equipment are protected in the case of a maximum credible event.

Feed System

Like the vessel itself, the feed system design is determined by the type and quantity of material to be treated. The system is designed to accommodate a batch process or semi-continuous process depending on the nature of the materials to maximize throughput and minimize personnel handling of the waste material, which minimizes risk.

In some applications, batches of waste are placed on a burn pan which is loaded into the vessel which is then closed and sealed. The waste is ignited, and is configured so that all of the material can burn without additional operator intervention.

In a tactical missile disposal system, operation is a batch process, with the convenient batch size usually a single rocket motor. Two types of systems have been developed for rocket motors which either place only the nozzle end into the vessel in a through-the-wall configuration or place the entire motor in the chamber for firing. Special holding fixtures are required to restrain the motor during firing.

If the system is designed for continuous or semi-continuous operation, the feed system must allow for the feeding of waste without exposing the operator to risks. If the vessel operates at a negative pressure, then gated chutes and tubes may be used to feed the waste to the ignition source. The system must be designed such that waste being fed into the vessel is directed to the ignition source to ensure ignition and burning. If a significant amount of bottom ash or metallic waste is left over from combustion, provisions must also be made for removal and cooling. In all systems, the waste preparation and feed operations must receive a rigorous and disciplined hazards analysis to ensure operator safety.

Ignition Source

In batch systems for bulk energetics, an electrically actuated ignition source is used with wiring that penetrates through the vessel wall so that it can be remotely controlled by an external operator.

Each item in a contained burn batch may have its own ignition system. In the case of a tactical missile disposal system, for example, the onboard ignition system of the missile may be used, if it is available and reliable. Depending on the reliability and condition of the onboard ignition system for the motor, an alternative ignition system may be utilized as a backup or as the primary ignition system.

For contained burn systems it is important that the material configuration and ignition source be utilized so that the energetic material burns and is not detonated. This generally is achieved by treatment of unconfined materials which are ignited with a “soft” ignition source which ignites the material via thermal means, without inducing shock.

In all cases, the ignition procedures should be carefully examined for hazards. In the case of automatic systems or pressure-rated systems the ignition system is interlocked with other equipment such as sealing valves and fans to ensure waste does not ignite until it is safe for it to do so.

Pollution Control System

Pollution control systems are tailored to the exact waste profile being treated. The components of the system may have several common elements, as detailed herein. If the system is a pressure rated operation, then gases are held in the tank until a predetermined temperature or pressure has been reached. In these systems, large particulate may settle out in the vessel itself, while the gas and fine particulate matter leaves the tanks at a suitable temperature for scrubbing. Pollution control systems may include wet or dry scrubbing.

The pollution control elements as described herein can be incorporated by design into the system according to the materials being treated and the pollution control requirements.

Venturi Style Wet Scrubber. This element utilizes a high pressure drop with fine water droplets at high velocity to remove particulate as well as scrubbing soluble species from the exhaust gas. The fine water spray also cools the gases. It is effective in scrubbing exhaust with a high quantity of soluble acid gases, such as HCl. It can remove particulate efficiently but is not as cost effective for removal of very small particulate as low temperature fabric filters (baghouses) and HEPA filters as smaller particulate sizes require higher pressure drop and energy usage for wet scrubbing. Once removed the acid gases must be neutralized, which typically results in a brine secondary waste stream. Particulate must also be filtered out and becomes a secondary waste stream of wet filter cake.

Spray Tower/Demister. This element typically follows the venture scrubber and utilizes water spray and plates or packing to create surface area to further remove soluble species such as acid gases.

Afterburner. The purpose of the afterburner is to raise the temperature of the exhaust gases to ensure the complete combustion of any partially reacted species such as methane, other volatile organgic compounds, or carbon monoxide. The El Dorado Engineering, Inc. (EDE) afterburner is designed to heat the exhaust up to the required temperature with a minimum residence time of two seconds for regulatory compliance.

Recuperator. A heat recuperator can be used to transfer heat from hot exhaust gases to preheat incoming combustion air resulting in fuel and energy savings.

Cyclone. A cyclone is used to remove larger particulate matter. Particulate is collected below the cyclone's hopper in a sealed disposable drum for convenient disposal.

Gas Cooler. The gas cooling system is designed to cool gases to the proper temperature for downstream pollution control elements, such as low temperature filtration units (e.g., baghouse). The gas cooler is designed with a well proven automated cleaning system, and designed specifically for challenging applications to prevent bridging or plugging of the gas cooler with particulate. Particulate is collected below the hopper in a sealed disposable drum for convenient disposal.

Low-Temperature Baghouse. The baghouse is a fabric-filtration collector, used for efficient particulate cleansing of the gas stream. The baghouse is automatically cleaned via a reverse pulse air jet to ensure proper operation and low maintenance. Particulate is collected below the hopper in a sealed disposable drum for convenient disposal.

Spray Dryer or Dry Sorbent Injection. A spray dryer is used to spray a fine mist of water to cool exhaust gases. The water may be supplied as a chemical solution with caustic materials to neutralize acid gases if they are present. A dry sorbent injection system can be used as an alternative to avoid water handling, which utilizes powdered caustic material injected upstream of the baghouse to remove and neutralize acid gases. Neutral salts are then collected as solid particulate in the baghouse.

High Temperature Ceramic Filters. These elements can be used instead of a baghouse to filter particulate without the requirement for cooling the gases. However, there are potential problems with toxic metals such as lead escaping filters as vapors at elevated temperatures. There are also concerns from environmental regulators regarding the potential formation of dioxins and furans in elevated temperature filters.

HEPA Filter. A HEPA filter is located downstream of the baghouse to provide ultra high efficient >99.9 % particulate filtration. This also acts as a guard for downstream equipment which may be incorporated (e.g., SCR) in the unlikely case a bag ruptures upstream. This removes particulate matter to levels below what normally exist in a home or office. This type of filtration is used in manufacturing clean rooms and hospitals, and far exceeds regulatory standards.

Ammonia Injection with SNCR. An SNCR (selective non catalytic reduction) system can typically provide 50 – 60% NOx reduction. The system is designed with an ammonia (NH_3) injection system and a high temperature reaction zone with the proper temperature, mixing, and residence time conditions to achieve maximum removal efficiency.

SCR. An SCR (selective catalytic reduction) system also utilizes ammonia injection with a proprietary catalyst formulation to achieve 90% or better NOx reduction. This system is recognized as best available control technology for NOx reduction. The catalyst provides for efficient removal of NOx at relatively low temperatures. This approach also provides an extra benefit of reducing dioxins, which are actually reacted and eliminated by the catalyst in this system rather than collected as with other alternative technologies.

This system has been successfully employed and proven at waste incinerator installations to meet stringent limits in many countries including the U.S., Netherlands, Italy, Japan, France, and Belgium.

The SCR system is based on the addition of ammonia to the NOx-containing flue gas and passing the mixture over an active catalyst. This converts the nitrogen oxides (NO and NO_2) to naturally occurring nitrogen (N_2) and water (H_2O). The proprietary design used by EDE provides high-activity catalyst and low pressure drop which results in more efficient NOx removal with lower energy consumption when compared to other commercial SCR NOx control technologies

Packed Bed Scrubber. A packed bed scrubber can be utilized with appropriately designed media to remove other constituents of concern which are not efficiently removed by other systems. EDE has utilized a proprietary packed bed scrubber to successfully and efficiently (>95%) remove dioxin and furan species from exhaust gases resulting from highly chlorinated energetic materials.

Activated Carbon Bed. Specially designed activated carbon can also be used to remove targeted species of concern. EDE has successfully used activated carbon beds to remove Mercury (Hg) from exhaust gases resulting from the combustion of munitions containing mercury fulminate. This system is capable of >99% Hg removal.

ID Fan/Stack. The Induced Draft (ID) fan provides negative pressure throughout the entire system and draws exhaust gases through the pollution control system to exit out the stack. When the fan is placed at the end of the equipment train, all vessels, joints and equipment operate at negative pressure to minimize fugitive emissions. The gases are exhausted through a stack of appropriate height, which includes sampling ports.

Permitting

Contained burn systems are typically permitted as miscellaneous units under RCRA Part B, subpart X. Most states also require an air permit.

Example Applications of Contained Burn Technology

Small Scale Batch Contained Burn Unit

A manufacturer of air bag propellants commissioned EDE to design a contained burn system capable of batch operations with 60 lbs. of waste propellants per batch. EDE designed a one-sixth scale unit to test and demonstrate the technology on a wide variety of propellant types prior to full-scale design. The test vessel was four feet in diameter and ten feet long, rated to a working pressure of 110 psi. (See Figure 1). The vessel was instrumented to collect pressure, temperature, exhaust flow rate, and emissions data. In Phase I testing, ignition and burn tests were conducted outside of the vessel to determine if the materials could be directly or secondarily ignited, and if the materials would sustain burning. In Phase II, testing within the vessel started with small batches and increased to ten pound batches to determine if the vessel would perform as designed and to validate and calibrate all instrumentation. In Phase III, all candidate materials were burned within the vessel to characterize operations. All of the propellants burned acceptably. In propellant burns, the pressure reached a peak of about 50 psi within about 50 seconds, and then cooled to about 10 psi in another 50 seconds. Most of the particulates settled out in the tank, and the remaining gases were vented through pollution control equipment.

Figure 1. Small Scale Batch Contained Burn

In all, over 200 test burns were conducted. Residues were tested for reactivity using differential scanning calorimetry and found to be non-reactive. Ash was also tested for regulated leachable products, and none were found.

Based on these test results, a full-scale system was designed with eight feet diameter vessels, thirty feet long. The multiple vessel system design was capable of approximately 500,000 pounds disposal per year, however, the manufacturer was able to open burn the propellants so the full-scale system was not constructed.

Australia

A similar small scale system was provided by EDE to a commercial facility in Australia, which has successfully utilized the system for contained burning of a wide variety of propellant and energetic materials.

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Semi-Continuous Feed Units (Multiple Locations)

This application (See Figure 2.) is a continuous feed, negative pressure system. The primary containment vessel in the pictured system is twelve feet in diameter and 30 feet long, which houses multiple feed stations. Specially designed burn barrels are located inside the vessel at each station, each equipped with an ignition source. Prepackaged wastes are fed at each station, with a specialized design to prevent overfeeding or propagation from the vessel to the feed load. Special design features include a rigorous blast analysis to determine the configuration of equipment inside the vessel, with provision for adequate combustion air. Gases are cooled by the addition of air downstream of the vessel, and emissions are ducted through a cyclone, baghouse and HEPA filter.

A thermocouple automatically determines the amount of cooling air added, and system alarms are based on vessel temperature and pre-cyclone temperatures. This system is capable of 20,000 pounds per year net explosive weight (NEW), and 40,000 pounds per year contaminated trash.

Figure 2. Semi-continuous system uses solid fuel as ignition source for wastes

Multiple systems of this type have been provided by EDE to commercial clients throughout the U.S., and used primarily to treat primary and secondary explosives, single base and double base propellants, pyrotechnics, and contaminated combustible waste. Each station is designed to be tailored for a specific type of waste. These have all been successfully permitted in their respective states.

Batch Unit for Tactical Rocket Motors, Nevada

Bechtel Nevada, under the direction of USADACS, contracted with EDE to design and fabricate a system to dispose of Shillelagh rocket motors at production rate and scale (See Figure 3). The motors consist of nitrocellulose based propellant.

This application used a pressure vessel approach, since each missile is a single batch. The missiles are placed in a holder and mated to the vessel under an off-gas collection hood. They are ignited using on-board ignition systems, and the primary grain and gas generator burn at the same time, exhausting into the 45 psig rated vessel. When the missile firing is complete, the gases are contained until they are cooled. The gases are metered through a baghouse and HEPA filter before discharge through a stack. The cycle is then repeated.

Figure 3. Pressure vessel designed to dispose of Shillelagh missiles.

A PLC controls the ignition sequence and valve positioning. The system is highly interlocked so that ignition cannot occur if valve positions are incorrect or other system parameters such as temperature and pressure are outside of set points. The system monitors all critical parameters to assure that safe and effective operating limits are maintained. On this particular system, control inputs are accepted through a graphical interface that also indicates system parameters in real time. The system is designed and was permitted for a rate of eight missiles per hour.

Commercial Demilitarization Facility Contained Burn Unit, Missouri

This system utilizes a semi-continuous feed of sawed MLRS rocket motor sections which are fed into the containment chamber and ignited with a pilot torch style ignition source. The exhaust gases are vented through a specially designed pollution control systems to remove particulate and acid gases. The system is permitted under RCRA Subpart X. To date more than a million pounds of propellant have been treated through this system.

AEDC – Contained Burn for Strategic Rocket Motors, Tennessee

A system located at Arnold Engineering Development center utilizes contained burn for altitude simulation and firing of very large strategic rocket motors (e.g., 50,000 pounds propellant). The system utilizes a water spray system with powdered caustic to remove particulate and acid gases.

Although the system is primarily designed for testing versus disposal, a large amount of propellant has been successfully burned in this system since it was commissioned (estimated at over 5 million pounds of propellant, including nitrocellulose based propellants). EDE performed test firings for contained burn of the tactical rocket motors at this facility with emissions measurements which demonstrated good air entrainment in the sealed chamber with complete combustion (no afterburner required).

Figure 4. AEDC Contained Burn Facility

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Contained Burn Test Facility, Aberdeen Maryland

A system located at Aberdeen Proving Ground was designed for contained burning with scrubbing of exhaust gases for large fuel fire tests that had prevoiously been done in the open, to eliminate pollution from open burning of the fuel. The system was built to handle large quantities of fuel being rapidly burned in a vessel 42 ft. radius by 22 ft. height. The exhaust from the vessel went through an afterburner, wet scrubber, dry filter and exhaust fan. EDE provided design for PAS equipment and safety burst discs for the facility.

Figure 5. ATC Contained Burn Facility

China Lake Batch Full Scale Demonstration Contained Burn, California

EDE performed full-scale demonstration testing of large intact tactical rocket motors, MLRS (216 pounds of propellant per motor) and Phoenix (365 pounds of propellant per motor). The thermal treatment chamber is approximately 15 feet in diameter and 80 feet in length. EDE equipped the chamber with a remotely actuated propellant loading system, an ignition system, and a pollution abatement system. The pollution abatement system was tailored to scrub alumina particulate and HCl from the exhaust gases, which are the primary products of combustion of the aluminized AP based propellants contained in these motor types.

Figure 6. China Lake - Contained Burn Chamber and Loading Door

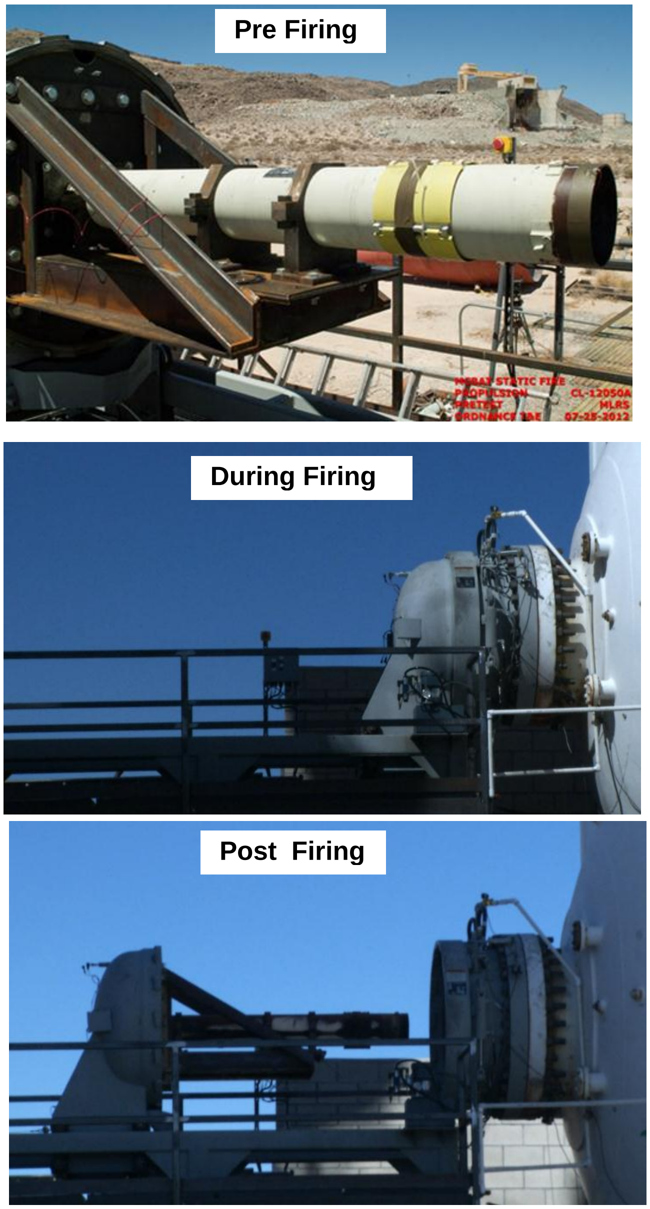

Figure 7. China Lake - EDE Designed Loading System

Testing showed that the peak pressures (70-80 psig) and temperatures reached in the chamber were consistent with the designed operating parameters and what was predicted based upon engineering design calculations. Very

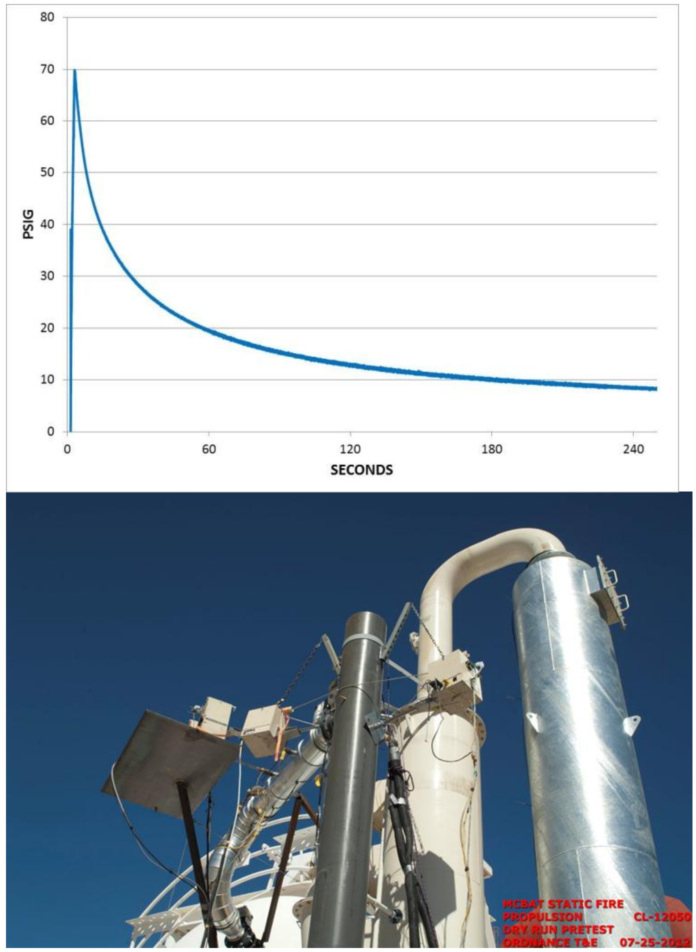

Figure 8. China Lake - Burn Chamber Pressure Data vs. Design Prediction/EDE Designed Pollution Abatement System

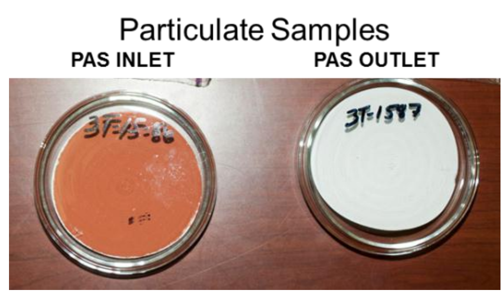

Figure 9. China Lake Particulate Matter Stack Test Results

complete combustion was achieved with very lower CO levels, which were much lower than those measured from open burning of the same motor type. The loading system worked well, providing quick operations to load materials and seal the chamber remotely with a safety interlock which prevents ignition unless the chamber is sealed.

The pollution abatement system performed according to design with very efficient removal of particulate and HCl, as well as highly efficient removal of dioxin and furan emissions. The demonstration was approved by Naval Weapons Station Safety and was performed with the approval and concurrence of California Environmental Regulatory Authorities under the applicable Air and RCRA Subpart X Permits.

Letterkenny – Batch Contained Burn for Tactical Rocket Motors, Pennsylvania

Based on the successful demonstrations performed at China Lake, EDE was asked to scale up the design for the production facility located at Letterkenny Army Depot near Chambersburg, PA. The construction of this facility is ongoing and the facility has been approved by the DDESB and has also received the necessary Air permit and RCRA Subpart X permit approvals by Pennsylvania Department of Environmental Protection. This facility is designed to process both intact and segmented tactical rocket motors, with a maximum propellant load of 805 pounds per batch cycle, with a maximum throughput rate of three cycles per hour.

Camp Minden Application – Batch Contained Burn for M6 Propellant and CBI

The application of Contained Burn technology at Camp Minden is for safe and environmentally clean destruction of 15.7 million pounds of M6 propellant and 300,000 pounds of CBI material currently in storage at the site over a short timeframe of one year. There are a wide variety of technologies being considered as potential alternatives to open burning disposal. There are no existing closed disposal systems or facilities which have previously completed this quantity of M6 in this amount of time. Any technology selected will thus be required to be scaled up via replication of multiple units or scaling up of system sizing to achieve the desired throughput. EDE has direct experience and in depth knowledge of numerous technologies, proven, and unproven, which are under consideration. EDE has conducted an internal comprehensive evaluation of potentially applicable technologies to select the best technology for this application according to established criteria including: Safety, Environmental Protection, Throughput, Technology Maturity (Well Proven), DDESB Approval, Schedule for Implementation, and Cost.

EDE proposes using Contained Burn technology as the best method to dispose of the stored materials safely and in an expeditious manner. This can be coupled with a highly efficient pollution control system to remove exhaust species of concern according to the desired emission levels and available budget.

The Minden system will utilize a burn chamber very similar in size to the facility designed and being built at Letterkenny. The Minden system will utilize a vertical cylindrical thermal treatment chamber constructed of steel as shown in the layout in Figure 9 below. Up to 880 pounds of propellant would be placed on a cold burn pan in preparation for treatment. The pan is then placed on the loading shelf located outside of the thermal treatment chamber with a forklift. Loading would then be accomplished remotely with no one in the area. A door similar to an autoclave would seal the chamber which will satisfy the ignition system interlock. The operator will then ignite the material remotely using an electronic ignition system. Once ignited, the flame would rise vertically mixing with the air in the chamber at high temperature promoting complete combustion.

The exhaust would then be metered via a small opening and a valve to control flow into a Pollution Abatement System (PAS). The pollution abatement system will be equipped with elements to clean the gases before they are released from the stack. The PAS will be equipped with an Induced Draft (ID) fan which will result in a negative pressure (or slight vacuum) throughout the system to prevent any fugitive emissions during operation.

Once the combustion products are vented from the chamber and the chamber pressure is confirmed to be under vacuum, the autoclave door will open and the shelf with the empty tray will be unloaded from the chamber remotely to the safe loading area. Personnel will confirm via camera that conditions are safe for entry and personnel will remove the empty burn tray for additional cooling and place a different cold loaded burn tray on to the shelf to repeat the cycle.

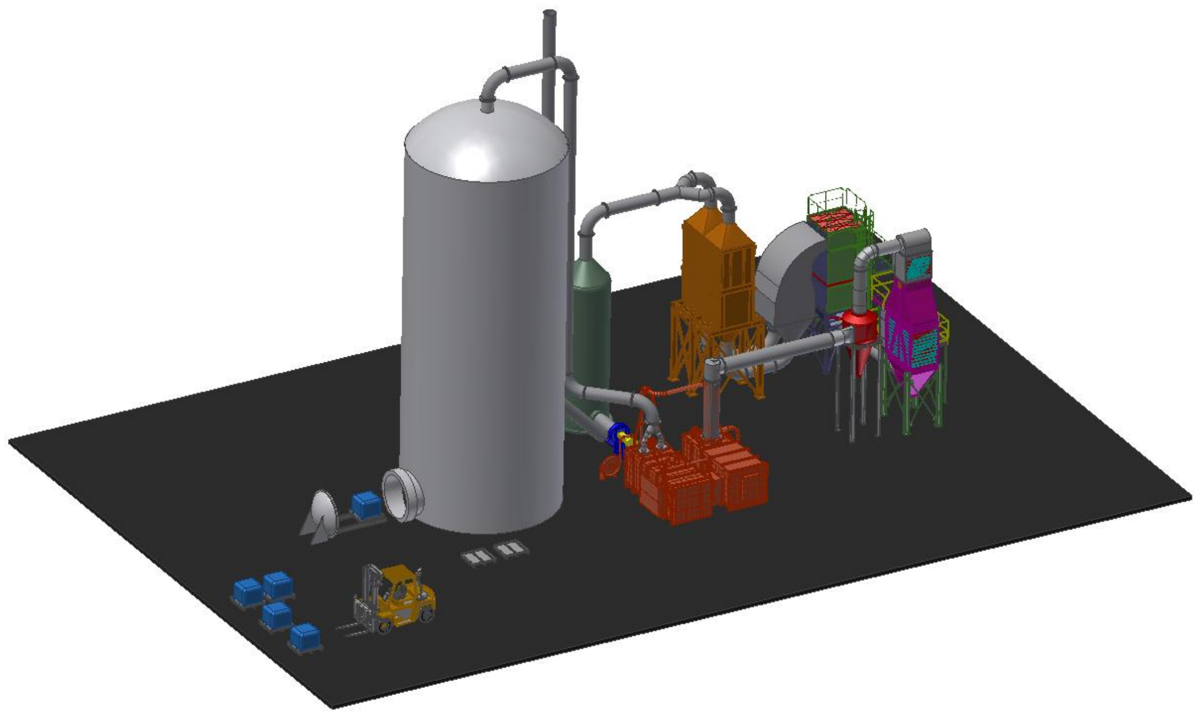

Figure 10. Minden Contained Burn System Layout, with All PAS Options Shown

Safety

Safety is paramount for the application of technology to any energetic material disposal project. EDE understands the safety hazards associated with energetic materials and always puts safety foremost. EDE has never had an injury from an explosive accident on any of our projects throughout our long company history.

This approach will also benefit from extensive testing, design, and rigorous hazards analysis efforts already completed on a very similar system (Letterkenny), which was recently approved by DDESB.

This process will not require additional up front handling compared to open burning. Burn trays can be prepared for loading according to the same established safe procedures used for open burning. This technology also will provide the capability to burn the materials in their existing packaging, if desired, which would significantly reduce the handling required. This would greatly reduce personnel exposure and risk to personnel over the life of this project compared to open burning and other alternative technologies. Test data exists from testing performed by independent explosives safety experts which shows that ignition and burning of M6 propellant boxes and super sacks from Minden results in burning of the material and not a detonation.

The system will be sited with all related operating personnel located at a safe distance (K24) away from the burn operation.

The system is equipped with safety interlocks to ensure that the chamber is sealed, all systems are functioning properly, and all instrument indications are at the appropriate levels prior to arming the electronic ignition system.

The ignition system is equipped with a pre-fire check sequence to confirm continuity and proper resistance levels in the ignition system to prevent ignition problems or misfires.

The ignition system and igniter are designed so that unintentional ignition cannot occur through stray voltage, electromagnetic radiation, electrostatic discharge, etc.

The system is equipped with safety interlocks to ensure that all personnel are located at the safe area prior to arming the ignition.

The contained burn chamber is designed according to ASME section VIII standards for pressure vessels, with a large safety factor compared to the design operating range.

The contained burn chamber is equipped with a rupture disc to vent gases from the chamber at a pressure well above designed operating conditions, but well within vessel design conditions to ensure that conditions can never exist which would cause a failure of the vessel wall.

Personnel remain at a safe remote location with respect to the chamber whenever the ignition circuit is armed; burning is ongoing, or pressure remains above 1 atm(g) in the chamber.

Personnel will be equipped with the proper PPE if they ever need to enter the chamber for maintenance or inspections

All equipment will be provided with lock out tag out provisions for maintenance

Protection of the Environment

This facility is being proposed as an alternative to open burning in order to provide superior protection to the public and the environment by containing all exhaust gases and products of combustion and removing those species and materials of concern prior to release of cleaned exhaust gases to the environment.

M6 consists of approximately 86% nitrocellulose, 10% Dinitrotoluene, 3% Dibutylpthalate, and 1% Diphenylamine.

The major products of combustion of M6 are carbon dioxide (CO_2), water (H_2O), and nitrogen (N_2). Potential minor products of combustion of M6 include solid ash or particulate matter (PM) and gaseous species: carbon monoxide (CO), Nitrogen oxides (NOx), as well as volatile organic compounds (VOC).

Elimination of additional personnel handling and exposure would also mean that the existing packaging materials would be consumed during the burn cycle. These materials include carboard boxes, fiberboard drums, super sack materials, and anti-static polypropelyne bags. The major and minor products of combustion of these materials are the same as M6 propellant and CBI material, with the addition of the potential for small amounts of chlorinated species from the polypropylene bags. This consideration needs to be weighed against the safety risks of the additional handling by personnel required to unpackage and separate these materials from the M6 for processing directly in steel burn trays. If it desired to not treat these packaging materials neat propellant would be loaded in to burn trays for processing.

EDE has extensive pollution control experience including state of the art pollution control for emissions from combustion of M6 propellant. EDE has provided rotary kiln explosive waste incinerators to clients worldwide, providing more systems than any other company. These systems employ pollution abatement systems designed by EDE according to the chemistry of the waste materials to meet all client and applicable regulatory requirements. EDE recently commissioned a turnkey facility for the Belgium Ministry of Defense which included disposal of M6 propellant with stack testing. The facility provided for Belgium utilized a state of the art pollution abatement system to meet stringent European requirements which are more stringent than U.S. standards. The performance of this equipment, including performance when treating emissions from burning of M6 propellant, demonstrated that the EDE PAS removed all products of concern to levels well below the stringent European standards, with essentially zero CO, VOC, and PM emissions, and >95% NOx reduction. For the Minden project the same proven EDE PAS equipment is offered as priced options so that the client can select the level of pollution abatement desired while factoring in budgetary considerations.

Stack testing can be performed to monitor emissions produced and ensure they are in compliance. The system is also equipped with controls instrumentation which interlocks the system so the burn cycle and subsequent venting of emissions through the pollution control system is not allowed to be performed unless the pollution control system is operating as designed. Critical parameters are measured and recorded to ensure the facility is operated in accordance with the design and environmental permit.

Throughput

The proposed design is intended to maximize throughput while providing a system priced within the available budget to complete the work load within a sufficient time period. The proposed system is designed with a nominal throughput rate of 2000 pounds propellant per hour. This equates to 334 operating days, with operations on a 24/7 basis, to complete 15.7 million pounds of M6 plus 300,000 pounds of CBI. Throughput can be increased by adding an additional chamber (at an increased cost).

Regulatory

Required approvals for construction and operation typically include DDESB approval of the site safety plan, as well as approval by local safety authorities. EDE has recently been through this process for the very similar system, the Letterkenny contained burn facility, which will streamline this process.

Environmental regulatory permits are also required, typically an Air permit and RCRA, Subpart X Permit. EDE has experience in preparing these permits and has recently completed the preparation, submission, and approval cycle for these permits at Letterkenny. This will expedite the process for acquiring the necessary approvals from Louisiana Department of Environmental Quality (LDEQ).

Schedule for Implementation

The timeline for implementation of the facility is greatly reduced due to the fact that EDE has already completed the design of a very similar sized contained burn system for Letterkenny. Sizing and drawings of key components are already completed. In addition, as discussed above, EDE has also recently completed the design and turnkey provision of a pollution abatement system on our EWI project in Belgium which employed every priced PAS equipment option proposed. Therefore design information and vendor contacts already exist to expedite this process. Fabrication can begin immediately upon notice to proceed for all long lead items.

The timeframe for construction of the proposed system is driven by the time required to construct the large contained burn chamber. All other equipment can be purchased or fabricated, delivered on site, and installed to the extent possible before completion of the chamber. Commitments have been obtained from the fabrication subcontractor to complete the chamber construction in 16-18 weeks. Another 3-4 weeks is anticipated to be required for mechanical and electrical installation for equipment and instrumentation that connect directly to the chamber, as well as the completion of systemization, operator training, and start up. The proposed timeframe for implementation is therefore 5-6 months, which is on a fully expedited basis.

It is the opinion of the EDE explosive chemist, as well as explosive experts and chemists which EDE has contacted who are familiar with the Minden situation, that this timeframe, combined with the timeframe to complete the treatment of the propellant, does not significantly increase risk of harm to the public versus the timeframe for open burning. As described above, the system could be designed with additional throughput capacity to complete the disposal more quickly, however, this would be at increased cost which may not be affordable within the given budget. The proposal being prepared by EDE represents our recommendation for the most cost effective solution to safely complete this project and minimizing risk to operating personnel, the public, and the environment.