Executive Summary

"LOUISIANA SOLUTION TO A LOUISIANA PROBLEM" – a safe and efficient remedy to this situation though the most experienced professionals in the industry.

Explosive Service International (ESI) is a Louisiana-based, Veteran-owned Small Business. Our resources are extremely vast and our personnel are some of the most experienced in our industry. Since our inception over twenty-eight (28) years ago, we have grown to become the largest explosive demolition and marine salvage contractor operating in the state of Louisiana and Gulf of Mexico. As an explosive demolition and disposal contractor, we are a specialized company that conducts only explosive operations and projects. We hold several US patents for explosive cutting tools that were developed to reduce the environmental impact that explosives can cause to our environment. We have pioneered procedures that achieved job success using smaller quantities of explosives for our customers. Whether we're working on land or at sea, we strive to achieve the safest and most efficient explosive operations in the business. We directly attribute our success to our safety oriented approach. Our experienced Explosive Technicians and proven explosive handling techniques exemplify our success as they carry out hundreds of blasting operations annually as well as manufacturer over 200,000 lbs. of 1.1 explosives annually at our licensed Louisiana based explosive manufacturing facility. We are proud to say we are accident free in a very specialized and otherwise dangerous profession. For additional details on ESI's operational abilities see (Appendix D).

We chose to serve as the prime for both the open burn RFP, as well as, the alternate technology bid request because we are uniquely qualified to conduct all aspects of the disposal work at Camp Minden. Our experience, resources and licensed personnel will allow us to resolve this complex project. We are a Louisiana company with Louisiana employees who are vested in our states best interest. Our capabilities and proven success in our industry will ensure a safe conclusion to this project.

We remain committed to working with the State and our partners to remove the potential threat of this M6 and CBI in the safest and most efficient manner. Our management team for this project has over <u>250 years of combined explosive experience</u> which will prove to be critical for success.

As a result of the State of Louisiana bid request for alternate technology to open burning at Camp Minden, we have carefully selected our team with sound and proven technology. The inherent dangers associated with this project were part of our decision matrix. Our team subs are uniquely qualified for each aspect of this project.

ESI chose to team exclusively with ***El Dorado Engineering, Inc***. (EDE) based upon their worldwide reputation for consulting, designing, and providing technology and equipment in the field of demilitarization of conventional and chemical munitions. EDE is the undisputed leader in designing and providing thermal treatment systems for energetic materials throughout the world. Their ability to supply proven methodologies and equipment for thermal treatment and pollution abatements systems is unmatched by their competition.

Environmental Quality Management, (EQM) EPA Region 6 ERRS contractor, has extensive knowledge and experience in managing response projects and has joined our team to provide overall project support related to the reporting and tracking needed for this project. They are the most experienced EPA Region 6 ERRS contractor with vast amounts of RCRA and CERCLA experience.

Southern Environmental Management Services Inc. (SEMS) is a Louisiana-based full service environmental management company with extensive experience in environmental management, compliance and reporting. They are a strong Louisiana environmental management company with Louisiana employees that also have a vested interest in a safe resolution to this project.

Ray Bell Contracting also a Louisiana-based contractor intimately familiar with conducting all construction related operations on the site. They routinely work at Camp Minden and are located in Doyline, La. They bring a skilled and knowledgeable presence to our team as well as local attributes due to their close proximately to Camp Minden.

The value of having this “Team” approach is paramount to the successful and safe completion of this project.

The ESI team has prepared a proposal to be fully responsive to the State of Louisiana-Louisiana Military Department’s (LMD) requirements. The ESI team is uniquely qualified for this project, and offers clear advantages to our competitors. Please consider the following:

- Safety – The ESI team understands the safety hazards associated with energetic materials and always puts safety foremost. The ESI team has never had an injury from an explosive accident on any of our projects.
- Experience – The ESI team has specialized in the development of operations associated with explosives as a routine in our day to day operations including all environmental and safety aspects.

- Knowledge – The ESI team has the practical knowledge of what works, and probably more importantly, what does not work in the explosives and munitions industry. The ESI team has a wide and vast knowledge pertaining to demilitarization and disposal methods.

These factors, coupled with the ESI team's excellent work history, assure the LMD not only of the projects success, but also a spirit of teamwork and cooperation throughout the project. These advantages will be illustrated and discussed further in subsequent sections of this proposal.

In view of the strengths of the ESI team, ESI recognizes both the value of our services to the LMD and our responsibility to offer them in such a way that objectives are met with a high degree of professionalism and cost/time efficiency. The ESI team is thus committing key management and technical personnel to the project. For further details pertaining to our project teams Key Personnel (see Appendix A - Key Personnel Resumes) summarized.

Alternate Technology to Open Burn

Bid Proposal

For:

Removal of Hazardous Materials in Connection with Explo Systems, Inc.
Camp Minden
1600 Java Road
Minden, Louisiana 71055-7924

Prepared By:

Explosive Service International
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Phone 225-275-2152
Fax 225-273-2029

Attention:
Louisiana Military Department
Deputy Director, Contracting and Purchasing
Brigadier General (Ret.) Owen Monconduit
718 E. Street Camp Beauregard
Pineville, La. 71360

Preparation Date:

03/18/2015

Revision 1

Confidential

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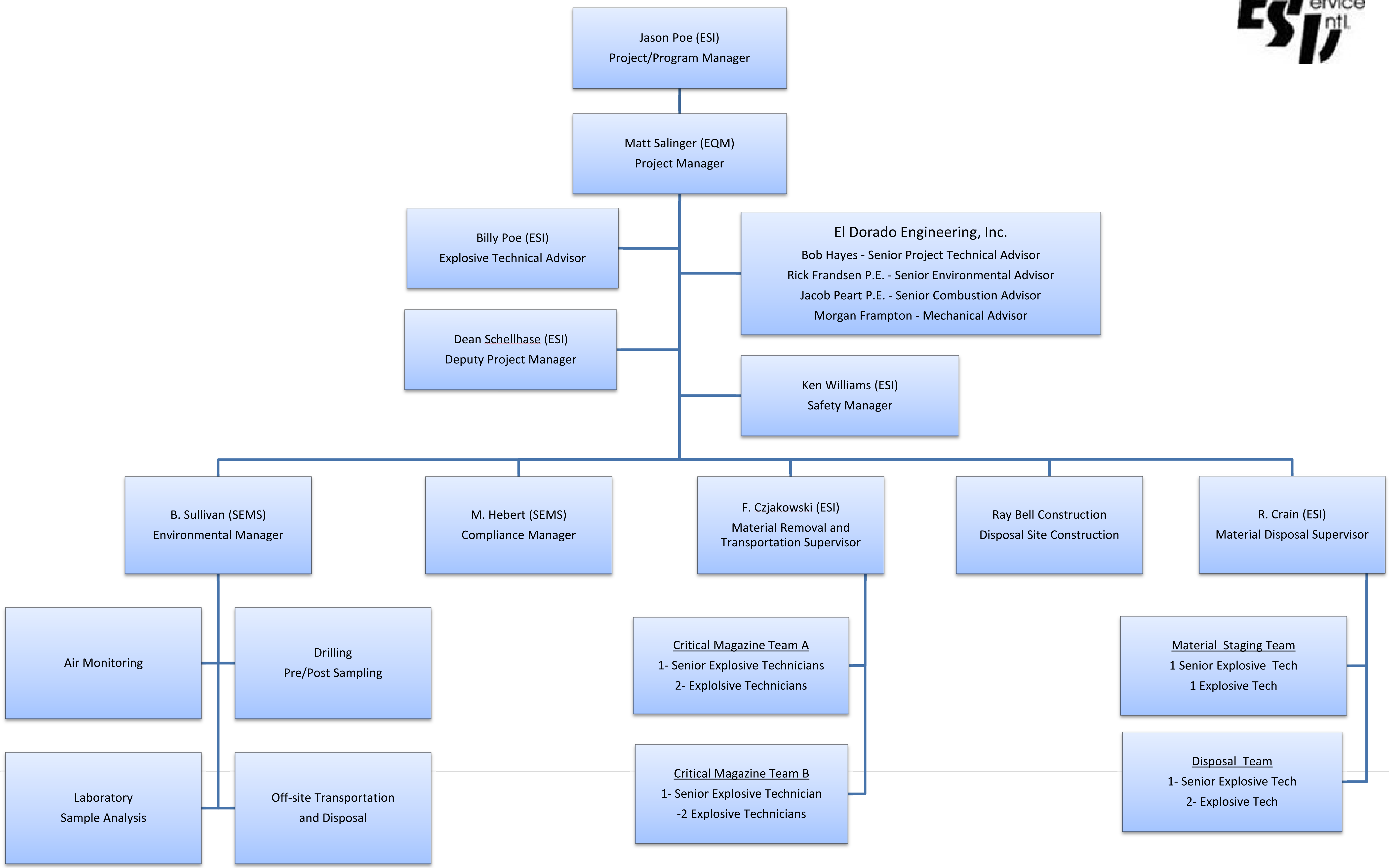
Program Management Organizational Chart



A detailed description of our key technology subcontractor, El Dorado Engineering Inc., and their capabilities is summarized in the following pages;

EL DORADO ENGINEERING, INC. (EDE)

Capabilities and Experience

EDE is a 34-year old, employee-owned, high technology firm, headquartered in Salt Lake City, Utah. As designers and consultants, EDE works on projects worldwide in their specialties of demilitarization of conventional munitions, chemical munitions, and rocket motors; environmental consulting, permitting and restoration; and hazardous/explosive waste treatment and disposal, including advanced pollution control technology.

EDE has unique technical skills, capabilities, and work experience for this project, employing individuals who are recognized experts in propellant and explosive related engineering operations and management and disposal of reactive hazardous wastes.

In house technical disciplines include mechanical engineering, chemical engineering, electrical engineering, environmental engineering, explosive chemists, and controls, including PLC and HMI programming. EDE personnel have an average of greater than 20 years of experience in their engineering fields of expertise.

EDE specializes in providing equipment and facilities, and developing technology for the handling, containment, detection, disposal, and treatment of explosives, ordnance, propellants, and explosive contaminated soil, and of related waste and hazardous waste materials.

EDE is intimately familiar with both environmental and safety requirements regarding ordnance and explosive wastes. EDE has never had an explosives safety related incident causing injury on any of their countless facilities or projects which they have completed over their entire company history. EDE specializes in environmental controls and has developed and fielded technology which easily meets the most stringent regulatory standards.

EDE is the recognized leader in Explosive Waste Incineration Technology and Thermal Treatment systems development including contained burning and transportable flashing furnace technology. EDE personnel have an intimate knowledge of past operations regarding explosives and chemicals at military installations throughout the U.S. EDE has also developed extensive procedures for sampling, cleanup and closure of explosive contaminated facilities.

EDE often uses their own extensive experience to develop “first of a kind” equipment and technology for demilitarization. EDE personnel have extensive experience with both traditional methods and the majority of new technologies that have been researched and developed for application in the demil sector over the last 40 years and as such have a unique perspective in understanding what works and probably more importantly what does not work from a technical and economic perspective. EDE has firsthand experience to recognize technologies that can be successfully applied, as well as recognizing foreseeable challenges associated with many alternative technologies.

In the past several years, EDE has:

- Selected to provide the capability of demilitarization of MLRS and other AP propellant containing rocket motors by contained burn thermal treatment with pollution control. This is one of the most high profile demilitarization projects for conventional munitions to be installed at a government army depot.
- Been selected as one of two companies for a large task order contract ($43 million) to provide demilitarization R&D for military organizations and facilities throughout the U.S.
- Designed and built an automated work cell for melting high explosive from obsolete mortars to recover the explosive for mining operations. This plant is currently being commissioned at Hawthorne Army depot.
- Designed and built a contained burn system to dispose of nitrocellulose propellant based tactical rocket motors
- Designed and installed Explosive Waste Incinerators (EWI) in Albania and Ukraine for NSPA (NATO).
- Provided professional consulting services to U.S. DOD installations to improve existing demilitarization operations
- Used their understanding of combustion processes and atmospheric dispersion to consult with NASA on go/no-go launch criteria for Space Shuttle launches, and environmental permitting of test facilities.
- Designed, installed and started EWIs in Taiwan, Germany, the UK, and Belgium.
- Designed and provided transportable flashing furnace (TFF) systems for decontaminating bomb cases, warhead parts, rocket motor bodies, range scrap, etc. and thermal treatment of small arms and initiating devices. EDE TFF systems have been deployed at Ravenna, Ohio; Anniston Missile Recycling Center, AL; Kaho'olawe HA; Vieques, PR; Hill AFB, UT; Talon, WV; Letterkenny Munitions Center, PA. Stationary systems have also been installed at multiple sites in North America and Europe.

- Designed, built, and installed a plant for recovering magnesium from obsolete flares. This utilizes automated material handling equipment for processing several types of flare munitions. This plant is installed at the Crane Naval Weapons Center.
- Provided professional consulting services for numerous foreign ministries of defense and U.S. DOD agencies in evaluating and selecting technology for specific demilitarization and disposal applications
- Designed and built contained burn systems to dispose of commercial energetic wastes and propellants for several commercial clients.
- Designed and fabricated car bottom flashing furnaces for decontamination of explosive contaminated metal parts and processing live ordnance.
- Helped both Eco Logic and CH2M Hill provide separate total solution designs for non-incineration chemical munitions demilitarization for Blue Grass Army Depot using unique chemical process technologies.
- Designed, built and installed a system to remove melt-cast explosives for reuse from bombs and warheads using microwave energy.
- Assisted the Ralph M. Parsons Company and Russian Federation in the design of a Chemical Munitions Demilitarization System, with a significant amount of work in Moscow.
- Prepared RCRA and air permits and supported environmental restoration projects across the U.S.
- Assisted Demil International and CH2M Hill in demonstrating contained detonation systems and procedures for demil and UXO remediation.
- Designed, built and installed a pilot system to remove melt-cast explosives for reuse from bombs and warheads using microwaves for Crane NSWC.

EDE's demilitarization experience includes all phases of design, fabrication, start-up and construction. EDE has designed and/or installed equipment at over 40 U.S. military installations. EDE has also provided turnkey facilities at many foreign military installations worldwide (see Figures 1 and 2).

EDE's hazardous material and waste experience includes: propellants, PCB's, PCP's, dioxins, furans, nerve agents, phosgenes, solvents, halogens, heavy metals, flammables, explosives, white phosphorus, Napalm, smokes, dyes, pyrotechnics, carcinogens, organotin paints, low level radioactive wastes, acids and corrosives.

EDE has designed, installed and permitted many EWIs located worldwide (see Figure 3). These incinerators are designed to meet all current environmental and safety regulations. EDE has designed innovative liquid and solid feed devices, pollution control equipment, automated discharge and sorting systems, storage and ancillary support equipment. In addition, EDE's projects also include designing, developing, and installing non-incineration thermal treatment processes such as Contained Burn Chambers, (CBC), (See Figures 4, 5, 6). Unique to the demilitarization (demil) industry is EDE's transportable thermal treatment systems which EDE designs and provides to many U.S. military sites (see Figures 7 & 8).

Photos and brief discussions of additional EDE demil projects are provided below.

EDE's EWI Kiln in Belgium

Nitrocellulose Propellant Contained Burn System

Commercial Propellant & Explosives Contained Burn System

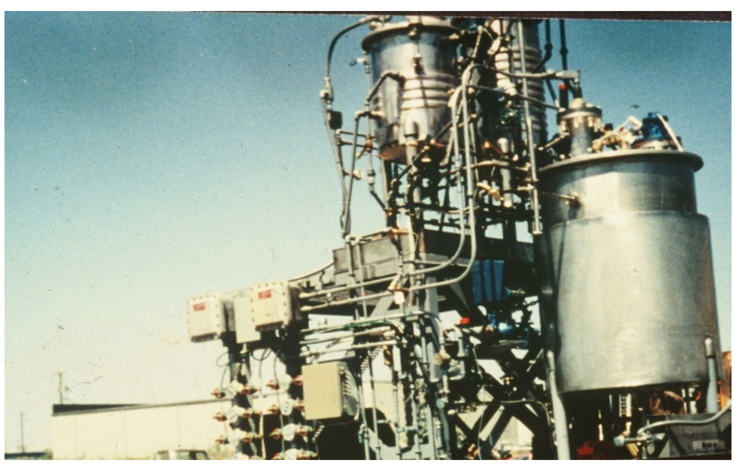
Contained Burn Chamber

Transportable Flashing Furnace

Flashing Furnace Processing Fuse Components

Magnesium Recovery Pilot Production Plant in Crane, Indiana

Training on a Car-bottom Furnace at NAMSA Site in Albania



Recycling Explosives by Blending Fuels to Fire a Boiler at Hawthorne Army DepotEDE is intimately familiar with size reduction problems associated with demil or recycle of large propellant grains and munitions. EDE personnel have developed and tested shears, saws, punches, crushers, and other mechanical processes to access or remove explosives from munitions. EDE has also participated in a wide variety of projects that include steam-out, washout, drill-out, hog-out, cavi-jet, microwave melt=out, and cryo-washout.


Punch Shear Operations

Slug Out

Environmental Permitting, Hazardous Waste Treatment

EDE has provided RCRA Part A & Part B permit applications for clients throughout the U.S. These have been for storage, treatment and incineration facilities including Subpart X open burning. EDE has also prepared air permit and PSD permit applications, RCRA closure plans, and Subpart J, tank assessments.

EDE has direct experience in virtually all aspects of RCRA and CERCLA/SARA implementation, including facility assessments, remedial investigations, feasibility studies, remedial design, construction, operation and maintenance programs, and related NEPA documentation, including EAs and EISs

EDE has broad base experience with applicable federal and state regulations, having performed services regarding explosive waste in virtually every section of the U.S. for the major explosive and propellant industries including Aerojet, Thiokol, United Technologies, Hercules, Honeywell, DuPont, Rockwell, Martin Marietta, Atlantic Research Corp., Tracor, Dyno Nobel, NASA, U.S. Army, U.S. Navy, and the U.S. Air Force in the assistance of permit preparation and environmental assessments regarding explosives and propellants.

EDE’s experience includes the preparation of closure plans for military installations, requiring Department of Defense Explosive Safety Board (DDESB) approval. EDE personnel also served on a joint services panel that surveyed Department of Defense military installations regarding explosive and chemical agent disposal operations and the impact of environmental regulations on these operations.

Robotics and Automation

Although EDE is not a robot manufacture or representative of any particular brand, EDE has developed robotic systems and automation to enhance production and worker safety on a wide variety of processes. EDE employs competent robotic experts who are adept at robot applications and at marrying standard robotic systems and peripheral equipment interfaces into a total robotic package. EDE personnel are experienced in solving client problems and providing cost effective and coordinated solutions.

Safety

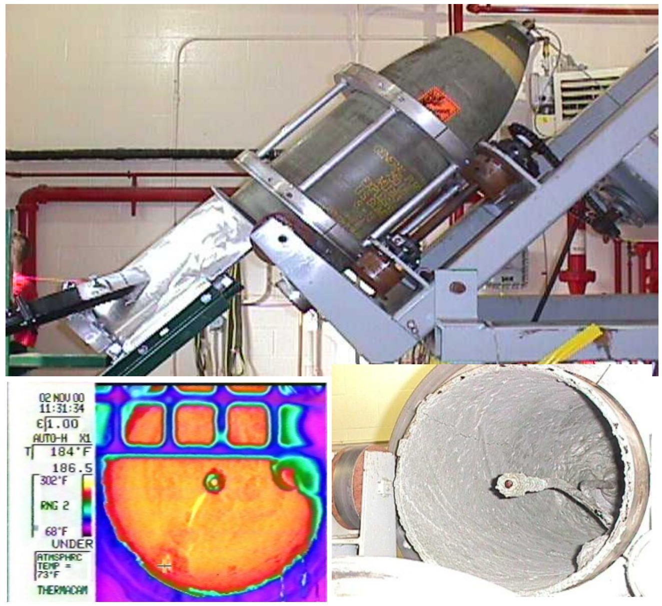
EDE has provided clients with hazards analysis and risk assessment services for processes, procedures, and equipment. EDE engineers are accustomed to working with all DOD safety manuals including AMCR 385-100 (Army Safety), OP-5 (Navy Safety) and AFM 127-100 (Air Force Safety). EDE staff is contributing authors to MIL-STD-398, the Health and Safety Manual for munitions facilities.

EDE has developed and validated a proprietary computer air model for open burning of explosives and static firing of rocket motors that is widely accepted in permitting these activities (Figure 14).

EDE personnel have extensive experience with the design and development of both wet and dry air pollution control systems, including the design and selection of combustion chambers, ductwork, fans, filters, NOx reduction systems, baghouses, scrubbers, heat exchangers, and controls.

EDE emissions model validation test, static firing Pershing rocket motor

EDE has worked on developing and demonstrating several novel technologies, such as Microwave melt-out of explosives from bombs for explosives recycling (Figure 15)



Microwave Melt-out

LOCATION OF SELECTED EDE EXPLOSIVE PROJECTS

SITES INVOLVED

1 Seneca IE, I, P
2 Letterkenny IE, I
3 Radford P
4 Anniston IE, I, P
5 Lex Blue Grass IE, I, P
6 Newport P
7 Crane, D, P
8 Badger IE, P
9 Joliet D
10 Pine Bluff D, I, P
11 Louisiana IE, I, P
12 Iowa IE, I
13 Lake City D, I
14 Cornhusker IE, I
15 Sunflower IE, I
16 Kansas IE, I, p
17 McAlester D, I
18 Red River P, IE, I
19 Pueblo D, P
20 Fort Wingate IE, I
21 Tooele/Dugway, I, P, D
22 Navajo IE, I
23 Hawthorne D, I, P
24 Umatilla D, I, P
25 Sierra IE, I, P
26 Aberdeen P, D
27 TRW P, D
28 Tracor P
29 Atlantic Research P
30 Aerojet P
31 Lawrence Livermore P
32 Hercules P
33 Thiokol P
34 Hill AFB P
35 Edwards AFB P
36 DuPont P
37 Martin Marrieta P
38 Rockwell P
39 Honeywell P
40 Cape Canaveral P
41 Memphis Defence Depot
42 Stennis Space Center P
43 Ravanna D, I, P
44 Talon, WV
45 Alabama Army Ammunition Plant D
46 Nellis AFB
47 Eglin AFB
Not Shown: Alaska, Hawaii,
INTERNATIONAL PROJECTS:
Germany,Taiwan, UK, Singapore, Albania, Russia, Korea, Ukraine, Canada, Australia, Belgium

CODES

I	Installed by El Dorado Corp.
IE	Individual experience; designed as individual prior to EDE employment
D	Designed by EDE
P	EDE prepared environmental permits

Figure 1: Map of EDE Projects

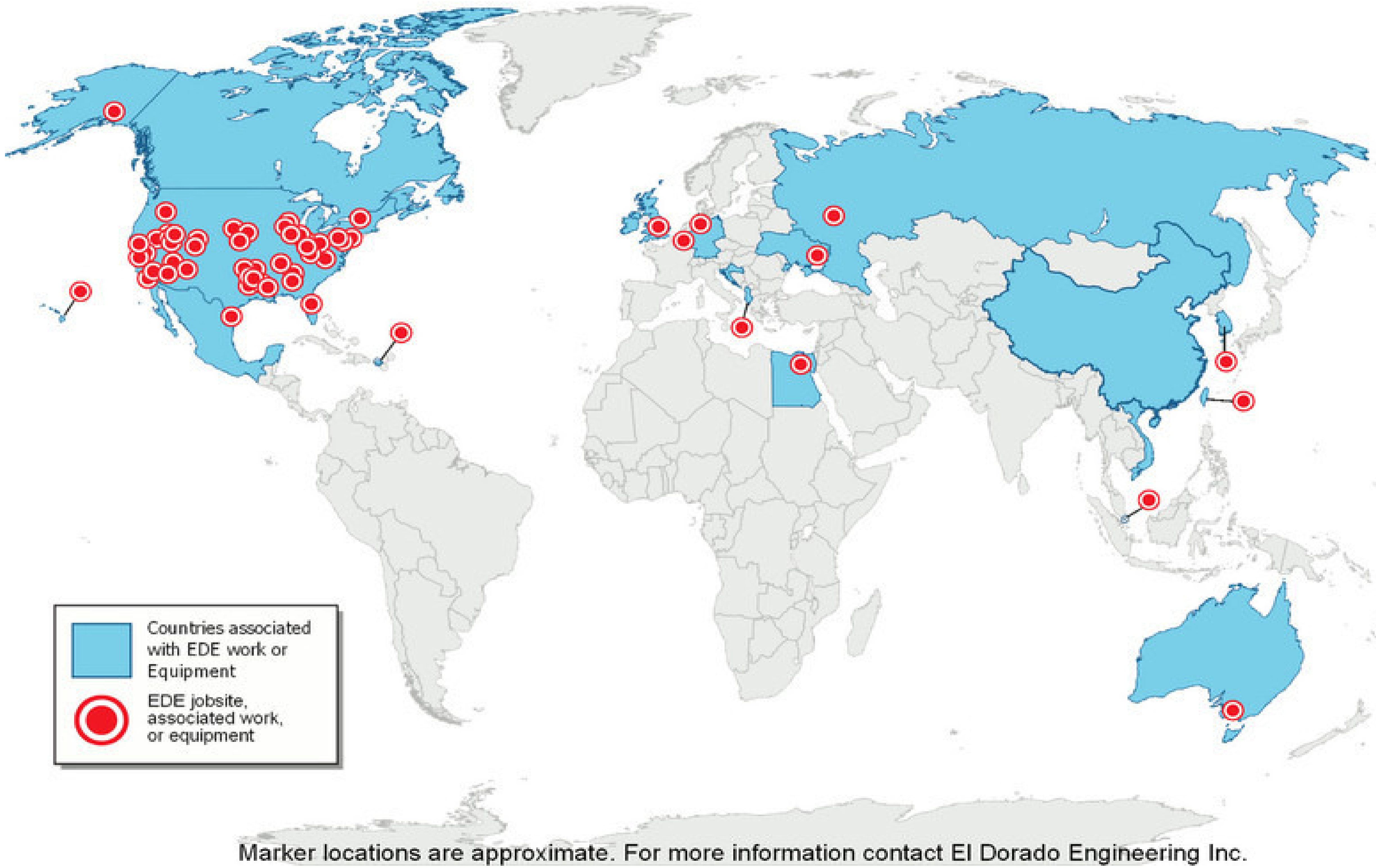


Figure 2: EDE Projects World-Wide

TECHNICAL PROPOSAL – Alternatives to Open Burn

Introduction

The ESI/EDE team has unique and extensive knowledge and experience regarding potential methods and technologies which can be employed to safely and successfully dispose of M6 propellant and CBI stored at Camp Minden, LA. The team has performed a thorough internal evaluation of potential technologies (See Appendix B) as an alternative to open burning, in order to propose and provide the best solution.

In response to the request from the Louisiana Military Department to provide a written proposal with "any and all disposal methods" other than the open burn tray process, the ESI/EDE team has included a proposal for two separate disposal methods based on well proven technology:

1. **Kiln Technology**
2. **Contained Burn Technology**

A technical and cost proposal is included for each technology to allow the reviewer to consider and compare each alternative. Priced options are also presented to allow the client flexibility to select those that provide the best performance to meet client and stakeholder needs within the available budget.

The ESI/EDE team has also been involved in the public dialogue committee process by responding to committee requests for information, listening to concerns of committee members, and answering questions from a wide variety of stakeholders. We have therefore made an effort to address committee feedback in this proposal to the extent practical to provide value to the reviewers in the selection process.

Each of these systems is based on well proven designs fielded by EDE for handling and treatment of bulk energetic materials and propellants. This proposal also includes priced options for additional pollution controls which can be employed according to available budget to meet the highest possible standards for emissions. A layout of the proposed system, with all priced pollution abatement system options shown, is provided in the figure below.

Each technology has unique advantages; both are provided to allow the client to consider these advantages, along with the costs, to select the best system according to stakeholder requirements, selection criteria, and available budget.

In selecting the right solution for Camp Minden, there are many competing considerations (i.e. cost, schedule, public opinion, technology, environmental, etc.).

However, it is most important for this project to take a risk based approach in selecting the right solution to ensure the safe and successful completion of the project. A risk based approach is at the forefront of the solutions the ESI/EDE team proposes and is the only responsible approach for this project.

Both systems utilize well proven technologies with feed systems and thermal treatment systems which have operated and been sited at DOD installations with Department of Defense Explosive Safety Board (DDESB) approval.

Both systems also utilize the most well proven pollution abatement system design, specifically developed and fielded by EDE for scrubbing exhaust products from thermal treatment of propellant; recent substantive emissions data from our installation in Belgium demonstrates unmatched performance.

Due to the maturity of the design for these systems both can be fielded relatively quickly, taking just a few months longer than mobilization for open burning, and can provide high throughput to complete the workload safely without an increase of risk compared to open burning.

Both options benefit from rigorous design safeguards and interlocks to provide the necessary engineering controls to ensure protection of personnel and minimize risk to equipment. This includes remote operation during thermal treatment for both systems.

The kiln system has the following unique advantages:

- Lowest cost solution, with faster time to implementation
- Although propellant must be removed from existing packaging, the feed system is based on a well proven system to minimize personnel handling, exposure, and risk with similar or less handling than open burning
- Nearly identical scale pollution abatement system to Belgium, provided cost/time efficiency for implementation

The contained burn system has the following unique advantages:

- This system has the capability to eliminate the need for un-packaging of propellant, which greatly reduces personnel exposure and risk, and eliminates contaminated packaging waste stream
- Very similar in scale to ongoing installation, which allows for cost/time efficiency and benefits from substantial specific hazards analysis already performed and implemented into the design

- Typically considered under RCRA subpart X in other states which provides the least difficult path for permit approval and compliance

It is recognized that the request for technology alternatives instead of open burning is driven primarily by public concern regarding potential emissions and pollution to the environment. The ESI/EDE team has direct experience and actual data from combustion of M6 and similar propellants from both open burn and closed burn disposal trial burns and tests. This data show that M6 burns quite completely, producing very small quantities of CO and hydrocarbons in the products, when sufficient air is provided in either an open or closed burn process. However, it must be emphasized that the data also show that a significant amount of NOx is produced. Based on this actual burn data the amount of NOx produced by either open burning, or any closed thermal treatment alternative, would be projected to far exceed 100 tons per year, with disposal of the 16 million pounds of M6/CBI at Camp Minden in a 12 month period. Therefore, the ESI/EDE team has proposed robust and highly efficient NOx reduction solutions as options for the proposed pollution control package. The proposed highly efficient NOx control, with proven NOx reduction on M6 propellant emissions, will ensure that NOx emissions can be controlled to be less than 100 tons per year at Camp Minden. If proven, highly efficient NOx controls are not implemented NOx emissions will be a major pollution source.

KILN PROPOSAL

Option 1

Option 1: Kiln Technical Proposal

Kiln System Key Advantages

- Lower Cost
- High Throughput
- Fastest Time to Implementation
- Proven Technology
    - Proven Feed System
    - Proven Thermal Treatment System
    - Proven Pollution Abatement System
- Automated Feed System Minimizes Material Handling
    - Propellant Only Handled Once to Remove From Existing Packaging
    - Feed System Design Prevents Propagation to Feed Hopper
- Personnel are Located Remote to Facility During Feeding and Thermal Treatment Process
- Contains All Combustion Products For Treatment in Pollution Abatement System
- Advanced Pollution Abatement System to Meet the Highest Possible Emissions Standards (Best Available Control Technology)
- No Large Secondary Waste Stream Created
    - No Water Discharge
    - High Mass Reduction – Very Low Ash Production
- Simple Operation and Controls with Robust Safety Interlocks
- Lowest Fuel Usage for Afterburner
- Similar Feed System and Thermal Treatment System Approved by DDESB Within Last 5 Years

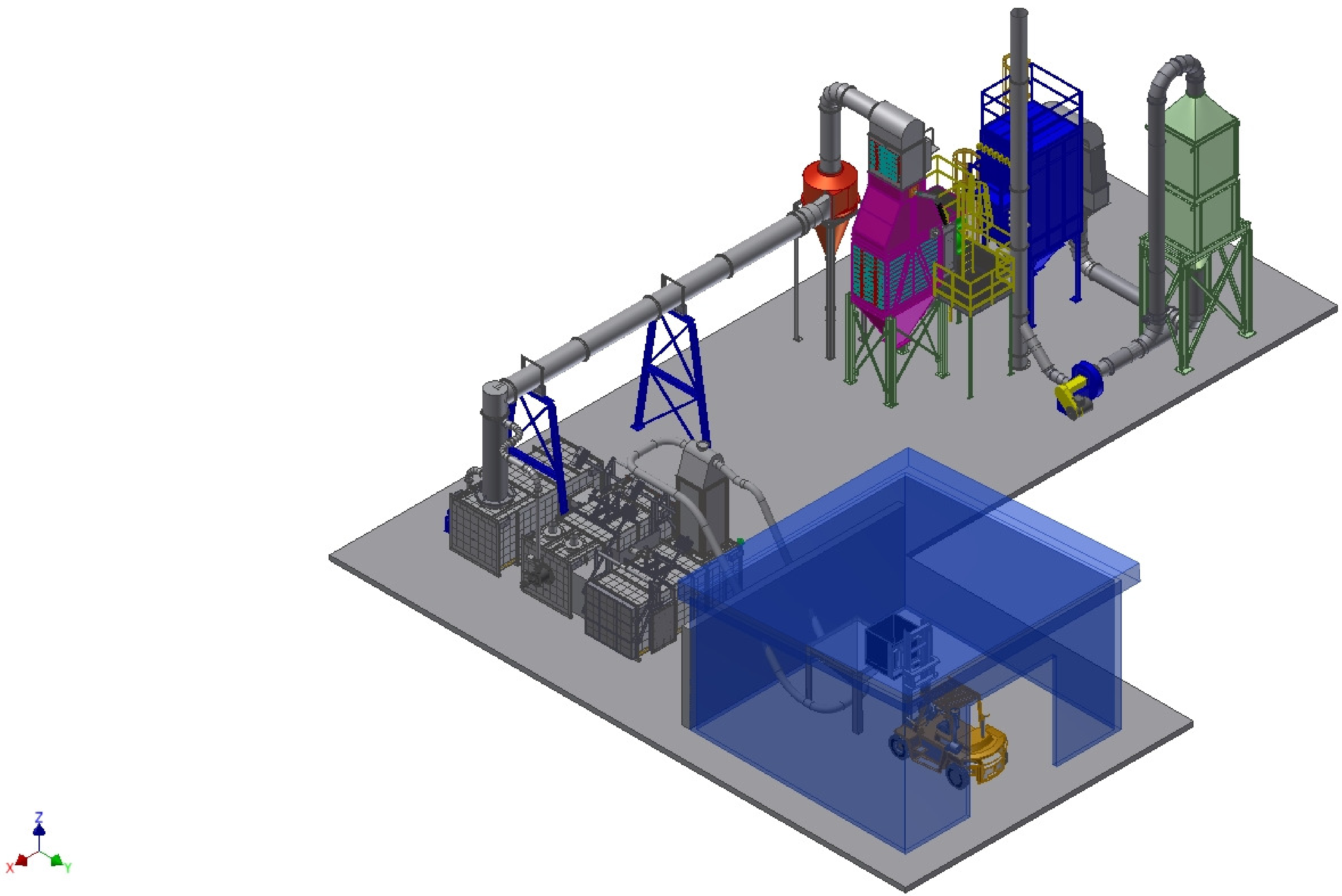
The ESI/EDE team proposes a Kiln Thermal Treatment System to dispose of the stored M6 propellant and CBI safely and in an expeditious manner at Camp Minden, LA. *The proposed Kiln system provides the lowest cost alternative for the project with a system that minimizes personnel handling and is based on a well proven feed system, thermal treatment system, and pollution abatement system, which are configured to optimize safety, throughput, and emissions for M6 and CBI treatment.*

This system consists of an automated semi-continuous feed system, an insulated kiln (primary thermal treatment system), and efficient pollution abatement system (PAS). The system is similar to kilns which EDE has provided in the past, with specific design features proposed to optimize throughput and operations for M6/CBI at Camp Minden.

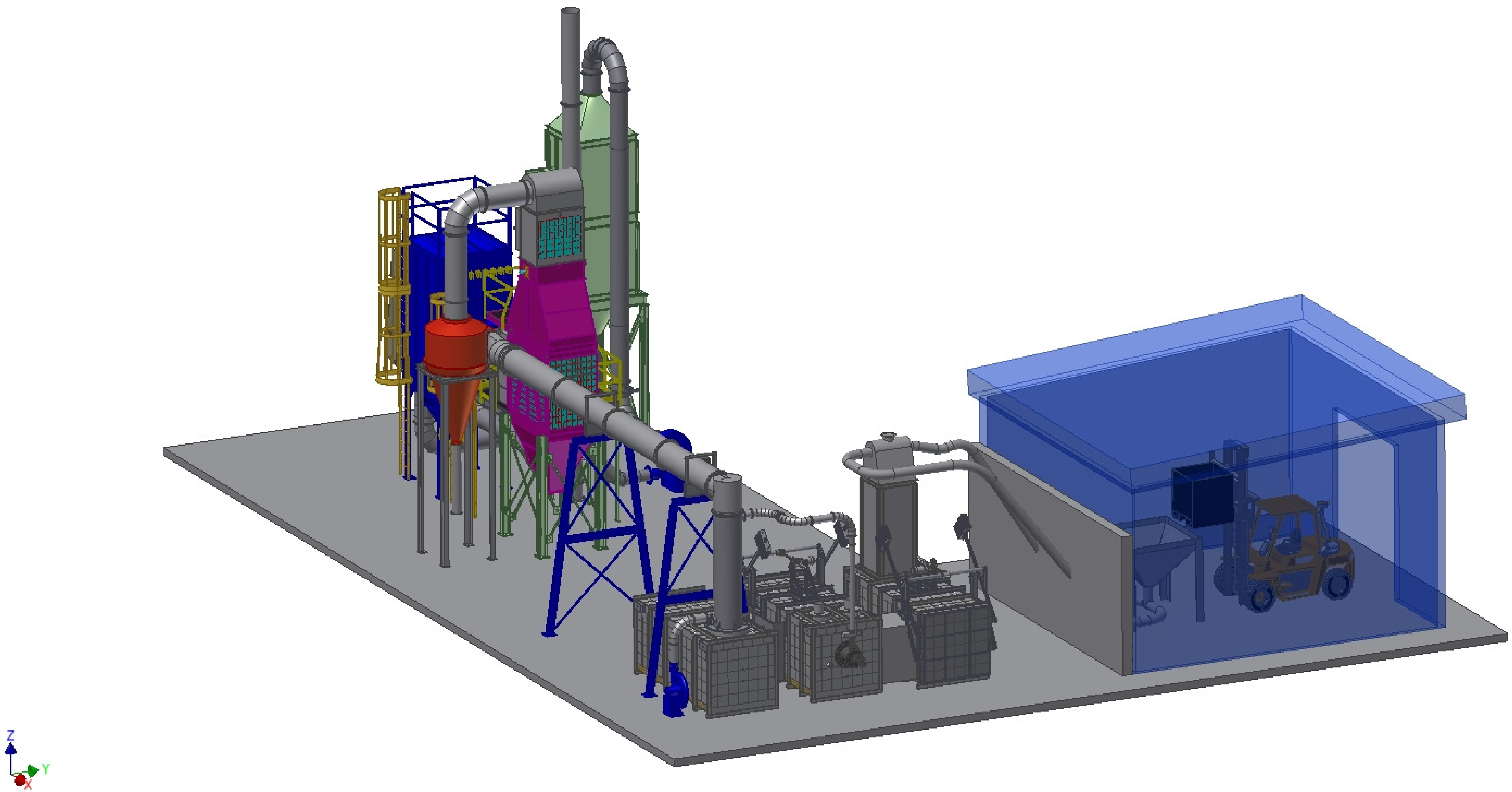
The ESI plan to remove M6/CBI material from each of the ninety (90) explosive magazines for disposal is outlined thoroughly in the included work plan. Magazines will be prioritized and M6/CBI material will be removed accordingly. Also similarly to the open burn bid, ESI plans to start with smaller quantities of M6/CBI and demonstrate successful demilitarization while building up to the full scale disposal operations proposed. Each day, M6/CBI material will be removed from magazines and transported from the magazine area to the disposal site. Upon arrival at the disposal site, the M6/CBI material packaging will be removed and the materials NET explosive weight will be recorded. The predetermined amount of M6/CBI material will be loaded into a transfer bin, weighed and transported by fork lift to the Kiln where it will be disposed of according to the ESI Kiln disposal procedures.

The primary design features include:

1. An automated feed system - to minimize personnel handling and exposure.
2. An insulated kiln - sized to minimize the stack exhaust flow rate while providing efficient combustion of the material and maintaining sufficient temperature to minimize fuel usage in the afterburner
3. An efficient pollution control system with proven performance in meeting the highest possible standards for emissions.



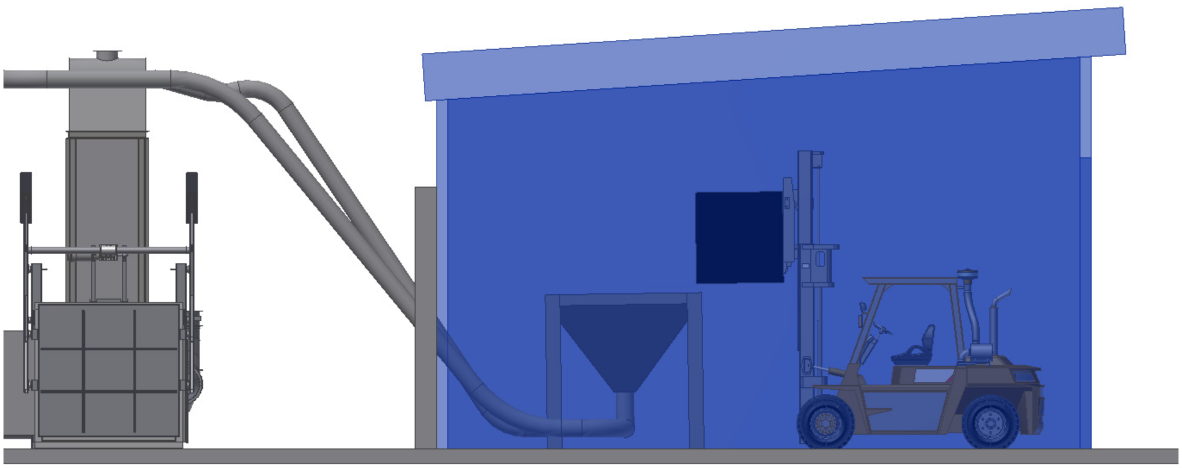
Kiln System (El Dorado Engineering Design)



Kiln System (El Dorado Engineering Design) Camp Minden, LA

Kiln Feed System Description

The kiln will use a semi-continuous feed system providing a controllable and consistent feed of M6 propellant. The system is controlled by the process logic controller with a variable feed rate to maintain correct temperatures and exhaust flow rates through the system. The system is equipped with four redundant safeguards to eliminate the risk of flame propagation from the kiln to the feed system.



Kiln Feed System Arrangement

The permanent feed hopper will be filled approximately once an hour by operators using a forklift and a bottom dumping hopper brought from the staging area. Once the operator has filled the permanent feed hopper (2-5 minutes), they are no longer required to be present in the feed area for operations, and can return to the staging area or control room.

The feed hopper and feed conveyor utilize a closed-loop water recirculation system to keep the propellant in the feed shelter under water to mitigate fire hazards with this propellant. M6 propellant is pulled from the bottom of the feed hopper and conveyed through a protection barricade and then to the top of the kiln feed. As the propellant is conveyed up to the kiln, it is dewatered. A second water trap is located near the kiln entrance as an additional redundant safeguard to eliminate the risk of flame propagation from the kiln.

Propellant is gravity fed on a semi-continuous basis, with a recirculating heavy water spray as a third redundant safeguard at this location to prevent flame propagation. This water spray drains by gravity down the tubular conveyor and is recirculated. Fresh cold air is also pulled into the kiln at this location to keep this area cool while providing supplemental combustion air to promote complete oxidation of propellant in the kiln.

This type of automatic feed system has been used by EDE in past operations for transporting and feeding similar materials with a 1.3 hazard classification. An example is the system EDE provided to handle and feed highly flammable flare composition materials at a DDESB approved facility at CRANE Naval Weapons Center, which had flammability risks far exceeding M6 material. The feed system was proven to be safe and effective.

All water used in the feed system is on a closed loop, with secondary containment provided. There is no liquid discharge to the environment during normal operations or off-normal events. Water used for cooling at the kiln is converted to water vapor that is carried through the kiln and pollution abatement system as a gas and is released in the stack as clean water vapor in the gas phase.

Feed System Safeguards

Multiple redundant safeguards are employed to mitigate risk of an unplanned event, with the ability to handle multiple failures while still providing protection of equipment and personnel. Specific safety features or safeguards of the proposed system are listed below:

1. The automated handling and feed system minimizes personnel handling and eliminates the requirement for personnel to be located at the kiln feed area during operations (unattended).
2. The automated system is controlled remotely via the PLC, which monitors critical operating parameters to limit and control the feed rate to prevent upset conditions
3. The feed system can be shut off remotely prior to operator entry
4. Propellant in the feed room is stored submerged in water which eliminates risks of flame propagation or initiation from thermal and electrostatic sources. The level is controlled and monitored by the PLC with alarms and feed cutoff interlocks to ensure safety.
5. Multiple redundant water traps/curtains are employed in the feed conveyor system to prevent flame propagation or ignition from thermal or electrostatic sources; these traps are on a closed loop.
6. A barricade wall is installed to protect the feed area, personnel and equipment, from any unplanned incidents in the kiln area. This barricade wall design has been proven through destructive testing to protect personnel in the event of a 7 lb. detonation, which is larger than the maximum credible event for this application.

7. The feed conveyor provides a semi-continuous feed, with separation between discrete increments of material so there is no continuous path of material for propagation
8. The feed conveyor is designed to vent on the kiln side of the barricade wall in case of any unplanned reaction in the conveyor resulting in overpressure

Kiln Description

The kiln design is based on kiln (or furnace) systems which EDE has previously provided to safely thermally treat bulk propellants and explosives. The system design is optimized for the Minden M6/CBI material to maximize throughput at the lowest possible cost.

The kiln employs a high temperature refractory brick liner on the floor with soft refractory block insulation on the walls and ceiling. This refractory is designed to allow for rapid heat up and to be easily repairable or replaceable. EDE has utilized this design on many thermal treatment systems and kilns.

Combustion air is supplied directly to the kiln to provide sufficient air and cooling. The kiln also utilizes a closed loop water cooled heat exchanger and water injection cooling sprays to control temperature in the kiln to the desired set point.

The kiln burner is used to heat the kiln to the required operating temperature before propellant feeding can begin; this is governed by an interlock. Once the kiln reaches the feed temperature set point the burner goes to pilot hold and propellant is fed into the kiln by the automated feed system described above. Combustion air is supplied to the kiln to provide sufficient air for complete combustion of the propellant in the kiln as well as cooling to the proper set point temperature.

As propellant is fed into the kiln it is heated above its auto-ignition point and it burns very completely at high temperature. The temperature of the kiln is maintained at a set point to ensure complete combustion of CO and organic compounds and also provide the proper temperature conditions for entrance to the secondary chamber where additional residence time at high temperature is provided to ensure very high destruction efficiencies with complete oxidation of these molecules. The temperature conditions are also maintained to be in the correct range for SNCR reduction of NOx emissions, discussed in greater detail below, in the secondary chamber.

A small amount of ash may collect over time in the kiln. It is expected that this will only require cleanout one time, at the completion of the project. The kiln is equipped with a large automated insulated door which provides convenient operator access in to the kiln for inspections, maintenance, or ash cleanout, while providing egress so the kiln is not a confined space. The kiln door is interlocked so it cannot be opened when the kiln is in operation. The kiln door is purposely designed to vent in the case of any unplanned explosion inside the kiln to prevent a large overpressure buildup in the kiln and prevent equipment damage or risks to personnel from such an incident. This design has been proven on similar systems which, unlike Minden, were used to treat 1.1 high explosive materials, which have the potential to detonate. On a few occasions when unplanned detonations of high explosives occurred in the furnace the door vented as designed, which prevented major damage to the equipment and did not result in any secondary fragment hazards for personnel, who are located at a remote distance or behind a barricade wall whenever explosive materials are in the kiln.

The burner in the kiln is supplied with a fuel train and air supply train as well as an automated flame safety system, which meets applicable NFPA standards. The flame safety system continuously monitors the flame and cannot be bypassed, which controls the light off sequence and automatically cuts off fuel to the burner in the event of the loss of flame, loss of fuel pressure, or loss of combustion air.

The pressure inside the kiln is maintained at a slight vacuum relative to ambient by the induced draft fan in the PAS during normal operations. The kiln temperature is continuously monitored with high and low level alarms to shut off feed to the kiln if the temperature is not maintained within the proper temperature range. The high-high alarm also shuts off the burner system to prevent any overheating of the kiln due to a burner equipment failure.

Protection of the Environment

This system 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 emissions and materials of concern prior to release of cleaned exhaust gases to the environment.

M6 consists of approximately 86% nitrocellulose, 10% Dinitrotoluene, and 3% Dibutylpthalate, and 1% Diphenylamine. CBI consists of 98% nitrocellulose, ~1.5% Diphenylamine, 0.1% maximum Potassium Nitrate, and 0.2% added graphite glaze. The major products of combustion of M6 and CBI 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).

The control of each species of potential concern is discussed in detail below. The proposed kiln system uses a burner for initial warm up but does not use a controlled flame device during waste feed. In some states this is not classified as a hazardous waste incinerator and MACT standards are not necessarily applicable. However, it is recognized that the interpretation of the CFR could result in this system having Subpart EEE MACT standards be applied by regulatory authorities.

Regardless, it is recognized that the major reason that alternative technologies are being considered is to minimize emissions to the environment. Therefore we have proposed pollution abatement equipment which will meet MACT standards and options which meet the highest possible standards for emissions, with proven performance on M6 combustion exhaust with emissions far below MACT limits. Pollution abatement equipment options are discussed and offered as priced options so that the client can select the level of pollution abatement desired while factoring in budgetary considerations.

The following table summarizes the pollution abatement options offered and the corresponding performance of the system with respect to potential emissions of concern.

KILN SYSTEM AND POLLUTION ABATEMENT SYSTEM (PAS) OPTIONS: PROJECTED REMOVAL EFFICIENCY AND EMISSIONS

Emissions	**Basic PAS [3]**		**Advanced PAS [4]**		**Maximum Removal Efficiency PAS [5]**	
	Percentage Reduction Compared to OB (%)	**Projected Avg. Stack Concentrations (ppm)**	**Percentage Reduction Compared to OB (%)**	**Projected Avg. Stack Concentrations (ppm)**	**Percentage Reduction Compared to OB (%)**	**Projected Avg. Stack Concentrations (ppm)**
CO [1, 2]	>95	<50 ppm	>99.99	<2	>99.99	<2
Lead [1]	NA	zero	NA	zero	NA	zero
NO2 [1]	Same as OB[8]	Same as OB[8]	>50	50% of OB[8]	>95	<<200 ppm[7]
Ozone [1]	NA	zero	NA	zero	NA	zero
PM 10[1]	>99.99	NA	>99.99	NA	>99.9999	NA
PM 2.5[1]	>99.99	NA	>99.99	NA	>99.9999	NA
SO2 [1]	NA	zero	NA	zero	NA	zero
Dioxins and Furans [2]	NA	zero	NA	zero	NA	zero
Mercury [2]	NA	zero	NA	zero	NA	zero
Cadmium [2]	NA	zero	NA	zero	NA	zero
Heavy Metals [2]	NA	zero	NA	zero	NA	zero
Total Hydrocarbons (THC) [2]	>95	<10 ppm	>99.9999	<1 ppm	>99.9999	<1 ppm
HCl and Cl Gas [2]	NA	NA	NA	NA	NA	NA
Principal Organic Hazardous Constituent (POHC) [2]						
2,4 Dinitrotoluene	>99.99	< 1 ppm	>99.9999	<< 1 ppm	>99.9999	<< 1 ppm
2,6 Dinitrotoluene	>99.99	< 1 ppm	>99.9999	<< 1 ppm	>99.9999	<< 1 ppm
Dibutyl Phthalate	>99.99	< 1 ppm	>99.9999	<<1 ppm	>99.9999	<<1 ppm
Diphenylamine	>99.99	< 1 ppm	>99.9999	<<1 ppm	>99.9999	<<1 ppm

NOTES:

OB: Open Burning

1 EPA Criteria Pollutants

2 40 CFR Part 63 Subpart EEE

3 Basic PAS: includes Contained Burn Thermal Treatment Chamber, Cyclone, Gas Cooler, Baghouse, Stack

4 Advanced PAS: includes Basic PAS plus Afterburner and SNCR NOx reduction

5 Maximum Removal Efficiency PAS: includes Advanced PAS plus HEPA Filter and SCR NOx reduction

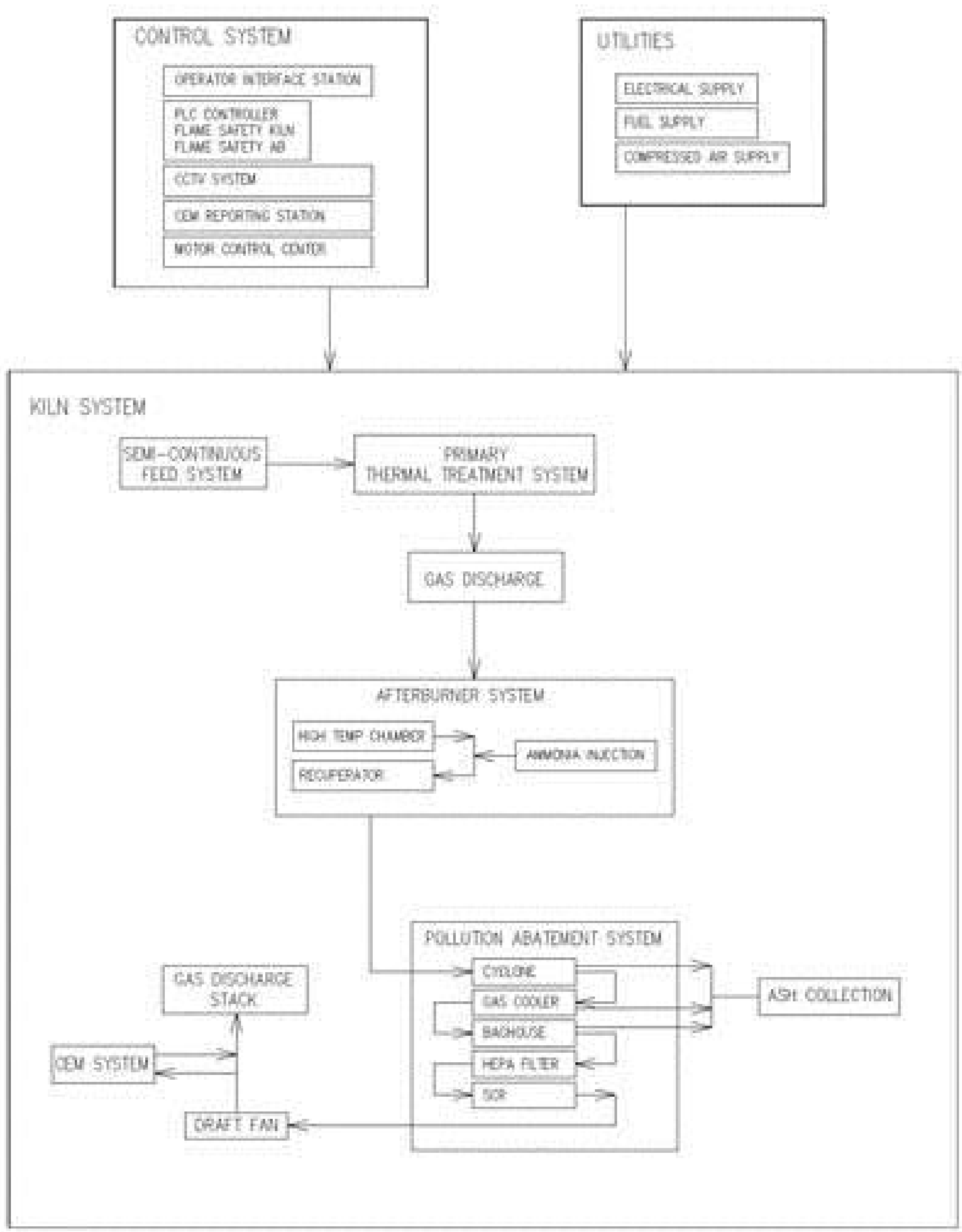
6 See Removal Efficiency by PM micron size for listed equipment:

Cyclone:	**5-10 micron: 99.9%;**	**2.5 micron: <99%;**	**submicron (0.3-0.5 micron) : <90%**
Baghouse:	**5-10 micron: >99.99%;**	**2.5 micron: >99.99%;**	**submicron (0.3-0.5 micron): 99.9%**
HEPA:	**5-10 micron: >99.9999%;**	**2.5 micron: >99.9999%;**	**submicron (0.3-0.5 micron) : >99.97%**

7 Catalyst vendor guarantee value, actual Belgium emissions on M6 propellant were < 10 ppm

8 NOx emissions from Open Burning (OB) or any closed thermal treatment system without PAS NOx reduction are projected to exceed 100 tpy

KILN SYSTEM PROCESS FLOW



Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs)

CO and VOCs are products of incomplete combustion. Complete combustion is achieved by providing sufficient oxygen, temperature, mixing, and time for the all species to completely oxidize. If you have enough oxygen with the right temperature, time, and ixing essentially all carbon oxidizes completely to CO_2 and CO is zero (complete combustion). Also all volatile organic compounds such as methane and non-methane VOCs are oxidized completely to CO_2 and water. In the real world when things burn if you don't have enough oxygen, mixing, temperature or time, CO or VOC can be produced.

During open burning there is plenty of oxygen available in the surrounding air, but mixing of that oxygen is limited to air entrained through the natural buoyant thermal plume forces. High temperature occurs during open burning in the flame zone, but the edge of the flame zone has reduced temperatures due to cold surrounding air. There is no control of residence time of the gases in the flame zone during open burning. Open burning conditions result in minor CO and VOC emissions due to these factors, with the EPA models predicting less than 0.01% CO during M6 open burning. VOC emissions are also produced at levels predicted to be below those predicted for CO.

The proposed Kiln System is designed to maximize complete combustion and minimize the production of CO and VOC emissions.

Many environmental regulations require an afterburner to provide a residence time of greater than 2 seconds at temperatures exceeding 1500°F. The kiln itself will operate above 1800°F, which will provide sufficient temperature to ensure oxidation and destruction of these potential emissions of concern, however, it will not provide a residence time greater than 2 seconds. In practice the high temperatures in the kiln will result in very high destruction of CO and total organics (>99.99%) even without the longer residence time, due to the high temperatures and mixing provided by the design of the combustion air injection locations.

If it is desired by the client to further reduce CO and VOC emissions to zero, an afterburner can be included as part of the PAS which would reduce CO and VOC emissions by >99.9999% compared to open burning, with stack emissions for these species becoming essentially zero (typically non-detect for continuous emissions monitoring systems). This has been validated via independent stack testing performed during combustion of M6 at an EDE explosives waste incineration kiln, which utilized an afterburner designed by EDE. An afterburner of the same design is included as a priced option for the kiln system. In addition to the capital investment for the afterburner, it also requires fuel (propane) which is factored in to the operating costs.

The afterburner will provide additional residence time. Although this secondary combustion chamber is equipped with a burner for cold start-up, in practice the burner will be in pilot hold or off during waste feed operations because the insulated design of the kiln and combustion of the propellant material will provide sufficient temperature to maintain temperatures above 1500°F throughout the afterburner. This is a key design feature of the kiln system which provides all the benefits of an afterburner, while greatly minimizing fuel use.

The overall cost of the afterburner is substantial, however it is considered as the maximum available control technology (MACT) for CO and organic compounds from thermal treatment processes, which will meet the highest possible standards for these emissions. The afterburner also provides the temperature required to remove NOx emissions from the exhaust by SNCR or SCR which is discussed in more detail below.

Particulate Matter (Residual Material)

Particulate matter (i.e., ash, dust, smoke) is produced by materials which cannot be converted to gases during oxidation (combustion) and remain in solid form. M6 is designed to be a relatively smokeless powder, but there is the potential for some minor production of particulate due to contaminates and/or soot particles produced by carbon in the propellant. During open burning the amount of particulate remaining is estimated to be well below 1% by mass. The kiln, as discussed above, provides additional residence time and very high temperature inside the primary thermal treatment chamber which reduces the amount of soot particulate generated by providing conditions for oxidation of soot to CO_2 gas.

Any large soot particles that settle in the bottom of the kiln can be manually cleaned out by an industrial vacuum periodically. The amount of soot expected would be very small from M6, with expected cleanout being only once at the completion of the project. M6/CBI do not contain any heavy metals so all particulate collected would be able to be disposed of in a regular landfill as non-hazardous waste.

Very fine particulate (i.e., PM_{10} and $PM_{2.5}$) can remain suspended in the gas exhaust stream. This is removed very efficiently by the priced equipment options that are detailed below.

<u>Cyclone</u> A cyclone is used to remove larger particulate matter. Typically the cyclone will achieve 99.9% efficiency for particulate matter 5-10 microns in size. Particulate is collected below the cyclone automatically through a hopper and into a sealed disposable drum. This provides for convenient disposal without dumping or additional handling which reduces the risk for personnel exposure or a spill of the particulate into the environment. The material will be characterized prior to off-site disposal. The particulate (e.g., ash) materials produced by this process are expected to be classified as non-hazardous waste. It is expected that the drum would require change out every 1-3 months.

Gas Cooler The gas cooling system is designed to cool the gases to the proper temperature for downstream pollution control elements such as highly efficient low temperature particulate filtration units (e.g., baghouse or HEPA filter). The gas cooler is designed with a well proven automated cleaning system, designed specifically for challenging applications to prevent bridging or plugging of the gas cooler with particulate. Particulate is collected below through a hopper into a sealed disposable drum for convenient disposal, similar to the cyclone. This material will be classified as non-hazardous waste. It is expected that the drum would require change out every 6-12 months.

Low-Temperature Baghouse The baghouse is a fabric-filtration collector, used for efficient particulate cleansing of the gas stream. The baghouse uses PTFE coated Nomex bags for high temperature operation. Particulate removal efficiencies are greater than 99.9% for 0.3-0.5 microns. Larger particulate is removed at 100% efficiency. The baghouse is automatically cleaned via a reverse pulse air jet to ensure proper operation and low maintenance. Particulate is collected below through the hopper in a sealed disposable drum for convenient disposal; from this process this material would be classified as non-hazardous waste. The fabric bags can require periodic replacement, however the interval for replacement is typically every 1-3 years, so it is not expected that they would require replacement during the life of this project. The pressure drop is monitored continuously at the baghouse so if a bag leaks or breaks it is immediately identified as an alarm condition. A baghouse of this type is typically considered maximum available control technology and easily meets MACT standards.

HEPA Filter A HEPA filter is located downstream of the baghouse to provide ultra-high efficient 99.97-99.99 % at 0.3 micron 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 in the baghouse. This type of filtration is most typically used in manufacturing clean rooms and hospitals, and far exceeds the most stringent regulatory standards. This filter removes particulate matter to levels in the stack which are far below what normally exist in the outdoors, home, or office.

Nitric Oxides (NOx)

M6 propellant contains nitrocellulose. Whenever nitrogen is a component of a material that is being burned, the potential exists for significant NOx production. In addition, when energetic materials burn in the presence of air at extremely high temperatures, NOx can be formed from reactions with nitrogen in the air due to the high flame zone temperatures. From a practical standpoint the temperature inside the kiln does not have much impact on the amount of NOx produced from the combustion of the propellant. NOX produced from the propellant is much more significant than “thermal NOx” produced from oxidation of nitrogen in the combustion air.

EDE has extensive expertise in the formation and control of NOx emissions from combustion of energetic materials. Based on this experience it is expected that the amount of NOx actually produced by open burning this material would far exceed the quantities predicted by the EPA OBODM model. Accurately measuring NOx emissions from open burning operations is challenging with respect to quantifying the tons per year which are produced. However measuring of NOx emissions from the stack will be very accurate in quantifying this value. Based on EDE’s experience, significant control of NOx emissions is expected to be required in the pollution abatement system to ensure that NOx levels do not exceed ton per year limits which may be applied to the permit for this project. Additional higher removal efficiencies are technically viable and proven by systems designed and fielded by EDE for removal of NOX from M6 flue gas, if it is desired to achieve the highest possible standards for NOx emissions.

EDE has extensive experience in the provision of NOx reduction systems, including the recently completed explosive waste thermal treatment project in Belgium which burned this exact type of propellant during demonstration testing. This facility easily met even the most stringent European standards for all emissions, including NOx, which are more stringent that U.S. regulatory standards.

The priced options that follow are proposed by EDE for NOX reduction.

Ammonia Injection with SNCR The system is designed with an ammonia injection system and a high temperature reaction zone with the proper temperature, mixing, and residence time conditions to achieve maximum removal efficiency. This results is the reaction of a portion of NOX (NO and NO_2) species with ammonia (NH_3) to form Nitrogen (N_2) and water (H_2O). The SNCR (selective non catalytic reduction) system provides 50 – 60% NO_X reduction. This optional system can only be provided as part of the afterburner system as it requires temperatures and residence times that can only be achieved with the use of the afterburner.

SCR A 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 NO_X reduction. The catalyst provides for efficient removal of NOx at relatively low temperatures. This approach also provides an extra benefit of reducing dioxin or furans at levels well above 90%; if there is any potential for their formation, they are actually reacted and eliminated by the proposed catalyst in this system rather than adsorbed or 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 (NH_3) 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. This is the system which EDE utilized in Belgium to achieve >99% NOx reduction during burning of M6 propellant. This system requires that an upstream gas cooler, baghouse, and HEPA filter be utilized to ensure the proper temperature conditions and protect the precious catalyst from fouling. The EDE Belgium facility has been continuously operating for well over the duration of this Camp Minden project, with continued excellent NOx removal performance being achieved with no sign of catalyst fouling or degradation.

Dioxin/Furan Emissions

Dioxin and furan emissions are not expected to be produced by combustion of M6 or CBI because neither material contains any chlorine which is required to produce these species. The SCR, offered as a priced option, for very efficient NOx removal also provides a high removal efficiency of these emissions in the event that any detectable quantities are formed.

Fugitive Emissions and personnel exposure

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. With the fan located by design at the end of the equipment train, all vessels, including the kiln, ductwork, joints and equipment in the PAS operate at a negative pressure relative to ambient which eliminates the potential for fugitive emissions. If there is a leak present in any of these components, fresh air leaks in to the system instead of fugitive emissions leaking out.

The gases are exhausted through a stack designed at the proper height to eliminate personnel exposure to exhaust gases which may be at elevated temperature and are primarily composed of CO_2, water, and nitrogen. These gases are then allowed to disperse and cool in the environment. The stack is equipped with sample ports for stack testing.

It is recommended that initial stack testing be performed at start up to ensure that all systems are functioning correctly and that emissions meet the regulatory requirements which are conditions of the permit. This is typical for this type of installation, and periodic testing can then be performed thereafter (typically on an annual basis). Key parameters of the PAS are monitored and can be recorded to ensure proper functioning. The system is designed with interlocks to prevent the exhaust of gases from the chamber unless all monitored operating parameters are within prescribed design limits. The system is designed to alert the operator if an operating parameter (such as a high or low temperature) falls outside of these limits so it can be corrected.

It is possible to equip the system with a continuous emission monitoring system (CEMS), however these systems are very costly from a capital investment standpoint and they can also be very costly to maintain. There are reputable vendors who provide such systems, and EDE has used them when required by client solicitations; for example a CEMS system was employed at our recent Belgium installation. Generally a service contract is needed by the operator with the CEMS equipment provider to periodically calibrate and maintain this equipment. The downtime caused by this equipment typically exceeds all other equipment causes combined. CEMS units can reliably measure O2, CO, NOx, and THC (total hydrocarbon) emissions. Accurate CEMS measurement for dioxin and furan species or PM is not viable, as these species must be measured according to the approved EPA methods by periodic stack sampling. The proposed system is equipped with sampling ports in the stack for use during periodic sampling, or for the CEMS option, if it is selected.

Throughput

The proposed design is intended to maximize throughput while minimizing personnel exposure and overall risks in order to safely complete the work load within a sufficient time period at the lowest cost. The system is designed with a maximum throughput rate of <u>2,400 pounds propellant per hour or 57,600.00 lbs. per day</u>. This equates to <u>278 operating days</u>, with operations on a <u>24/7 basis,</u> to complete 15.7 million pounds of M6 plus 320,000 pounds of CBI. Throughput can be increased by adding an additional Kiln at an additional cost.

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 very similar kiln systems. Sizing and drawings of key components are already completed.

In addition EDE has also recently completed the design and turnkey provision of the pollution abatement system on the EWI project in Belgium which employed every priced equipment option proposed with proven performance cleaning M6 exhaust emissions. The size of the pollution abatement system for the proposed kiln system at Camp Minden is selected to be identical to what was provided in Belgium for treatment of M6 propellant. PAS design information and vendor contacts already exist to expedite this process. This allows for a highly expedited implementation of the system. Fabrication can begin immediately on all long lead items.

EDE has secured commitments for equipment fabrication and anticipates that the system can be fielded in 4 months after award, which is only 1 month longer than for open burning.

It is the opinion of the EDE explosive chemist, as well as independent explosives safety experts and chemists which EDE has contacted who are familiar with the Camp 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. It is also recognized that possible public protests and opposition could delay open burning implementation and completion.

Regulatory

Required approvals for construction and operation at DOD installations typically include DDESB approval of the site safety plan, as well as approval by local safety authorities. EDE has fielded the feed system and kiln equipment at DOD sites with prior DDESB approval, which would be expected to expedite review and approval if it is requested from DDESB for this facility.

Environmental regulatory permits are also required. This type of system has been permitted under RCRA subpart X in other states with the interpretation that the burners are only used for warm-up and that "controlled flame combustion" as described in 40 CFR 260.10 is not employed during feeding of the waste, and therefore not considered as a hazardous waste incinerator. It is recognized however, that this view is subject to interpretation by the state regulatory authorities which may choose to classify the proposed unit as a hazardous waste incinerator, which would impose subpart EEE/MACT requirements.

As a Subpart X unit, the system would be operated in a manner as defined by 40 CFR 264 to endure protection of human health and the environment.

This shall include prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in the ground water or subsurface environment; prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, or wetlands or on the soil surface; prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air. These pathways are discussed in more detail in the work plan.

If MACT standards are applied, they can be easily met with the proven PAS options offered. The lower cost of this system may allow for utilization of even more advanced pollution controls within the available budget.

Both ESI and EDE have direct experience working with state regulatory agencies to permit facilities for thermal treatment of energetic materials. We understand the regulatory framework and the type of information required by state authorities. We have this information readily available since we have fielded so many similar systems, including the very similar PAS system in Belgium, which will expedite the permit review and approval process.

KILN COST SUMMARY

KILN SYSTEM PRICE PROPOSAL

PHASE-1	MOBILIZATION & SITE PREPARATION			
Item	Designation	Unit of Issue	Unit Price	Total Price
001	Pre-mobilization Includes: Permitting, Licensing, Ordering, Training & Reporting	Lump Sum	$220,547	$220,547
002	Mobilization and Site Ancillary Setup Includes: Environmental, Site Work, Construction & Magazine	Lump Sum	$661,642	$661,642
003	Supply of Turnkey Kiln System with Basic Pollution Abatement System (PAS) Includes: Site Specific Design, Civil & Electrical Infrastructure Thermal Treatment System &Automated Feed System Air, Instrumentation &Power Distribution Equipment Controls (HMI, PLC, MCC) & CCTV System Installation &Systemization Initial Stack Testing (up to 1 week) BASIC PAS: Cyclone, Gas Cooler Heat Exchanger, Baghouse, ID Fan, All Ductwork & Stack	Lump Sum	$5,881,260	$5,881,260
		Phase-1 Cost		$6,763,449

PHASE-2	REMOVAL & DISPOSAL OPERATIONS			
Item	Designation	Unit of Issue	Unit Price	Extended Price
005	M6 Propellant - 15,700,000 lbs.	Unit Cost/lb.	$0.90/lb.	$14,130,000
006	Clean Burning Igniter - 320,000 lbs.	Unit Cost/lb.	$0.51/lb.	$163,200
			Total Phase-2	$14,293,200

PHASE-3	SITE RESTORATION & DEMOBILIZATION			
Item	Designation	Unit of Issue	Unit Price	Total Price
007	Environmental , Site Recovery & Restoration	Lump Sum	$194,643	$194,643
008	Final Reporting and Project Closeout	Lump Sum	$81,000	$81,000
			Total Phase-3	$275,643

TOTAL PROJECT	$21,332,292

KILN SYSTEM PRICE PROPOSAL OPTIONS

ADDITIONAL POLLUTION ABATEMENT OPTIONS			
Option 003 -01	ADVANCED PAS: Includes: High Temp. Afterburner, Heat Exchanger SNCR system (NOX reduction), Ductwork & Controls	Lump Sum	$1,116,717
Option 003 -02	BEST AVAILABLE PAS Includes: SCR system for NOx Reduction, HEPA, Ductwork & Controls	Lump Sum	$1,244,500
Option 004	BASIC CONTINUOUS EMISSIONS MONITORING SYSTEM (CEMS) Includes: Sample Probe, Pumps, Lines, Purge System, Shelter, Cal. Valve Panel, Gas Conditioner, Factory Test, Cal. Gas System, O2 Analyzer, & CO Analyzer	Lump Sum	$342,375
Option 004-01	CEMS NOx Analyzer, Cal. Gases, Spare Parts	Lump Sum	$22,550
Option 004-02	CEMS THC Analyzer, Cal. Gases, Spare Parts	Lump Sum	$27,115
Option 004-03	CEMS Stack Flow Meter	Lump Sum	$31,900

- Pollution abatement and CEMS options above are in addition to proposed cost on previous page.

CONTAINED BURN SYSTEM PROPOSAL

Option 2

Contained Burn System Key Advantages

- Proven Technology
  - Proven Feed System
  - Proven Thermal Treatment System
  - Proven Pollution Abatement System
- Minimizes Material Handling
  - Capability to Treat in Existing Packaging = Least Amount of Handling and Personnel Exposure of Any Technology
  - If Propellant is Removed From Existing Packaging, it is Only Handled Once
  - Significant Risk Reduction
- High Throughput
- Allows For Convenient Thermal Treatment of Contaminated Packaging
- Personnel are Located Remote to Facility During Feeding and Thermal Treatment Process
- Contains All Combustion Products For Treatment in Pollution Abatement System
- Advanced Pollution Abatement System to Meet the Highest Possible Emissions Standards (Best Available Control Technology)
- No Large Secondary Waste Stream Created
  - No Water Discharge
  - High Mass Reduction – Very Low Ash Production
- Simple Operation and Controls with Robust Safety Interlocks
- Low Maintenance
- Permitted in Other States Under RCRA Subpart X
- Similar Feed System and Thermal Treatment System Approved by DDESB Within Last 18 Months

ESI/EDE is separately proposing using a Contained Burn System coupled with a highly efficient pollution abatement system for destruction of the stored M6 propellant and CBI safely and in an expeditious manner. This system, although more expensive than the proposed kiln system, has a couple of significant advantages:

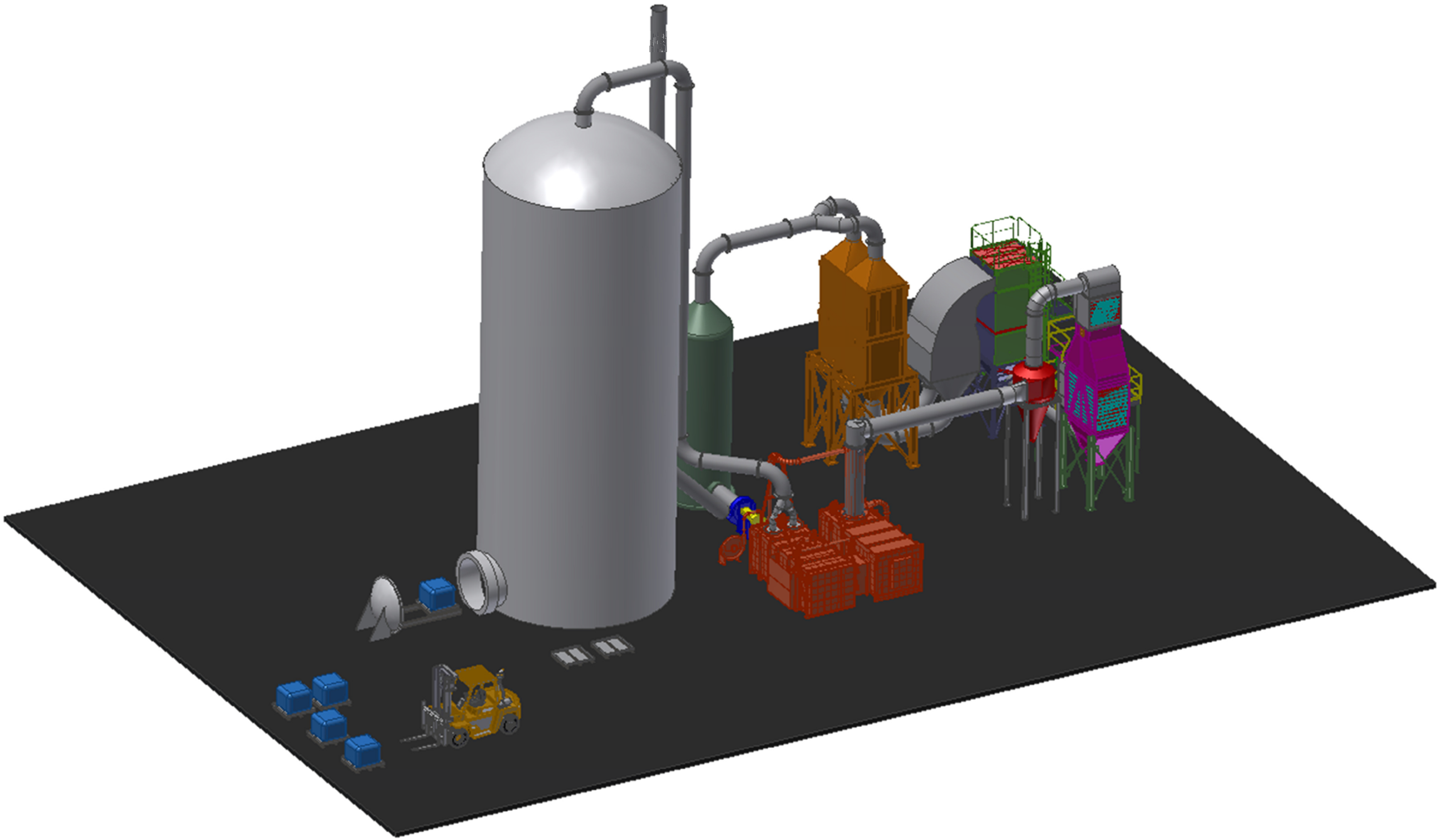
1. M6 propellant and CBI can be thermally treated in the existing packaging configurations which significantly reduces personnel handling, exposure, and risk as well as eliminating a major potentially contaminated secondary waste stream.

2. This system has been permitted in other states under RCRA, subpart X, and is typically exempt from the constraints, time and costs associated with hazardous waste incinerator permit requirements.

Contained Burn technology can be thought of as "open burning indoors." Materials are prepared and ignited similar to traditional open burning operations but the exhaust gasses are completely 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.

This well proven technology consists of a simple feed mechanism and the Contained Burn Chamber (CBC) coupled with a highly efficient pollution abatement system to both capture and remove exhaust emissions of concern to meet the required emission levels. This proposal includes priced options for additional pollution controls which can be employed according to available budget to meet the highest possible standards for emissions.

A layout of the proposed system, with all priced pollution abatement system options shown, is provided in the figure below.



Camp Minden Contained Burn Layout – Single Chamber with All PAS options show

The Camp Minden system will utilize a vertical cylindrical Contained Burn Chamber constructed of steel as shown in the layout figure. Propellant is treated in a batch process. Up to an 880 pound (net weight) super-sack (or equivalent quantity of smaller packaging or neat propellant) is placed in a transfer bin in preparation for treatment at a staging area remote to the Contained Burn Chamber. The transfer bin, containing M6 or CBI material, is then transported to the Contained Burn Chamber and placed into a cold burn tray. The burn tray with live material is then placed on the loading shelf located outside of the thermal treatment chamber with a forklift. The operators then leave the area and loading of the burn tray into the chamber is accomplished remotely via PLC controls. The loading system includes an autoclave door which seals the Contained Burn Chamber, which also satisfies one of the ignition system interlocks. The operator, located at the control room then ignites the M6 or CBI material remotely using an electronic ignition system. Once ignited, the flame rises vertically, mixing with the air in the sealed chamber at high temperature with long residence time promoting complete combustion.

The exhaust gases within the Contained Burn Chamber are then metered via a motorized controlled valve to control flow into the Pollution Abatement System (PAS). The Pollution Abatement System is equipped with elements to clean the gases before they are released from the stack; these elements are discussed in detail below. The PAS is equipped with an Induced Draft (ID) fan which results in a negative pressure (or slight vacuum) throughout the system to prevent fugitive emissions during operations.

Once the combustion products are vented from the Contained Burn Chamber and the chamber pressure is confirmed to be under vacuum, the autoclave door is opened remotely and the shelf with the empty tray is removed from the chamber remotely via the motorized feed system to the safe loading area. Personnel will confirm via closed circuit camera that conditions are safe for personnel to then enter the area to remove the empty burn tray which is inspected and staged at a different location for additional cooling. The operator then places a new cold burn tray containing live material on to the shelf to repeat the cycle.

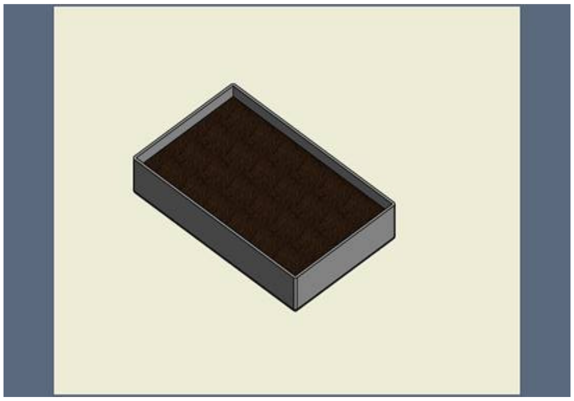
The proposed Contained Burn System will provide a maximum throughput rate of approximately <u>2,640 pounds per hour or 63,360 lbs. per day</u>. This will provide a <u>capability to complete the destruction of the M6 and CBI workload at Camp Minden in less than one year</u> following start of operations.

The proposed Contained Burn System approach utilizes the same technology employed by EDE and others as a simple and successful alternative to open burning, while containing all of the exhaust gases and solid particulate produced by the burn cycle and then removing the emissions of concern from the exhaust via a pollution abatement system. This approach has been used at other facilities to successfully burn millions of pounds of propellant, while protecting the environment with pollution abatement systems tailored to the type of propellant being treated. It has been used for both ammonium perchlorate based propellants and nitrocellulose based propellants, as well as primary and secondary explosives materials.

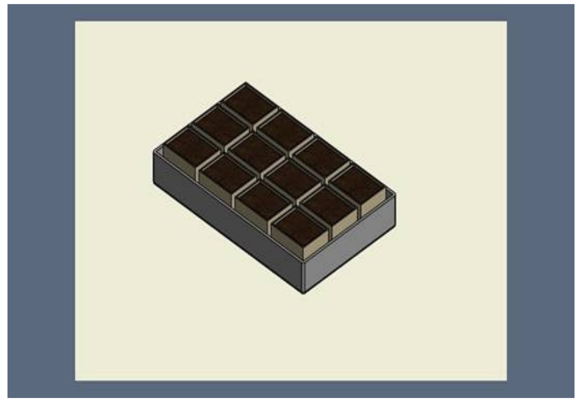
The application for Camp Minden is actually very similar in scale to a facility currently being constructed by EDE for the U.S. Army at Letterkenny Army Depot, near Chambersburg, Pennsylvania. The Letterkenny system is sized for a maximum of 805 pounds of propellant per burn cycle, with a maximum of three burn cycles per hour. The Letterkenny system is designed to burn intact and segmented tactical rocket motors with propellants which contain aluminum fuel, rubber binder, and chlorinated compounds (ammonium perchlorate), which results in significant quantities of fine particulate (smoke) and acid gases as major combustion products. The Contained Burn System being constructed at Letterkenny Army Depot is actually a much more challenging application from both a material configuration and environmental standpoint than the M6 and CBI disposal at Camp Minden, as these nitrocellulose based materials are cleaner burning with major products of combustion consisting of carbon dioxide and water.

The ESI/EDE team knows with the large amount of material at Camp Minden, assumed to be about 15,700,000 pounds of M6 and 320,000 pounds of CBI, that minimizing the required handling of these materials significantly reduces risk, and promotes safety, by reducing personnel exposure. Our team realizes that LMD may not allow the M6 and CBI packaging materials to be introduced into the Contained Burn Chamber. The scope of this proposal does not include burning any of the packaging with these materials.

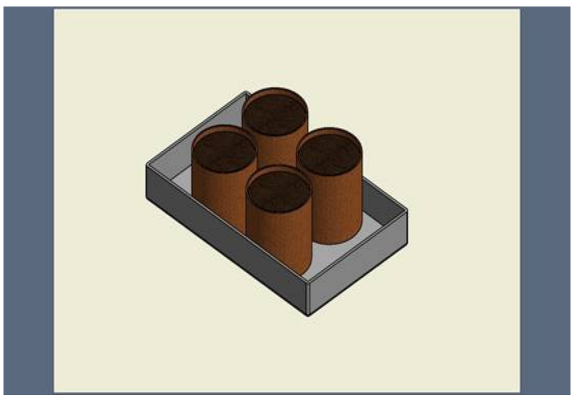
However, a key advantage of this technology is that it allows for direct thermal treatment of M6 propellant in the existing packaging (boxes, drums, and super-sacks). This eliminates the need for emptying out these packages, significantly reducing the handling of live materials, reducing personnel exposure, and significantly reducing risk for the entire operation. It also provides the capability for the packaging to be thermally treated along with the propellant, which eliminates this waste stream and prevents the release of potentially contaminated packaging materials off site. Due to the nature of this propellant and the grain size it does not readily transition to a detonation when ignited in an unconfined state, such as an open box, drum, or super-sack. Material characterization testing has been performed, including critical height tests on similar material, and actual burn tests with M6 from Minden in the existing box and super-sack packaging, which demonstrates that M6 propellant will burn and not transition to a detonation when ignited in the configuration which can be utilized at the proposed facility.



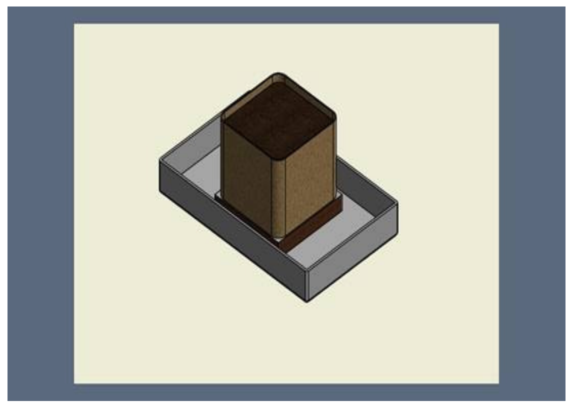
Neat Product



Boxes



Drums



Super-Sack

Burn Tray Configurations

As previously stated, due to the LMD's desire not to dispose of the packaging material onsite, the M6 and CBI will be introduced into the Contained Burn Chamber in "Neat" batches without packaging.

The ESI plan to remove M6/CBI material from each of the ninety (90) explosive magazines for disposal is outlined thoroughly in the included work plan. Magazines will be prioritized and M6/CBI material will be removed accordingly. Also similarly to the open burn bid, ESI plans to start with smaller quantities of M6/CBI and demonstrate successful demilitarization while building up to the full scale disposal operations proposed. Each day, M6/CBI material will be removed from magazines and transported from the magazine area to the disposal site. Upon arrival at the disposal site, the M6/CBI material packaging will be removed and the materials NET explosive weight will be recorded. The predetermined 880 lbs. of M6/CBI material will be loaded into a transfer bin, weighed and transported by fork lift to the Contained Burn Chamber where it will be disposed of according to the ESI contained burn procedures. Upon completion of the contained burn process cycle, the empty burn tray will be removed from the chamber and a cold tray containing another 880 lbs. of M6/CBI material will be introduced into the chamber. Residue ash will be removed from the tray after each cycle. As a result of the contained burn process, all residue ash is anticipated to contain non-hazardous characteristics. Prior to shipment offsite, the ash will be sampled and profiled accordingly for disposal. The aforementioned contained burn procedure will be conducted on a twenty-four (24) hour basis to achieve the daily disposal rate required.

Safety

While open burning required large quantities of M6 and CBI to be set up, handled, and burned 2-3 times a day, the Contained Burn Chamber will burn much smaller quantities of M6 and CBI on a continual (24 hour/day) basis. Upon start-up operations, ESI will begin introducing M6/CBI to the Contained Burn Chamber in smaller quantities and work towards the targeted 880 lbs. into the chamber for treatment. An additional benefit of the Contained Burn Chamber includes a reduced exposure to ESI personnel as they introduce smaller quantities of M6 and CBI materials in operating the Contained Burn Chamber. Continual (24 hour/day) operations of the Contained Burn Chamber will require a continuous 1250’ safety zone. ESI evaluated the work areas available at Camp Minden and has chosen Area-I due to its secluded location which will only require closing the roadway to Area-I. This location will minimize road closures on Camp Minden and not impact military and civilian operations on Camp Minden on a daily basis.

The proposed Contained Burn System at Camp Minden will 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 expedites the implementation of this system without compromising safety.

The Contained Burn process poses a reduced risk to ESI personnel by reducing the amount of handling required compared to open burning and other alternative technologies, especially if the M6 and CBI materials are treated in their current packaging, which significantly reduces the handling required.

Test data exists from testing performed by independent explosives safety experts showing that ignition and burning of M6 propellant boxes and super sacks from Camp Minden results in burning of the material and not a detonation.

The Contained Burn System will be sited with all related operating personnel located at a safe distance (K24) away from the burn operation to meet DOD and Army requirements. Also, the Contained Burn 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 which meets DOD and Army requirements. The ignition system and igniter are designed so that unintentional ignition cannot occur through stray voltage, electromagnetic radiation, electrostatic discharge, etc., which meets DOD and Army requirements. Additionally, this ignition system is equipped with safety interlocks to ensure that all personnel are located at the safe area prior to arming for ignition again meeting DOD and Army requirements.

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. This 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.

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

ESI personnel will be equipped with the proper PPE and follow established confined space entry procedures 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 system 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 emissions 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. CBI consists of 98% nitrocellulose, ~1.5% Diphenylamine, 0.1% maximum Potassium Nitrate, and 0.2% added graphite glaze. The major products of combustion of M6 and CBI 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 ESI personnel handling and exposure would also mean that the existing packaging materials would be consumed during the burn cycle. These materials include cardboard boxes, fiberboard drums, super-sack materials, and anti-static polypropylene 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 ESI personnel required to un-package and separate these materials from the M6 for processing directly in steel burn trays.

The control of each species of potential concern is discussed in detail below. The proposed contained burn system is not classified as a hazardous waste incinerator and MACT standards are not necessarily applicable. However, it is recognized that the major reason that alternative technologies are being considered is to minimize emissions to the environment. Therefore we have proposed pollution abatement equipment which will meet MACT standards and options which meet the highest possible standards for emissions, with proven performance on M6 combustion exhaust with emissions far below MACT limits. Pollution abatement equipment options are discussed and offered as priced options so that the client can select the level of pollution abatement desired while factoring in budgetary considerations.

The table below summarizes the pollution abatement options offered and the corresponding of the performance of the system with respect to potential emissions of concern.

CONTAINED BURN SYSTEM AND POLLUTION ABATEMENT SYSTEM (PAS) OPTIONS: PROJECTED REMOVAL EFFICIENCY AND EMISSIONS

Emissions	**Basic PAS [3]**		**Advanced PAS [4]**		**Maximum Removal Efficiency PAS [5]**	
	Percentage Reduction Compared to OB (%)	**Projected Avg. Stack Concentrations (ppm)**	**Percentage Reduction Compared to OB (%)**	**Projected Avg. Stack Concentrations (ppm)**	**Percentage Reduction Compared to OB (%)**	**Projected Avg. Stack Concentrations (ppm)**
CO [1, 2]	>90	<100 ppm	>99.99	<2	>99.99	<2
Lead [1]	NA	zero	NA	zero	NA	zero
NO2 [1]	Same as OB[8]	Same as OB[8]	>50	50% of OB[8]	>95	<<200 ppm[7]
Ozone [1]	NA	zero	NA	zero	NA	zero
PM 10[1]	>99.99	NA	>99.99	NA	>99.9999	NA
PM 2.5[1]	>99.99	NA	>99.99	NA	>99.9999	NA
SO2 [1]	NA	zero	NA	zero	NA	zero
Dioxins and Furans [2]	NA	zero	NA	zero	NA	zero
Mercury [2]	NA	zero	NA	zero	NA	zero
Cadmium [2]	NA	zero	NA	zero	NA	zero
Heavy Metals [2]	NA	zero	NA	zero	NA	zero
Total Hydrocarbons (THC) [2]	>90	<10 ppm	>99.9999	<1 ppm	>99.9999	<1 ppm
HCl and Cl Gas [2]	NA	NA	NA	NA	NA	NA
Principal Organic Hazardous Constituent (POHC) [2]						
2,4 Dinitrotoluene	>99.99	< 1 ppm	>99.9999	<< 1 ppm	>99.9999	<< 1 ppm
2,6 Dinitrotoluene	>99.99	< 1 ppm	>99.9999	<< 1 ppm	>99.9999	<< 1 ppm
Dibutyl Phthalate	>99.99	< 1 ppm	>99.9999	<<1 ppm	>99.9999	<<1 ppm
Diphenylamine	>99.99	< 1 ppm	>99.9999	<<1 ppm	>99.9999	<<1 ppm

NOTES:

OB: Open Burning

1 EPA Criteria Pollutants

2 40 CFR Part 63 Subpart EEE

3 Basic PAS: includes Contained Burn Thermal Treatment Chamber, Cyclone, Gas Cooler, Baghouse, Stack

4 Advanced PAS: includes Basic PAS plus Afterburner and SNCR NOx reduction

5 Maximum Removal Efficiency PAS: includes Advanced PAS plus HEPA Filter and SCR NOx reduction

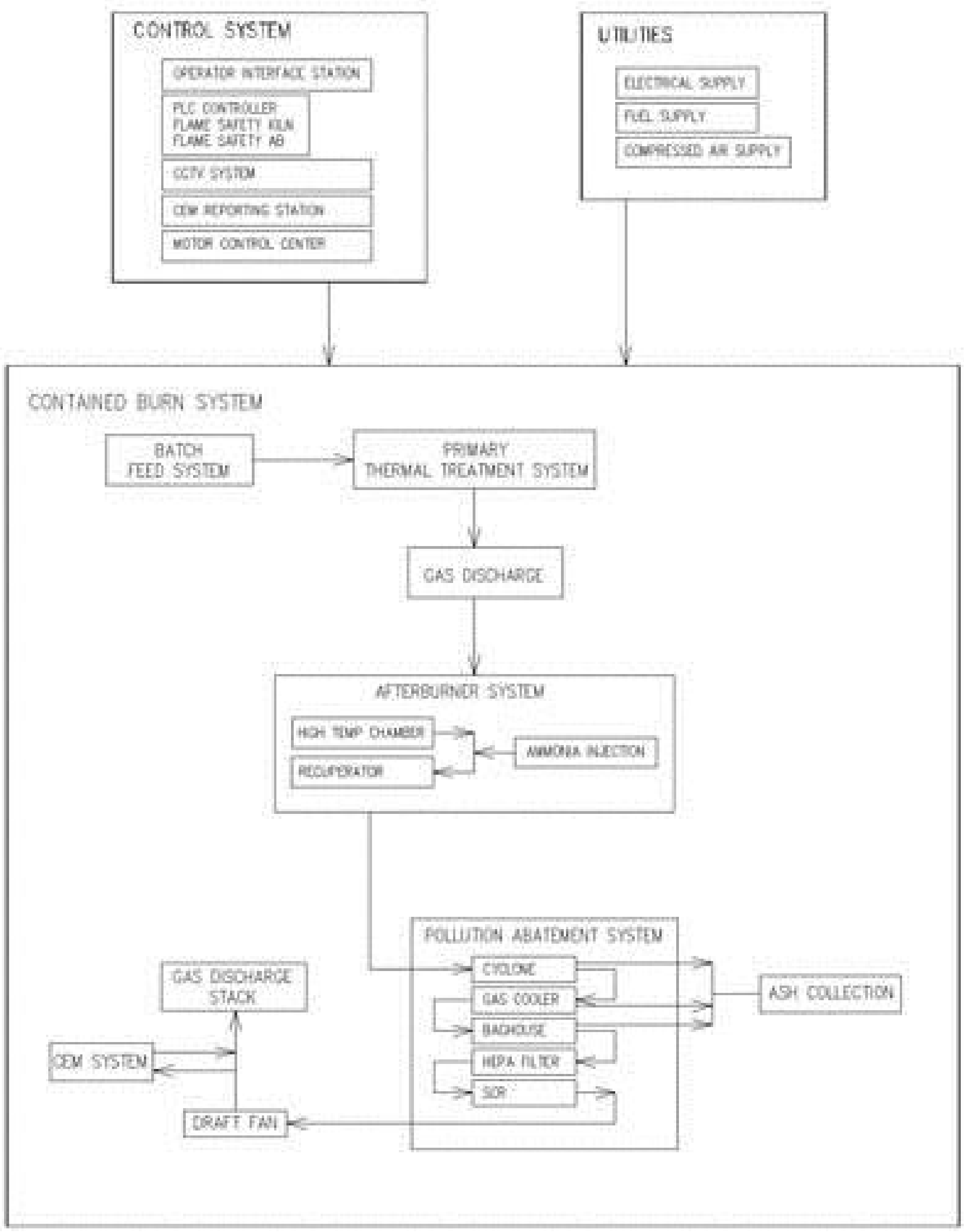
6 See Removal Efficiency by PM micron size for listed equipment:

Cyclone:	**5-10 micron: 99.9%;**	**2.5 micron: <99%;**	**submicron (0.3-0.5 micron) : <90%**
Baghouse:	**5-10 micron: >99.99%;**	**2.5 micron: >99.99%;**	**submicron (0.3-0.5 micron): 99.9%**
HEPA:	**5-10 micron: >99.9999%;**	**2.5 micron: >99.9999%;**	**submicron (0.3-0.5 micron) : >99.97%**

7 Catalyst vendor guarantee value, actual Belgium emissions on M6 propellant were < 10 ppm

8 NOx emissions from Open Burning (OB) or any closed thermal treatment system without PAS NOx reduction are projected to exceed 100 tpy

CONTAINED BURN SYSTEM PROCESS FLOW



Carbon Monoxide (CO) and Volatile Organic Carbon (VOCs)

CO and VOCs are products of incomplete combustion. Complete combustion is achieved by providing sufficient oxygen, temperature, mixing, and time for the all species to completely oxidize. If you have enough oxygen with the right temperature, time, and mixing essentially all carbon oxidizes completely to CO_2 and CO is zero (complete combustion). Also all volatile organic compounds such as methane and non-methane VOCs are oxidized completely to CO_2 and water. In the real world when things burn if you don't have enough oxygen, mixing, temperature or time; CO or VOC can be produced.

During open burning there is plenty of oxygen available in the surrounding air, but mixing of that oxygen is limited to air entrained through the natural buoyant thermal plume forces. High temperature occurs during open burning in the flame zone, but the edge of the flame zone has reduced temperatures due to cold surrounding air. There is no control of residence time of the gases in the flame zone during open burning. Open burning conditions result in minor CO and VOC emissions due to these factors, with the EPA models predicting less than 0.01% CO during M6 open burning. VOC emissions are also produced at levels predicted to be below those predicted for CO.

The proposed Contained Burn System is designed to maximize complete combustion and minimize the production of CO and VOC emissions. A major factor in sizing the Contained Burn Chamber is to provide enough air, and a little extra, to ensure sufficient oxygen for proper combustion each burn cycle. In addition to providing sufficient air, the contained burn process results in the gases being mixed inside the closed chamber during combustion and held in the chamber at high temperature for an extended residence time, providing additional temperature and time for oxidation of these species. This results in a significant reduction in the production of CO and VOC compared to open burning. Test data for other energetic propellant materials show a reduction in CO of about 75% by contained burn compared to open burning. The reduction in VOC would be expected to be similar. This results in levels of CO and VOC that are well within regulatory limits without the use of a secondary combustion chamber (afterburner). Most environmental regulations require an afterburner to provide a residence time of greater than 2 seconds at temperatures exceeding 1500°F. The proposed Contained Burn System will provide these conditions for gases throughout the majority of the chamber, but the chamber walls, although several hundred degrees, will not reach 1500°F so gases right next to the wall will not be hot enough to guarantee zero CO emissions.

If it is desired by the client to further reduce CO and VOC emissions to zero, an afterburner can be included as part of the PAS which would reduce CO and VOC emissions by >99% compared to open burning, with stack emissions for these species becoming essentially zero (typically non-detect for continuous emissions monitoring systems). This has been validated via independent stack testing performed during combustion of M6 at an EDE explosives waste incineration kiln, which utilized an afterburner designed by EDE. An afterburner of the same design is included as a priced option for the contained burn system. In addition to the capital investment for the afterburner, it also requires fuel (propane) which is factored in to the operating costs. The overall cost of the afterburner is substantial, however it is considered as the maxim available control technology for CO and organic compounds from thermal treatment processes, which will meet the highest possible standards for these emissions. The afterburner also provides the temperature required to remove NOx emissions from the exhaust by SNCR or SCR which is discussed in more detail below.

Particulate Matter (Residual Material)

Particulate matter (i.e., ash, dust, smoke) is produced by materials which cannot be converted to gases during oxidation (combustion) and remain in solid form. M6 is designed to be a relatively smokeless powder, but there is the potential for some minor production of particulate due to contaminates and/or soot particles produced by carbon in the propellant. During open burning the amount of particulate remaining is estimated to be well below 1% by mass. Contained burning, as discussed above, provides additional residence time and temperature inside the thermal treatment chamber which reduces the amount of soot particulate generated by providing conditions for oxidation of soot to CO_2 gas.

The proposed system also provides for settling time of any remaining large particulate inside the chamber before venting. Any large soot particles that settle in the bottom of the chamber can be manually cleaned out by an industrial vacuum periodically. The amount of soot expected would be very small from M6, with expected cleanout being only once at the completion of the project. Cardboard and fiberboard packaging could produce more ash particulate, but the cleanout frequency is still expected to be very infrequent, perhaps 2-3 times over the entire duration of the project. M6 and its current packaging do not contain any heavy metals so all particulate collected would be able to be disposed of in a regular landfill as non-hazardous waste.

Very fine particulate (i.e. PM_{10} and $PM_{2.5}$) can remain suspended in the gas exhaust stream. This is removed very efficiently by the following priced equipment options:

Cyclone A cyclone is used to remove larger particulate matter. Typically the cyclone will achieve 99.9% efficiency for particulate matter 5-10 microns in size. Particulate is collected below the cyclone automatically through a hopper and into a sealed disposable drum. This provides for convenient disposal without dumping or additional handling which reduces the risk for personnel exposure or a spill of the particulate into the environment. The material will be characterized prior to off-site disposal. The particulate (e.g. ash) materials produced by this process are expected to be classified as non-hazardous waste. It is expected that the one (1) 55-gallon drum would require change out every 1-3 months.

Gas Cooler The gas cooling system is designed to cool the gases to the proper temperature for downstream pollution control elements such as highly efficient low temperature particulate filtration units (e.g., baghouse or HEPA). The gas cooler is designed with a well proven automated cleaning system, designed specifically for challenging applications to prevent bridging or plugging of the gas cooler with particulate. Particulate is collected below through a hopper into a sealed disposable drum for convenient disposal, similar to the cyclone. This material will be classified as non-hazardous waste. It is expected that the drum would require change out every 6-12 months.

Low-Temperature Baghouse The baghouse is a fabric-filtration collector, used for efficient particulate cleansing of the gas stream. The baghouse uses PTFE coated Nomex bags for high temperature operation. Particulate removal efficiencies are greater than 99.9% for 0.3-0.5 microns. Larger particulate is removed at 100% efficiency. The baghouse is automatically cleaned via a reverse pulse air jet to ensure proper operation and low maintenance. Particulate is collected below through the hopper in a sealed disposable drum for convenient disposal; from this process this material would be classified as non-hazardous waste. The fabric bags can require periodic replacement, however the interval for replacement is typically every 1-3 years, so it is not expected that they would require replacement during the life of this project. The pressure drop is monitored continuously at the baghouse so if a bag leaks or breaks it is immediately identified as an alarm condition. A baghouse of this type is typically considered maximum available control technology and easily meets MACT standards.

HEPA Filter A HEPA filter is located downstream of the baghouse to provide ultra-high efficient 99.97-99.99 % at 0.3 micron 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 in the baghouse. This type of filtration is most typically used in manufacturing clean rooms and hospitals, and far exceeds the most stringent regulatory standards. This filter removes particulate matter to levels in the stack which are far below what normally exist in the outdoors, home, or office.

NOx

M6 propellant contains nitrocellulose. Whenever nitrogen is a component of a material that is being burned, the potential exists for significant NOx production. In addition, when energetic materials burn in the presence of air at extremely high temperatures; NOx can be formed from reactions with nitrogen in the air due to the high flame zone temperatures. From a practical standpoint the temperature inside the contained burn chamber, or other thermal treatment systems, such as kilns, incinerators and furnaces, does not have much impact on the amount of NOx produced from the combustion of the propellant. Test data from EDE prior experience with propellants containing significant quantities of nitrogen indicate that contained burn generally results in similar or lower levels of NOx compared to open burning. When M6 is burned in a furnace with a fired burner, there is also NOx produced by the combustion of this fuel, however it is much smaller than the amount produced by the M6 combustion itself Accurately measuring NOx emissions from open burning operations is challenging with respect to quantifying the tons per year which are produced. However measuring of NOx emissions from the stack will be very accurate in quantifying this value. Based on EDE experience, significant control of NOx emissions is expected to be required in the pollution abatement system to ensure that NOx levels do not exceed ton per year limits which may be applied to the permit for this project. Additional higher removal efficiencies are technically viable and proven by systems designed and fielded by EDE, if it is desired to achieve the highest possible standards for NOx emissions.

EDE has extensive experience in the provision of NOx reduction systems, including our recently completed explosive waste thermal treatment project in Belgium which burned this exact type of propellant during demonstration testing. This facility easily met even the most stringent European standards for all emissions, including NOx, which are more stringent that U.S. regulatory standards.

The priced options that follow are proposed by EDE for NOX reduction.

Ammonia Injection with SNCR The system is designed with an ammonia injection system and a high temperature reaction zone with the proper temperature, mixing, and residence time conditions to achieve maximum removal efficiency. This results in the reaction of a portion of NOX (NO and NO_2) species with ammonia (NH_3) to form Nitrogen (N_2) and water (H_2O). The SNCR (selective non catalytic reduction) system provides 50 – 60% NO_X reduction. This optional system can only be provided as part of the afterburner system as it requires temperatures and residence times that can only be achieved with the use of an afterburner.

<u>SCR</u> A 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 NO_X reduction. The catalyst provides for efficient removal of NOx at relatively low temperatures. This approach also provides an extra benefit of reducing dioxin or furans at levels well above 90%; if there is any potential for their formation, they are actually reacted and eliminated by the proposed catalyst in this system rather than adsorbed or 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 (NH_3) 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. This is the system which EDE utilized in Belgium to achieve >99% NOx reduction during burning of M6 propellant. This system requires that an upstream gas cooler, baghouse, and HEPA filter be utilized to ensure the proper temperature conditions and protect the precious catalyst from fouling. The EDE Belgium facility has been continuously operating for well over the duration of this Camp Minden project, with continued excellent NOx removal performance being achieved with no sign of catalyst fouling or degradation.

Dioxin/Furan Emissions

Dioxin and furan emissions are not expected to be produced from contained burning of M6 because M6 does not contain any chlorine which is required to produce these species. However if any packaging materials containing chlorine are consumed during the burn process in order to reduce operator handling, risk, and costs, there is the potential for dioxin furan production. The amount of chlorine in the packaging material compared to the mass of propellant and air involved in the process makes it likely that dioxin or furan would not be produced at any detectable levels, and may not be produced at all. When materials were burned which contain similar small amounts of plastic in EDE explosive waste incinerator kilns, measured dioxin and furan levels were well within regulatory standards and generally are non-detect even without the SCR. The SCR essentially ensures a high removal efficiency of these emissions in the event that any detectable quantities are formed.

Fugitive Emissions and personnel exposure

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. With the fan located by design at the end of the equipment train, all vessels, ductwork, joints and equipment in the PAS operate at a negative pressure relative to ambient which eliminates the potential for fugitive emissions. If there is a leak present in any of these components, fresh air leaks in to the system instead of fugitive emissions leaking out.

The gases are exhausted through a stack designed at the proper height to eliminate personnel exposure to exhaust gases which may be at elevated temperature and are primarily composed of CO_2, water, and nitrogen. These gases are then allowed to disperse and cool in the environment. The stack is equipped with sample ports for stack testing.

It is recommended that initial stack testing be performed at start up to ensure that all systems are functioning correctly and that emissions meet the regulatory requirements which are conditions of the permit. This is typical for this type of installation, and periodic testing can then be performed thereafter (typically on an annual basis). Key parameters of the PAS are monitored and can be recorded to ensure proper functioning. The system is designed with interlocks to prevent the exhaust of gases from the chamber unless all monitored operating parameters are within prescribed design limits. The system is designed to alert the operator if an operating parameter (such as a high or low temperature) falls outside of these limits so it can be corrected.

The system thus does have the capability to “hold, test, and release” which is sometimes considered the “gold standard” from an environmental perspective, however due to the composition of the M6 and CBI combustion products, hold test and release monitoring is not considered to be necessary.

It is possible to equip the system with a continuous emission monitoring system (CEMS), however these systems are very costly from a capital investment standpoint and they can also be very costly to maintain. There are reputable vendors who provide such systems, and EDE has used them when required by client solicitations, for example a CEMS system was employed at our recent Belgium installation. Generally a service contract is needed by the operator with the CEMS equipment provider to periodically calibrate and maintain this equipment. The downtime caused by this equipment typically exceeds all other equipment causes combined. CEMS units can reliably measure O2, CO, NOx, and THC (total hydrocarbon) emissions. Accurate CEMS measurement for dioxin and furan species or PM is not viable; these species must be measured according to the approved EPA methods by periodic stack sampling. The proposed system is equipped with sampling ports in the stack for use during periodic sampling, or for the CEMS option, if it is selected.

Throughput

The proposed design is intended to maximize throughput while minimizing personnel exposure and overall risks in order to safely complete the work load within a sufficient time period. The system is designed with a maximum throughput rate of 2640 pounds propellant per hour or 63,360 lbs. per day. This equates to 253 operating days, with operations on a 24/7 basis, to complete 15.7 million pounds of M6 plus 320,000 pounds of CBI. Throughput can be increased by adding an additional chamber (at an increased cost).

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 propellant contained burn system for Letterkenny. Sizing and drawings of key components are already completed. In addition EDE has also recently completed the design and turnkey provision of the pollution abatement system on our EWI project in Belgium which employed every priced equipment option proposed with proven performance cleaning M6 exhaust emissions. Therefore design information and vendor contacts already exist to expedite this process. Fabrication can begin immediately on all long lead items.

The timeframe for construction of the proposed system is driven by the time required to construct the large thermal treatment chamber. All other equipment can be purchased or fabricated, delivered on site, and installed to the extent possible before completion of the chamber. We have secured commitments for equipment fabrication and anticipate that the system can be fielded in 5 months after award, which is only 2 months longer than the time allotted by LMD for open burning.

It is the opinion of the EDE explosive chemist, as well as independent explosives safety experts and chemists which EDE has contacted who are familiar with the Camp 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. It is also recognized that possible public protests and opposition could delay open burning implementation and completion.

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 been through this process for a very similar system recently for the Letterkenny contained burn facility which will streamline this process, if DDESB is asked to review or approve this facility.

Environmental regulatory permits are also required, typically an Air permit and RCRA, Subpart X Permit. Contained Burn Systems have been permitted in many states as a Subpart X Miscellaneous Units. *The primary thermal treatment chamber is not defined as an incinerator as it does not have "controlled flame combustion" as described in 40 CFR 260.10. As a Subpart X unit, the system will be operated in a manner as defined by 40 CFR 264 to endure protection of human health and the environment.*

This shall include prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in the ground water or subsurface environment; prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, or wetlands or on the soil surface; prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air. These pathways are discussed in more detail in the work plan.

EDE has experience in preparing these permits and has recently completed the preparation, submission, and approval cycle for these permits for a very similar facility at Letterkenny. This will expedite the process for providing the necessary information and acquiring the required approvals from Louisiana Department of Environmental Quality (LDEQ).

CONTAINED BURN CHAMBER COST SUMMARY

CONTAIN BURN SYSTEM PRICE PROPOSAL

PHASE-1	MOBILIZATION & SITE PREPARATION			
Item	Designation	Unit of Issue	Unit Price	Total Price
001	Pre-mobilization Includes: Permitting, Licensing, Ordering, Training & Reporting	Lump Sum	$220,547	$220,547
002	Mobilization and Site Ancillary Setup Includes: Environmental, Site Work, Construction & Magazine	Lump Sum	$736,412	$736,412
003	Supply of Turnkey Contained Burn System with Basic Pollution Abatement System (PAS) Includes: Site Specific Design, Civil & Electrical Infrastructure Thermal Treatment Chamber & Loading System, PAS Valve, Air, Instrumentation & Power Distribution Equipment Controls (HMI, PLC, MCC) & CCTV System Installation &Systemization Initial Stack Testing (up to 1 week) BASIC PAS: Cyclone, Gas Cooler Heat Exchanger, Baghouse, ID Fan, All Ductwork & Stack	Lump Sum	$7,713,145	$7,713,145
			Total Phase-1 Cost	$8,670,104

PHASE-2	REMOVAL & DISPOSAL OPERATIONS			
Item	Designation	Unit of Issue	Unit Price	Extended Price
005	M6 Propellant - 15,700,000 lbs.	Unit Cost/lb.	$0.90/lb.	$14,130,000
006	Clean Burning Igniter - 320,000 lbs.	Unit Cost/lb.	$0.51/lb.	$163,200
			Total Phase-2	$14,293,200

PHASE-3	SITE RESTORATION & DEMOBILIZATION			
Item	Designation	Unit of Issue	Unit Price	Total Price
007	Environmental , Site Recovery & Restoration	Lump Sum	$394,643	$394,643
008	Final Reporting and Project Closeout	Lump Sum	$81,000	$81,000
			Total Phase-3	$475,643

TOTAL PROJECT	$23,438,947

CONTAINED BURN SYSTEM PRICE PROPOSAL OPTIONS

ADDITIONAL POLLUTION ABATEMENT OPTIONS			
Option 003 -01	ADVANCED PAS: Includes: High Temp. Afterburner, Heat Exchanger SNCR system (NOX reduction), Ductwork & Controls	Lump Sum	$2,872,497
Option 003 -02	BEST AVAILABLE PAS Includes: SCR system for NOx Reduction, HEPA, Ductwork & Controls	Lump Sum	$1,327,000
Option 004	BASIC CONTINUOUS EMISSIONS MONITORING SYSTEM (CEMS) Includes: Sample Probe, Pumps, Lines, Purge System, Shelter, Cal. Valve Panel, Gas Conditioner, Factory Test, Cal. Gas System, O2 Analyzer, & CO Analyzer	Lump Sum	$342,375
Option 004-01	CEMS NOx Analyzer, Cal. Gases, Spare Parts	Lump Sum	$22,550
Option 004-02	CEMS THC Analyzer, Cal. Gases, Spare Parts	Lump Sum	$27,115
Option 004-03	CEMS Stack Flow Meter	Lump Sum	$31,900

- Pollution abatement and CEMS options above are in addition to proposed cost on previous page.