El Dorado Engineering, Inc.
Applications of Contained Burn Technology

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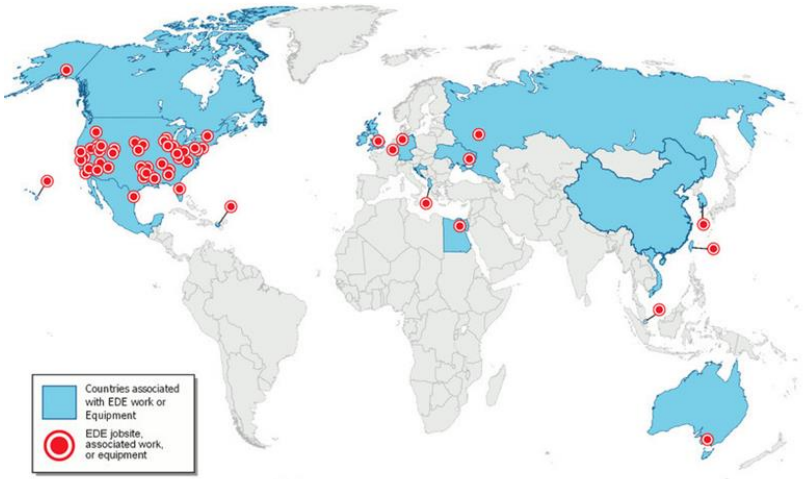
El Dorado Engineering, Inc.
Designers - Consultants

- Over 34 yrs. Specializing in the Demilitarization Industry, HQ in Salt Lake City, UT

- Capabilities Include:
  - Design
  - Consulting
  - Fabrication
  - Installation
  - Commissioning
  - Training
  - Permitting



- Specialize in demilitarization of conventional munitions, chemical munitions, bulk propellants, explosives, and pyrotechnics (PEP), and rocket motors
  - Thermal Treatment
  - Pollution Control Systems
  - Recycling/Conversion of energetic materials and munition related waste
  - Disassembly Machines
  - Environmental consulting, permitting and restoration, related to PEP

Take pride in record of safety, project cooperation, and client satisfaction

El Dorado Engineering, Inc.

RECENT PROJECTS INCLUDE:

- Developed and constructed small-scale semi-continuous feed contained burn facilities for disposal of commercial energetic wastes for many private commercial clients
- Design/build contained burn systems to dispose of small tactical rocket motors (<50 lbs NEW)
- Design/Build turnkey facility for contained burn of large tactical rocket motors (e.g. MLRS) for U.S. Army at Letterkenny Army Depot, Pennsylvania*****
- Design/Build turnkey contained burn system for Bulk Single Base Propellant for emergency response removal action at Camp Minden, Louisiana*****
- Design & install turnkey induction heating meltout system for explosives recycling from mortars*****
- Turnkey Rotary Kiln Explosive Waste Incinerators Worldwide, including international facilities in: Taiwan, Germany, Albania, U.K. , South Korea, Ukraine, & Belgium.
- Turnkey Flashing Furnace Systems and Contaminated Waste Processors (Ravenna AAP, Eglin AFB, Hill AFB, Anniston AD, China Lake NWS, Puerto Rico, Hawaii, Talon, WV, Letterkenny AD, Albania, Belgium, Mexico)
- Design & Construct a facility to demilitarize flares, reclaiming and recycling magnesium
- Design, Build, and Demonstrated water jet washout system for chemical munitions
- Used our understanding of combustion processes & atmospheric dispersion to consult for NASA on go/no-go launch criteria for Space Shuttle Launches, and permitting of Demil & test facilities

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***** *Ongoing*

Demilitarization Technology Considerations

- Safe
- Environmentally Responsible
- Effective
- Robust
- Simple
- Proven
- Inexpensive
- Versatile

Non-Open Burning
Thermal Treatment Alternatives

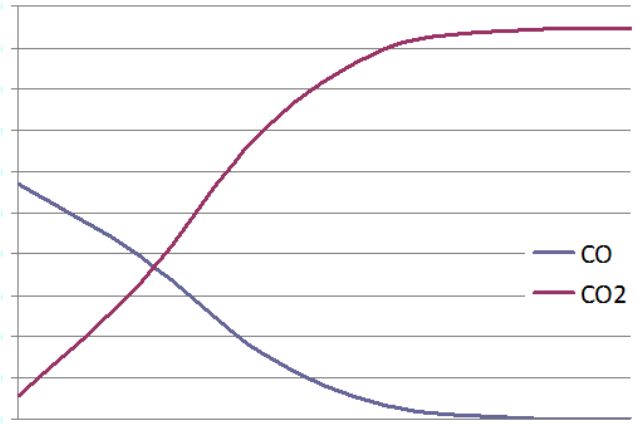
- **Contained Burn**
- Rotary Kiln
- Static Kiln
- Tunnel Furnace
- Contained Detonation
- Car-bottom Furnace
- Transportable Furnace
- Co-firing Boilers

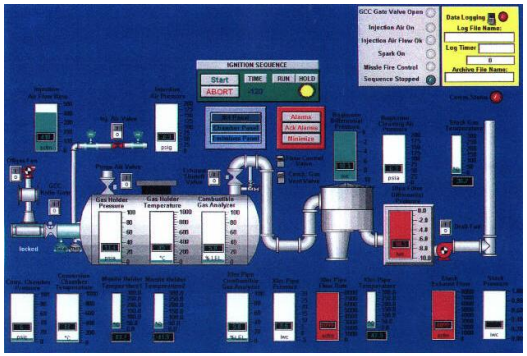
Contained Burn Systems

- Bulk Propellant, Explosives
- Tactical Rocket Motors
- Air Bag Propellants
- Igniters, Detonators
- PEP Contaminated Waste

Contained Burn Technology System Elements

- Feed System:
  - Minimize Handling
  - Batch or Semi-Continuous
- Containment Vessel:
  - Promote Proper Combustion
  - Contain Products
- Ignition Source: Reliable, Safe
- Pollution Abatement System
  - Meter and Scrub Exhaust
  - Prevent Fugitive Emissions
- Controls





Commercial Clients
Various Turnkey Systems

- Semi-Continuous Feed
- Multiple Stations
- Different Feed Types
- Continuous Exhaust
- Efficient Pollution Control
- Simple Permitting

Contained Burn
Batch Cycle Process

- Feed System Interlocked with Ignition Controls
- Ignition Source
  - Electric Match
  - Hot Wire
- Containment Vessel
- Metering Valve
- Pollution Control System
- Controls/Data Acquisition

Contained Burn Technology Scaling

10 pounds per burn cycle

50,000 pounds per burn cycle

Contained Burn

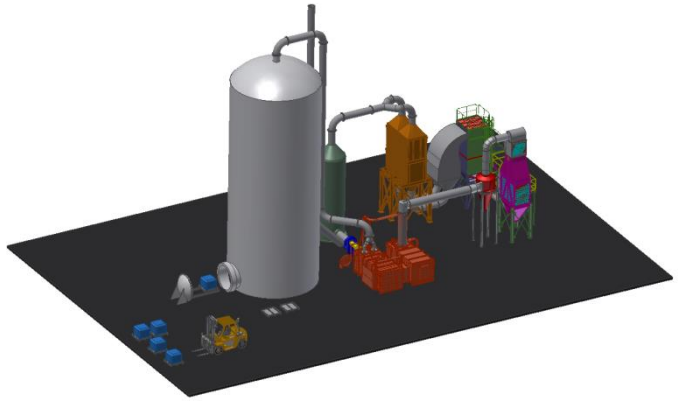
Recent Applications

Small Tactical Rocket Motors (2 Projects)

- Small Tactical Rocket Motors (<20 lbs propellant)
- Design Throughput: >40 motors per day
- Multi Stage (dual grain) double based propellant
- Dry scrubber PAS (OGT) for particulate

Ammonium Perchlorate Rocket Motor Demil (ARMD)

- Flexibility for Wide Variety of Tactical Rocket Motor Types
- 60 – 1605 lbs propellant per RM
- Design throughput: up to 3 cycles per hour
- Off Gas Treatment for HCl, particulate, and dioxin/furan
- Full-Scale demonstration performed for:
  MLRS (216 lbs NEW) and PHX (365 lbs NEW)
- Production Facility Under Construction, Startup Spring 2016



Camp Minden M6 Bulk Propellant

- Throughput >15 million lbs of M6 propellant in One Year
- Off Gas Treatment similar to Belgium EWI
- Emergency Response: Design/Build < 8 months
- Production Facility Under Construction, Startup 1Q 2016

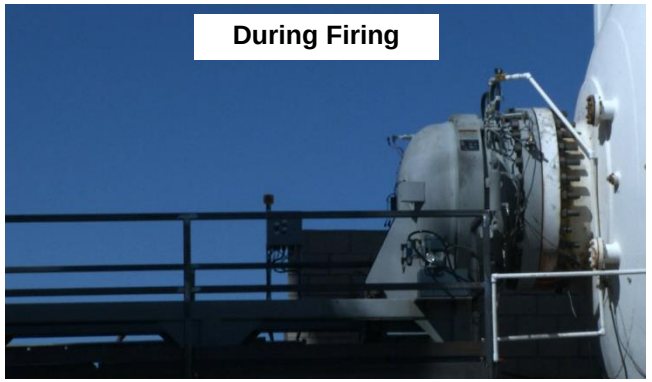
ARMD

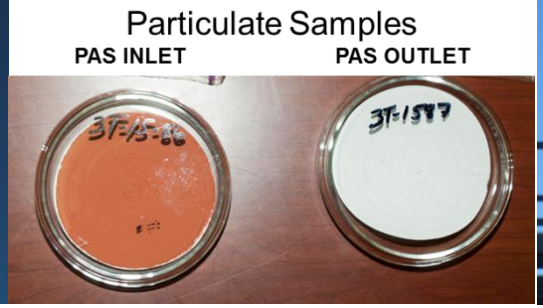
- Large Workload
  - 60 – 1605 lbs Propellant/Motor
  - Challenging Chemistry
- Thorough Technology Evaluation
  - Non Open Burning
  - Numerous Stakeholders
- Contained Burn Selected
- Construction Ongoing
  - Letterkenny, PA
  - RCRA and Air Permits Approved
  - DDESB

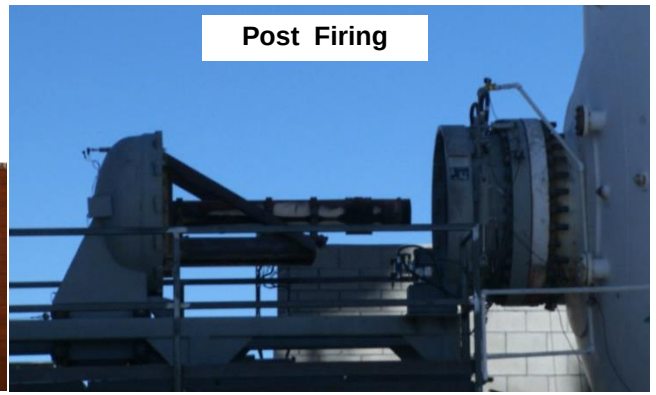
ARMD

PROCESS DESIGN

- RM's are placed on firing stand
- RM's are remotely loaded into system
- Remote automated chamber sealing with ignition interlock
- RM's are static fired intact
- Propellant burns as designed
- Gases are contained in chamber
- Gases cool and are metered through economical pollution abatement system

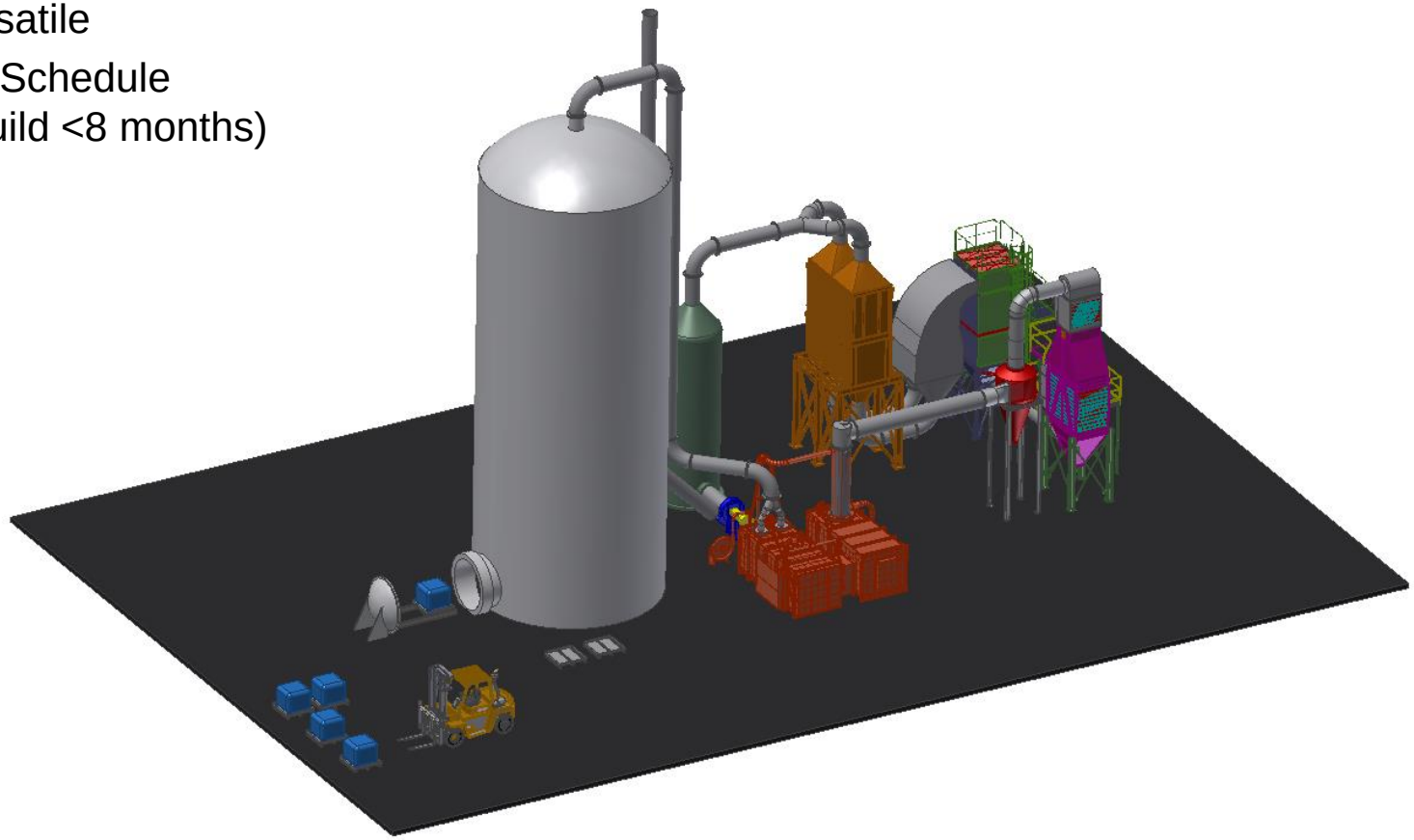






Camp Minden Contained Burn System

- Intense Public Scrutiny
- Advanced Pollution Control
- Throughput (>15 million lbs/yr)
- Highly Versatile
- Expedited Schedule (Design/Build <8 months)
- Up to 880 lbs per Cycle
- Up to 3 cycles per Hour



Key Advantages of Contained Burn

- Safety
- Versatile
- Inexpensive
- Proven
- Efficient Pollution Control
- Relatively Simple Permitting