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PICATINNY ARSENAL, NJ

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2015 Global Demilitarization Symposium

A Productivity Improvement Study of the APE-1236M2 Rotary Kiln Incinerator

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Participating Organizations

- Office of the Product Manager for Demilitarization
- Armament Research, Development and Engineering Center (ARDEC)
- Joint Munitions Command
- Public Health Center
- Defense Ammunition Center – Technical Center for Explosives Safety (USATCES)
- Department of Defense Explosives Safety Board (DDESB)
- Engineering and Support Center Huntsville
- Tooele Army Depot (TEAD)
- Crane Army Ammunition Activity (CAAA)
- Coterie Environmental
- Camber Corporation

Acknowledgements

- **General Dynamics - Ordnance and Tactical Systems**
  - **Review of Joplin Facility Rotary Kiln Incinerator**

- **Lake City Army Ammunition Plant and Orbital-ATK**
  - **Review of Lake City Army Ammunition Plant Energetic Waste Incinerator**

Overview

- **Study Objectives**
- **APE-1236M2 Baseline Assessment**
- **Gap Analysis**
- **Recommendations**
- **Conclusions**
- **Summary**

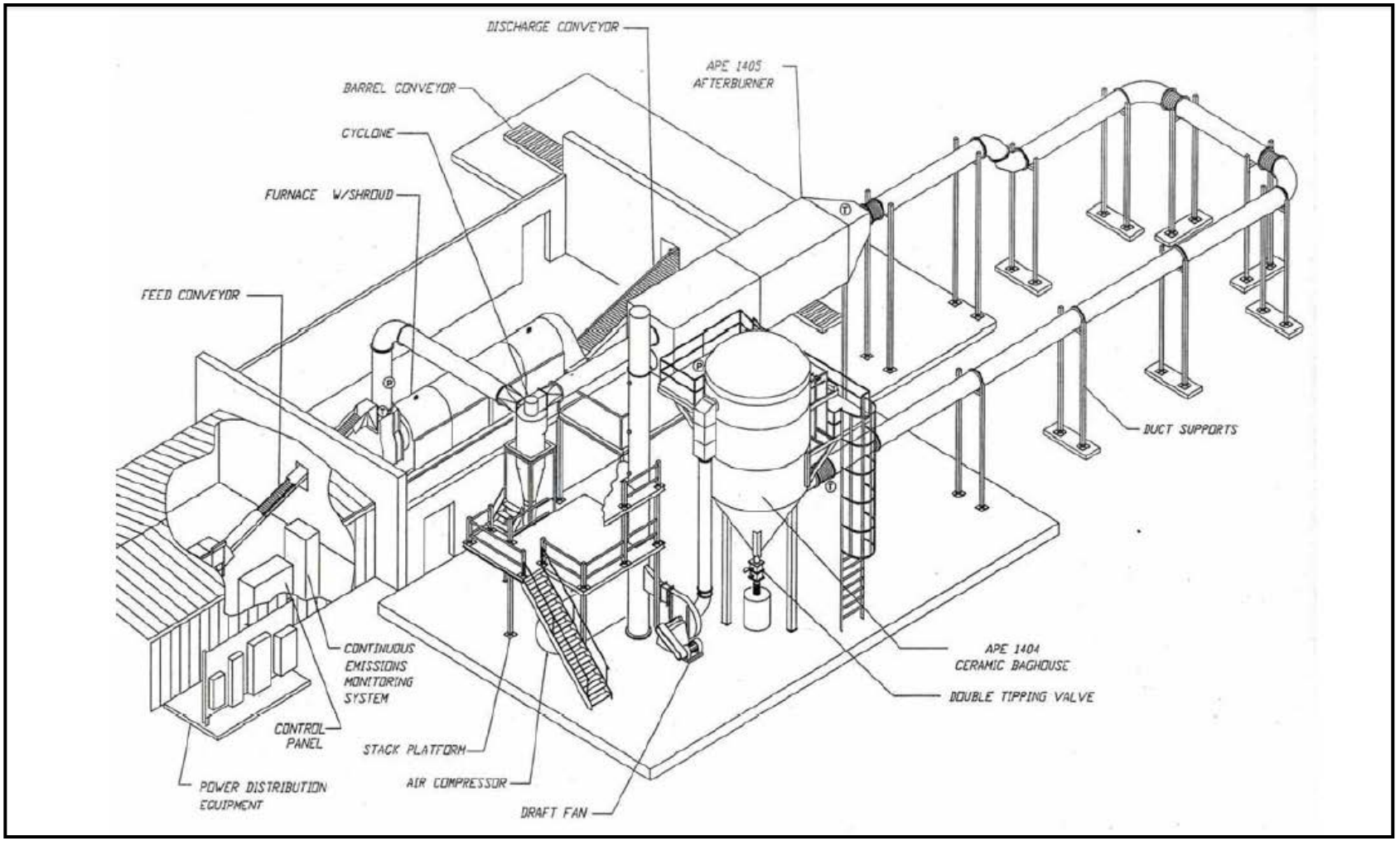
Study Objectives

- **Study Objective:**
  - **To develop a plan to increase the capacity and efficiency of the APE-1236M2 incinerators for conventional ammunition demilitarization including the APE-1405 2 second afterburner and APE-1404 high temperature ceramic baghouse**

- **Approach:**
  - **Form Integrated Product Team (IPT) to leverage technical, safety, logistics, operational, and safety expertise from within the demil enterprise to perform a critical evaluation of the existing APE-1236M2 capability and to identify opportunities for improvement of this proven demilitarization asset**

- **Deliverable:**
  - **Final report documenting limitations and inefficiencies of the current system and a list of recommendations for providing improved demilitarization capability and lower associated costs**

APE-1236M2 System Description



APE-1236M2 System Description

- Rotary Kiln Furnace Retort and Supporting Equipment
  - Feed Conveyor
  - Cast Steel Rotary Kiln and Fuel-fired Burner
  - Ancillary Equipment
- Air Pollution Control System
  - Cyclone
  - APE-1405 2-Second Afterburner
  - Stainless Steel Ducting
  - APE-1404 High Temperature Ceramic Baghouse
  - High Temperature Draft Fan
  - Stainless Steel Exhaust Stack
- Control and Gas Monitoring System
  - Programmable Logic Controller (PLC) System and Continuous Emissions Monitoring System (CEMS)

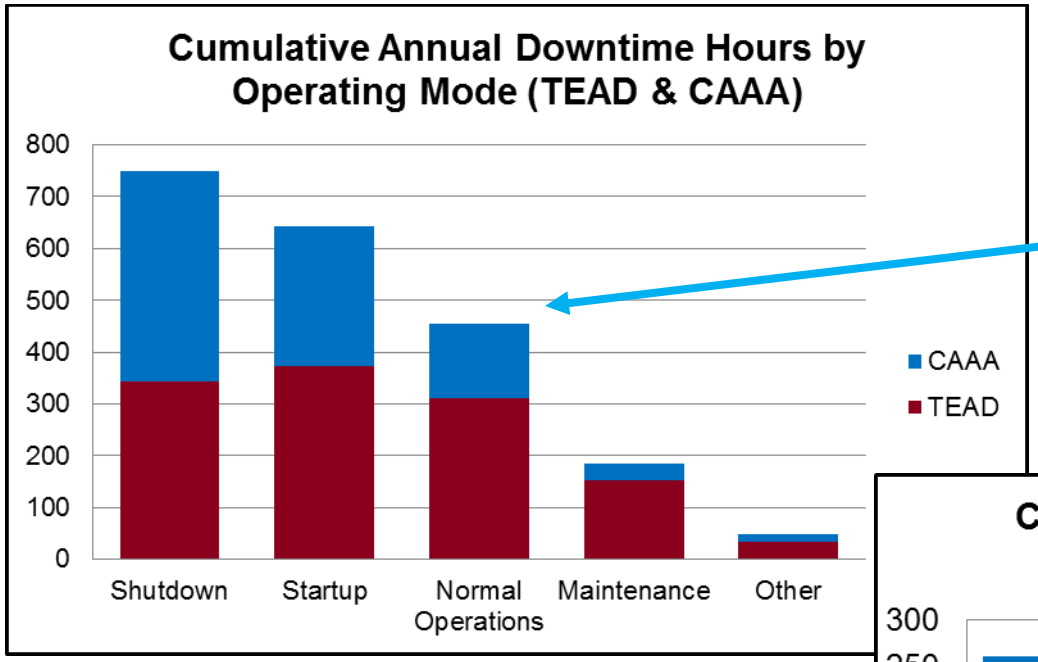
APE-1236M2 Baseline Assessment Approach

- **Process Documentation Review**
  - **Design Documentation**
  - **Operating and Maintenance Manuals**
  - **Safety Analyses**
- **Operational Assessments**
  - **TEAD**
  - **CAAA**
- **Safety Constraints**
  - **Site Safety Plans, Standard Operating Procedures, Inspection Procedures**
- **Regulatory and Compliance Testing Processes**
  - **Permits, Compliance Test Data, and Operating Parameter Limits**
- **Logistics and Workload Planning Processes**
  - **Workload Assignment, Staffing, and Scheduling**

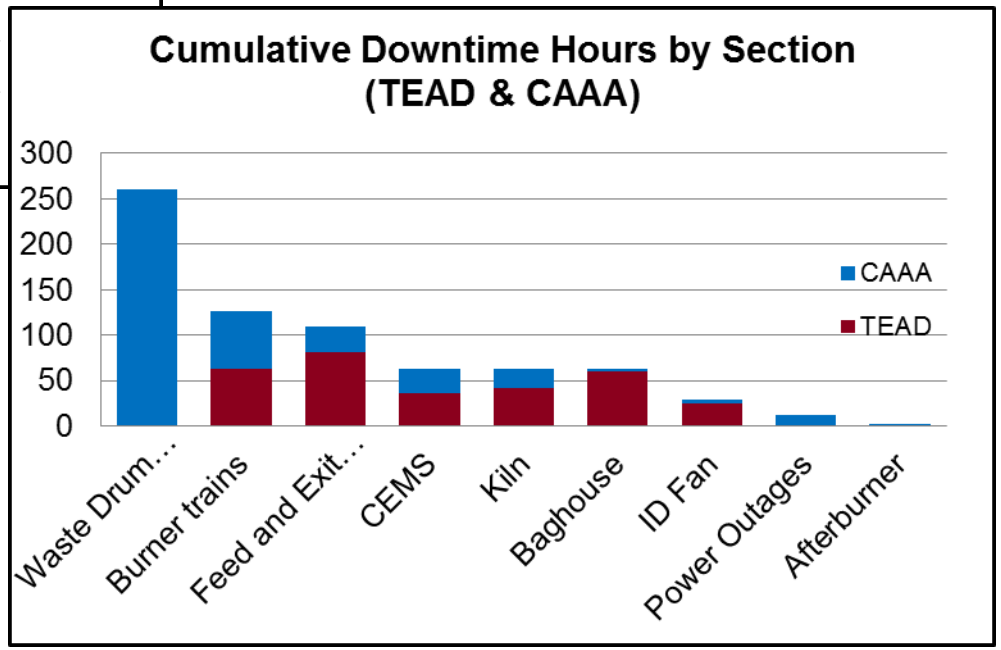
APE-1236M2 Baseline Assessment Findings

- **A number of factors contribute to limit the capability and effectiveness of the APE-1236M2 incinerators**
  - **Operations – Low historical operational availability (48%-54%) due to operating schedules and insufficient preventive maintenance**
  - **Design – High repair times for equipment in personnel exclusion areas; undersized buffers; inefficient and/or custom components; design features that limit capacity for processing explosives; lack of automated feed systems**
  - **Safety – Significant gap between system safety limits and operational limits; reliance on labor intensive visual inspections**
  - **Regulatory Compliance – Large site-to-site variation in waste feed limits; lack of enterprise level engagement in test plan development; lack of system environmental performance baseline; demonstration of low PEP rates**
  - **Logistics – Accuracy of data used to populate Demil Optimizer database; lack of robust spare parts program; issues associated with estimation of capabilities and costs at MIDAS family level**

Operational Analysis



Similar pattern of component failures with exception of waste drum buffer issue



Significant inefficiency associated with single shift operations

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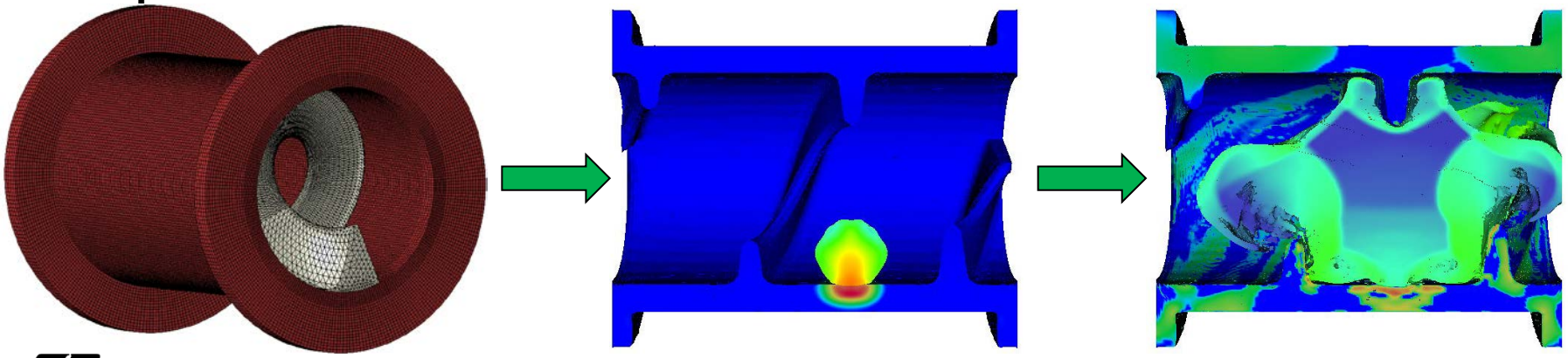
Safety and NEW Processing Analysis

- **Significant gap between system safety limits and operating limits for processing explosives**
- **Conflicting NEW limits for processing energetics in technical references:**
  - **Hazards and Safety Analysis Explosive Waste Incinerator – July 1979**
    - **6.00 lbs. per flight TNT equivalent based on blast overpressure surrounding enclosure**
    - **Significant equipment damage was observed at this safety limit**
  - **TM 9-1300-277 Technical Manual – General Instructions for Demilitarization/Disposal of Conventional Munitions**
    - **Item NEW restriction of 800 grains per item**
  - **Generally followed net propellant/explosive/pyrotechnic constraint of 240 lb/hr**
  - **Highlights the need for better understanding of system explosive processing limits**
- **All material inspected in accordance with DODI 4140.62 following processing**

Blast and Structural Response Modeling

- **Used Finite Element/Finite Volume Hydrocode (Abaqus V13) for stresses; Results passed to FESafe and NASGRO to predict fatigue and crack growth, respectively, for 9 gram, 21gram, 0.5 lb., and 1 lb. cases**
  - **Evaluated the stresses resulting from detonations of various charge sizes and the effects of cyclic detonations on crack growth and retort fatigue life**
  - **"C" retort sections can withstand ~800 detonations of ½ lb. NEW charge before critical crack formation; exhibit 6x the life of the thinner "B" sections**
  - **Established predictive failure and inspection criteria and conducted parametric studies on standoff and retort thickness**

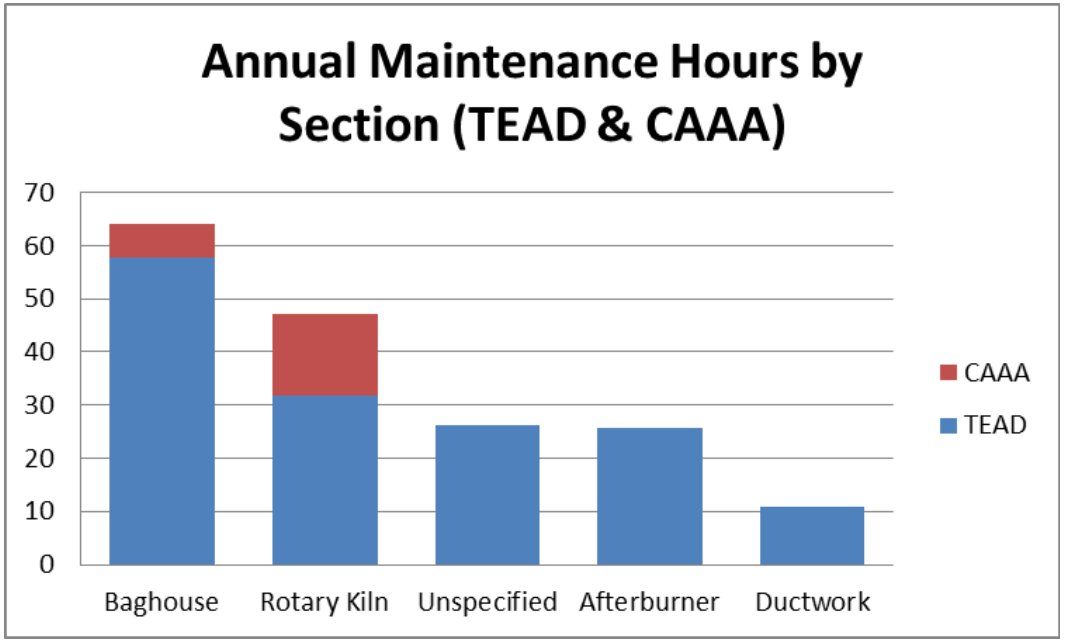


Regulatory and Compliance Testing Analysis

- **APE-1236M2 incinerators are considered as Maximum Achievable Control Technology (MACT) units permitted under both the Resource Conservation and Recovery Act (RCRA) and Title V of the Clean Air Act (CAA)**
- **Air emissions standards established under 40 CFR 264.340 (Subpart O – Incinerators) for hazardous air pollutants**
- **Comprehensive Performance Test (CPT) every 5 years with confirmatory test midway between CPTs**
- **Operating Parameter Limits developed as a result of these CPTs vary significantly among depots, limiting feed rates and associated workload options**
  - **e.g. PEP (56 lb/hr – 238 lb/hr), SVM (0.2 lb/hr – 2.0 lb/hr)**
  - **Generally results from reducing pollutant feed rates in response to unexpected results in mini-burn testing; only considering short-term workload objectives without engaging enterprise stakeholders**
  - **Lack of standardized processes to trigger diagnostics and repairs rather than test plan adjustments**

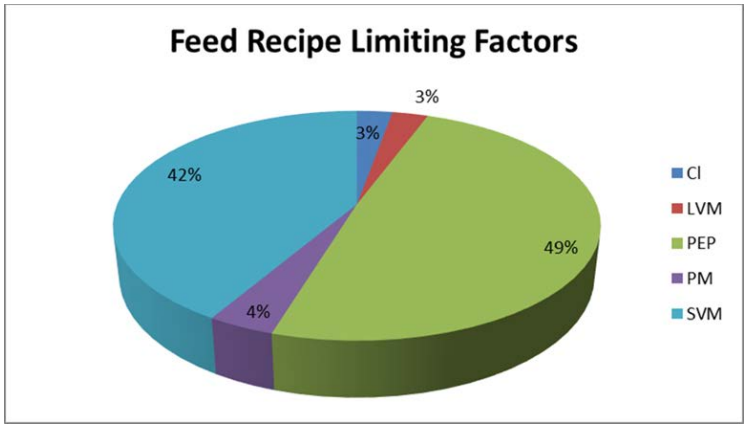
Logistics and Workload Assignment Process Analysis

- **Reviewed processes for assigning workload, staffing, and maintaining the APE-1236M2 incinerator**
  - **Questionable accuracy of historical operating cost data**
  - **Lack of robust spare parts program**
  - **Limited evidence that preventive maintenance programs are followed**
  - **Process data that is collected is not in a format that supports process analysis and optimization**



Historical Performance and Environmental Compliance Gaps

- **Stockpile and Historical Operating Cost Review**
  - **Limited tools for measuring actual demilitarization costs**
  - **Limited capabilities for Propellants/Explosives/Pyrotechnics and Semi-volatile metals; poor design for dioxin/furan control**



- **Permitting and Environmental Compliance Gaps**
  - **Lack of performance baselines and standardized performance testing approaches to maximize capability and workload flexibility**
- **Safety Gaps**
  - **Reliance on 2x100% visual inspection rather than approved means designations**

Safety Gaps, Logistics Gaps, and Analysis of Alternatives

- **Logistics and Workload Assignment Gaps**
  - **Limited integration of constituent data, regulatory limits, stockpile data, and historical cost for workload optimization**
  - **Inefficient operating schedules**
  - **Lack of data acquisition and depot continuous improvement processes**
- **Conducted Evaluation of Commercial and GOCO Demilitarization Incinerators**
  - **GD-OTS Rotary Kiln Incinerator and LCAAP Energetic Waste Incinerator**
- **Alternate Technology Assessment**
  - **Feed System Improvements**
  - **Kiln Improvements**
  - **Discharge Conveyor and Inspection System Improvements**
  - **Pollution Abatement System Improvements**

Analysis of Alternatives

Gap Analysis Alternatives										
Alternative		Targeted Improvement Area								
Type / Category	Description	Capacity	RAM	Efficiency	Effectiveness	Flexibility	Reduce Cost/ton	Safety	Environmental	
Feed System	Provide Bulk Feed Capability				X		X	X	X	
	Provide Dual Feed Capability	X			X	X	X	X		
	Upgrade Feed Housing			X					X	
	Upgrade Feed Conveyor			X						
Kiln	Kiln Burner Upgrade			X	X					
	Increase Kiln Length					X	X		X	
	Increase Retort Wall Thickness						X		X	
Debris Conveyor and Inspection	Upgrade Debris Conveyor			X						
	Modify SOPs to Use Mold Release Agents on Debris Conveyor			X						
	Redesign Debris Handling System			X						
	Submit of Item-Specific Exemptions				X			X	X	
	Install Final Deactivation Equipment w/ Metals Separation					X			X	
Pollution Abatement System	Upgrade Afterburner Burner			X	X					
	Install Evaporative Cooler / Dry Reagent Injection / Fabric Filter Baghouse	X		X	X	X	X	X		X
	Install Catalytic Oxidizer / Wet Scrubber	X				X	X			X
	Install Supplemental Particulate Matter Control Techology					X				X
	Install Wet Electrostatic Precipitator	X				X	X			X
Permitting and Environmental Compliance	Establish Enterprise-wide Compliance Testing Standards	X			X			X		X
	Establishment Pre-test Maintenance and Decontamination Procedures	X			X			X		X
	Develop Pollution Abatement System Baseline Performance Criteria	X		X	X					X
	Modify SOPs to Allow Removal of Debris for Certain Items During Operation	X		X	X					
Logistics and Workload Assignment	Develop Improved Workload Planning Tools and Optimization Tools				X		X	X		
	Switch Incinerator Operations to Continuous, Campaign Basis	X		X	X			X		
	Change Workload Assignment Practices to Support Continuous Operations	X		X	X			X		
	Development of Improved Cost Reporting Tools				X			X		
	Establish Continuous Improvement and Leaning Programs at Depot Level			X	X			X		
	Develop Process Data Acquisition and Historian System			X	X			X		

Recommended Process Upgrades

- **Feed System Upgrades**
  - **Redesign feed system, controls, and feed housing to allow for automated bulk feeding and mixed feed recipes**
- **Discharge Conveyor Upgrades**
  - **Evaluate options for reducing accumulation of material on conveyor resulting in stoppages and poor reliability**
  - **Upgrade barrel capacity or provide means for removal during operations**
- **Burner Upgrades**
  - **Replace old proportional burners with more efficient burners to provide optimized fuel:air stoichiometry, improved efficiency, better turndown ratios, and better temperature control**

Recommended Process Upgrades – Cont'd

- **Pollution Abatement System Upgrades**
  - **Replace high temperature ceramic baghouse with evaporative cooler/fabric filter baghouse combination to improve maintainability, reduce dioxin/furan and SVM emissions, and enable more efficient reagent delivery**
- **Rotary Kiln**
  - **Add additional retorts and increase retort wall thickness to uniform 4" over the length of the kiln to provide increased PEP processing capability and longer residence times for deactivation of energetics; pursue item-specific approved means designations for many of the items that are routinely processed to reduce inspection costs**

Conclusions

- **A productivity improvement study of the APE-1236M2 incinerator was conducted by an Integrated Product Team consisting of Demilitarization Enterprise stakeholders**
  - **Inefficiencies resulting from equipment designs, operating schedules, logistics tools and processes, workload assignment, maintenance, environmental permitting, and safety constraints were identified as target areas for productivity improvement efforts**
  - **An analysis of alternatives was completed and a set of recommendations were provided for addressing inefficiencies resulting from equipment designs**
- **This study highlights the need for continued productivity improvement efforts and increased collaboration among demil enterprise stakeholders as a means of optimizing existing capabilities**
  - **Productivity improvement opportunities identified at several levels due to engagement of broad subject matter expertise**