CRITICAL ENERGETIC MATERIAL INITIATIVE

IM/EM Technology Symposium

16 MAY 2012

OUSD(AT&L)/S&TS/Land Warfare and Munitions

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Critical Energetic Materials Initiative

- **Problem Statement**
  - There is no coordinated effort to determine how the Department of Defense should ensure the availability of energetic materials critical to warfighter needs.
- **Scope**
  - Focused solely on energetic compositions, their ingredients and the precursors and reagents used to produce them. For the purposes of this effort energetic materials (EM) is defined as a class of compounds and formulations containing a high amount of stored chemical energy which may be manipulated to be released in a controlled manner through weapon systems. This would include, but not limited to, materials such as explosives, propellants, pyrotechnics, and their ingredients.
- **OSD Role**
  - Coordinate efforts across Departments/Services/Agencies
    - Gain efficiencies for Department
    - Proactively identify problems and solutions before significant impacts to the Department
  - Provide recommended solutions to DoD senior leadership for decision
- **OSD Stake Holder Initiative Support**
  - S&TS / MIBP / I&E / L&MR / R&E
- **Energetics Community Initiative Support**
  - Services/DoD Agencies/Departments
    - Army, Navy, Air Force, Marine Corps
    - Defense Logistics, DARPA, DCMA, DTRA, MDA, SOCOM
    - NASA,DOE: NNSA, SNL, LLNL, LANL
  - Industry
    - National Warheads and Energetics Consortium

Critical Energetic Materials Initiative

- **Critical Energetic Workshops**
  - Conducted two workshops
    - Explored Scope and Interest in “Critical” Energetics
    - Representation from OSD/Industry/Services/Agencies/DOE
- **Critical Energetic Material Tiger Team Goals**
  - Develop/refine the definition of a “critical” energetic material
  - Identification
    - Develop/Exploit a process to determine the energetic materials and their ingredients at risk of becoming unavailable to the Department of Defense in the short term (within 3 years) and long term(3-10 years).
  - Prioritization
    - Establish criteria to determine materials that are “critical” for the department
    - Quantify the risk for such materials.
  - Mitigation (IPT Goal)
    - Determine a process to establish mitigation plans for materials deemed “critical” by the IPT.
  - Strategic Plan (IPT Goal)
    - Develop a Strategic Plan to define and mitigate long term issues impacting “critical” Energetics

Workshop #1

- Participants
  - ~ 60 attendees across DoE, Industry (NWEC), DoD Services and DoD Components
- Goals
  - Develop Problem Statement
  - Define “energetics” and “critical energetics”
  - Identification of Critical Energetics
    - Briefings
      - Industry Perspective - Charlie Zisette / TTCP – Dr. Jamie Neidert / SMCA-IBAT – Paul Sundberg
    - Focus on current efforts used within DoD/Industry to identify problems
  - Prioritization of Critical Energetics
    - Briefing on Single Point Failures – Brian Meierdiercks
    - Focus on currently available techniques to identify most challenging problems
  - Risk Mitigation Efforts
    - Briefing on TATB Working Group – Tim Mahoney and Crane Robinson
    - Explored risk mitigation strategies
  - General Outcome
    - An IPT would best address the issue of critical energetic materials

Workshop #2

- Participants
  - ~ 45 attendees across DoE, Industry (NWEC), DoD Services and DoD Components
- Goals
  - Review of "Real World" Problems
    - Review of specific material issues
    - BT, Lead Azide, TATB, etc…
  - "Business Case" for OSD Involvement
    - Cross Service/Department Material Issues
    - Proactively identify problems/Improve efficiency
    - Service(s) can not solve problem
  - Foreign Supply - Industrial Policy
    - Policy
    - Source reliability
    - Material suitability
  - Proposed IPT Structure
    - Charter, Process, Model, Cost
    - Roles and Responsibilities
      - Membership/Participation
      - Functions & Requirements
  - Review of established Critical Energetic Material Lists

Critical Energetic Materials Case Studies

- Case Studies
  - Butanetriol (BT)
  - Triaminotrinitrobenzene (TATB)
  - Ammonium Perchlorate (AP)
  - Lead Azide
  - Hydroxyl-Terminated Polybutadiene (HTPB)

These are critical to OSD due to Industrial Base issues as well as supply of critical materials to the warfighter.

Energetic Material Case Studies
Butanetriol (BT)

- **Background**
  - BT Is A Precursor Material For Butanetriol Trinitrate (BTTN) Which Is Required In The Production Of Minimum Smoke Propellants
  - No Domestic Sources Found That Could Produce BT In The Required Quantities
  - Only Source Identified was Shanghai Fuda Fine Chemicals Which Is Located in China
  - Section 1211 of FY 2006 NDAA prohibits acquisition of USML items from China
  - Request For Procurement Of Up To 65,000 Lbs Of Foreign Source BT To Support Hellfire, Javelin And TOW Production
  - Waiver Signed By SECARMY On 4 Nov 2008
  - DoD developing a domestic BT source (RFAAP, HAAP, PennKem, Dow)
- **Impact**
  - PEO MS Requested Procurement of Cytec Manufactured BT From NSWC IHD Inventory
    - Stockpile is consumed
  - No domestic or NATO supplier
    - Scale up and purity are the issues
  - ATK Expected To Begin Production Of Rocket Motors Utilizing Foreign Source BT For Hellfire In The Late April/Early May Timeframe
  - Current BT Procurements Expected To Support Production Into, or Through, 2012
  - Programs Impacted
    - TOW/JAGM/Javelin/Griffin/Hellfire/Chaparral
- **Mitigation Plan**
  - Use Chinese produced BT
  - 18-24 month production window at current run rate
  - Continue evaluating potential domestic suppliers

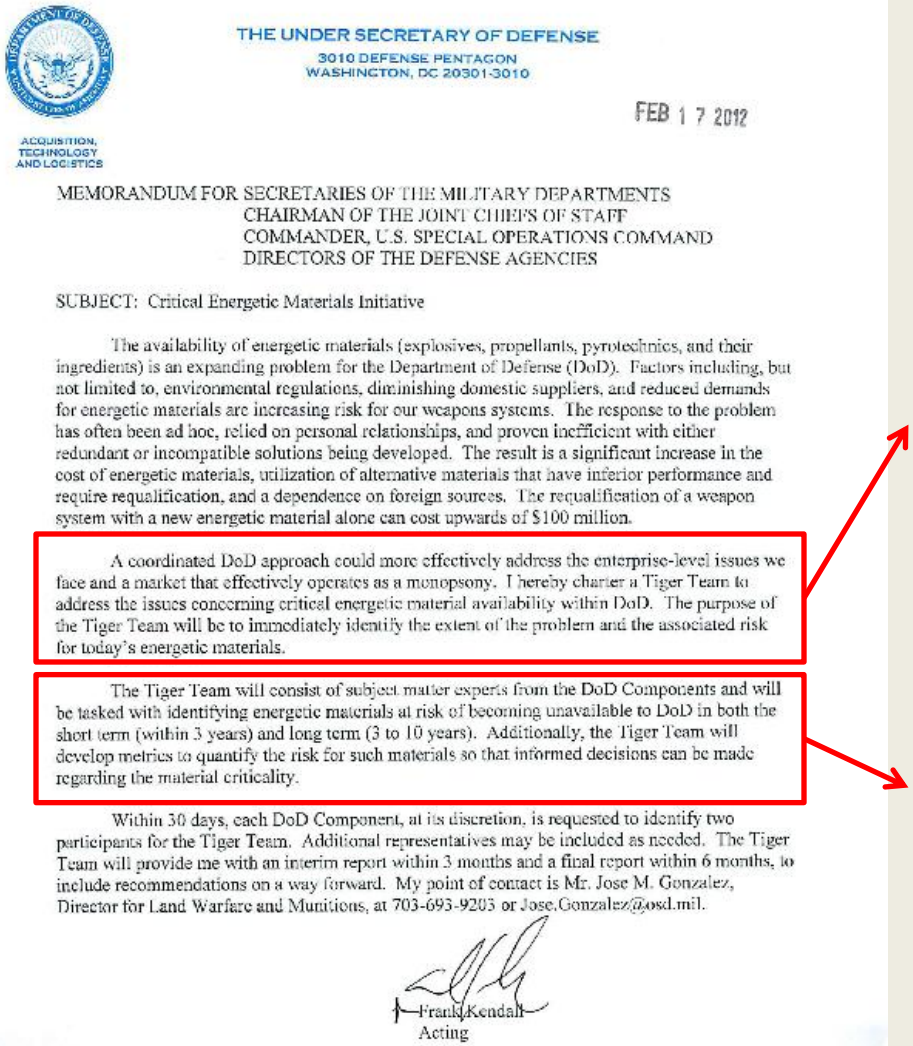
Energetic Material Case Studies
Triaminotrinitrobenzene (TATB)

- **Background**
  - Triaminotrinitrobenzene (TATB) is one of the least sensitive explosive materials known, used in PBXN-7 and PBXW-14
  - 1993 CONUS TATB production ceased
  - 2005 last qualified OCONUS source ceased production and closed in 2006
- **Impact**
  - DoD left without a source for TATB
  - Programs Impacted
    - PM CAS Mortar Systems
    - Tactical Tomahawk / SLAM ER / JSOW / Quickstrike Mine
    - AF & Navy Bombs
  - No suitable replacement available
  - Services unable to solve problem without OSD support
  - DoD dependant on limited DOE stockpile
- **Mitigation Plan**
  - DoD/DOE working group recommends establishing CONUS Benziger TATB Route
    - Two GOCO Vendors – ATK Radford and BAE Holston
  - $11.8M needed immediately for CONUS Source of TATB
  - CONUS TCB Manufacture (RFI issued)
    - Environmental production challenges
  - Leverage DOE TATB Strategic Stockpile
  - $2.5M Funding for reclaimed TATB
    - Potential R3 demonstration for munitions applications

CRITICAL ENERGETIC MATERIAL TIGER TEAM

- USD (AT&L) redirected effort to a Tiger Team
  - Did not want open ended body established
  - Wanted clear deliverables
  - Wanted to see “business case” for initiative
- Initiative coordinated at across Dept
  - Service Acquisition Executives
  - Directors of the Defense Agencies
  - OUSD (AT&L)
  - Office of General Council

TIGER TEAM MEMO



THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION, TECHNOLOGY AND LOGISTICS

FEB 17 2012

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
COMMANDER, U.S. SPECIAL OPERATIONS COMMAND
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Critical Energetic Materials Initiative

The availability of energetic materials (explosives, propellants, pyrotechnics, and their ingredients) is an expanding problem for the Department of Defense (DoD). Factors including, but not limited to, environmental regulations, diminishing domestic suppliers, and reduced demands for energetic materials are increasing risk for our weapons systems. The response to the problem has often been ad hoc, relied on personal relationships, and proven inefficient with either redundant or incompatible solutions being developed. The result is a significant increase in the cost of energetic materials, utilization of alternative materials that have inferior performance and require requalification, and a dependence on foreign sources. The requalification of a weapon system with a new energetic material alone can cost upwards of $100 million.

A coordinated DoD approach could more effectively address the enterprise-level issues we face and a market that effectively operates as a monopsony. I hereby charter a Tiger Team to address the issues concerning critical energetic material availability within DoD. The purpose of the Tiger Team will be to immediately identify the extent of the problem and the associated risk for today's energetic materials.

The Tiger Team will consist of subject matter experts from the DoD Components and will be tasked with identifying energetic materials at risk of becoming unavailable to DoD in both the short term (within 3 years) and long term (3 to 10 years). Additionally, the Tiger Team will develop metrics to quantify the risk for such materials so that informed decisions can be made regarding the material criticality.

Within 30 days, each DoD Component, at its discretion, is requested to identify two participants for the Tiger Team. Additional representatives may be included as needed. The Tiger Team will provide me with an interim report within 3 months and a final report within 6 months, to include recommendations on a way forward. My point of contact is Mr. Jose M. Gonzalez, Director for Land Warfare and Munitions, at 703-693-9203 or Jose.Gonzalez@osd.mil.

Frank Kendall
Acting

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Critical Energetic Material (CEM) Tiger Team Notional POA&M

	Tasking (in months)	1	2	3	4	5	6
	Establish IPT and Working Definitions						
Phase 1 CEM Identification	Develop CEM Identification Process						
	Identify Short Term Critical Energetics						
	Identify Long Term Critical Energetics						
	Complete CEM Identification Process					*	
Phase 2 CEM Risk Quantification	Develop Risk Quantification Process						
	Identify Impact Factors						
	Identify Likelihood Factors						
	Quantify Energetic Material Risk						
	Populate Energetic Risk Matrix						*

* - Milestones w/ deliverables

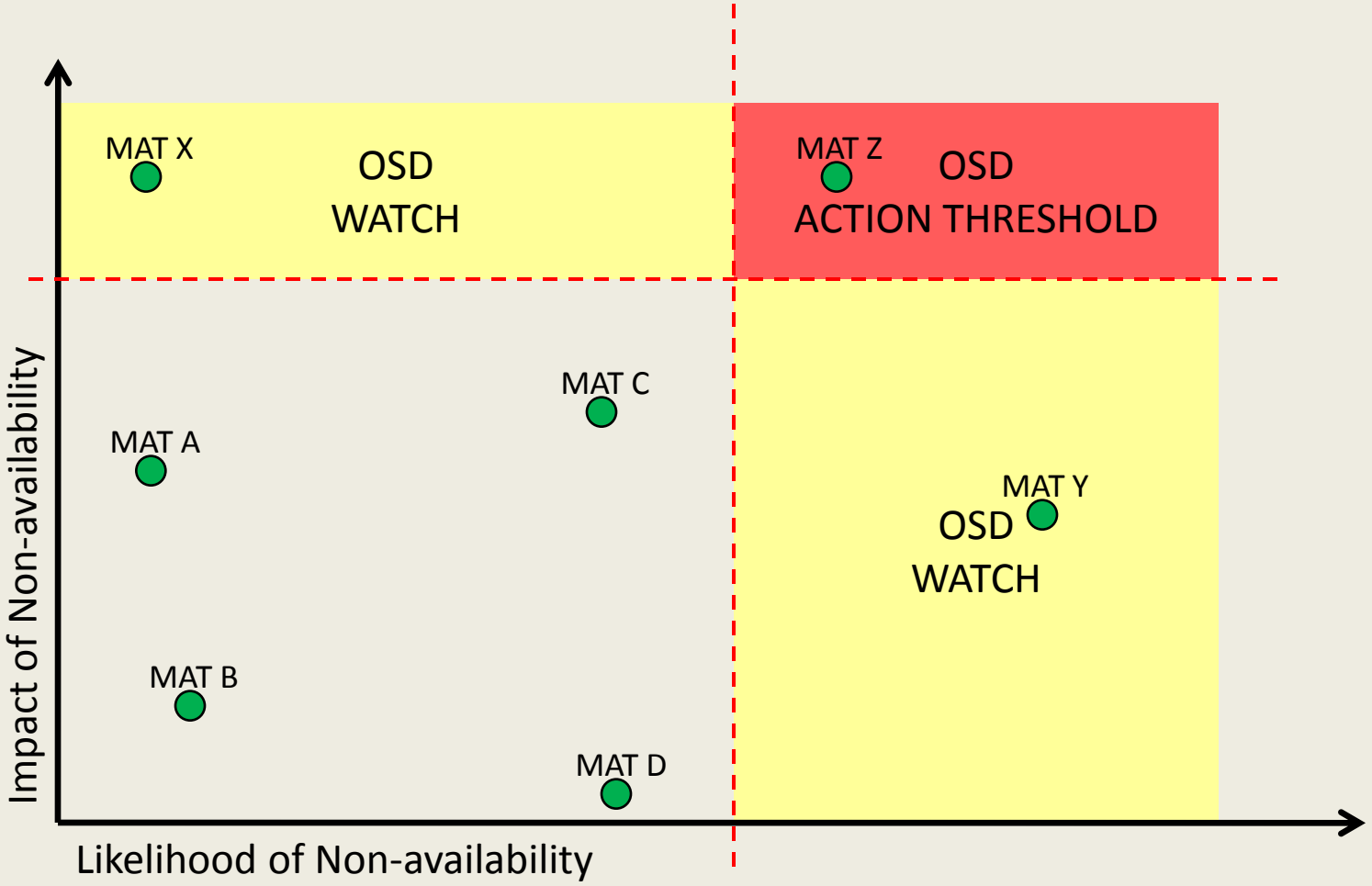
TIGER TEAM EFFORT

- Tiger Team Effort/Structure
  - Problem Scale – discuss methodology to determine extent of problem (Memo response)
  - Associated Risk – present risk matrix developed in workshops (Memo response)
- Deliverables
  - Mid Term Report – discuss/draft outline for report (Memo response)
  - Final Report - discuss/draft outline for report (Memo response)
- Energetic Material Availability Impact
  - Current State – discuss energetic material availability impact of current practices
  - Proposed State – discuss expected benefits of coordinated approach
- Identification Process
  - Current Efforts – what the Dept is currently doing to identify energetic materials of concern
  - Current Gaps – what the Dept is missing in the identification of materials of concern
  - Path Forward – planned approach to capture all energetic materials of concern

TIGER TEAM EFFORT

- Risk Quantification
  - Risk Likelihood Factors – develop risk matrix likelihood factors
  - Risk Impact Factors – develop risk matrix impact factors
- Energetics Teams – identify team members to execute identification and risk quantification
  - Explosives
  - Propellants
  - Pyrotechnics
- Current Status
  - Tiger Team starting mid-April
- Current Participants
  - Navy/Army/Air Force/Marine Corps/SOCOM
  - DARPA/DCMA/DTRA/MDA/DLA
  - OSD – I&E/R&E/MIBP/L&MR
  - DOE
  - Industry

CEM IPT Notional Product
OSD Matrix



Impact Factors
- # of Systems
- Qty NEW
- Cost
- Schedule
- Multi-Service
- Inter-Agency
- Alternative Materials

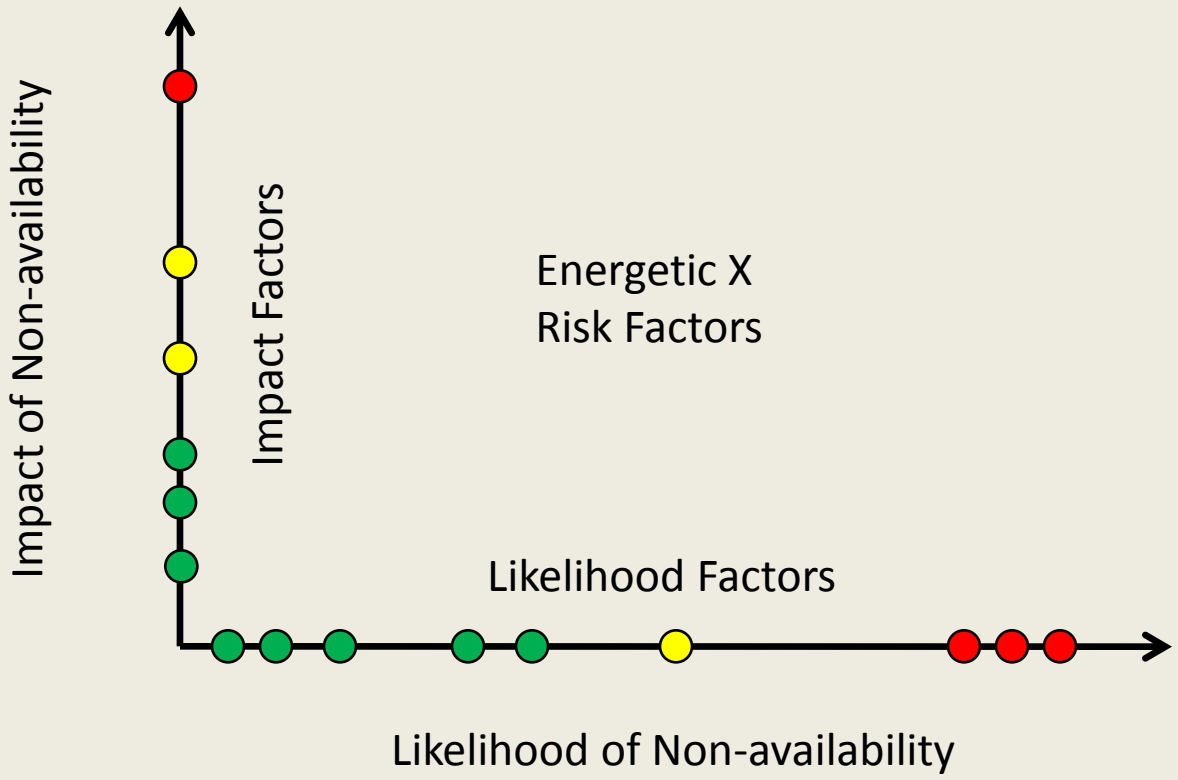
Likelihood Factors
- # of Manufacturers
- Environmental Issues
- Safety

DoD Market Share
Stockpile Levels
Market Forces

Legislation
Regulation

CEM IPT Notional Product Material Matrix

Impact Factors
- # of Systems
- Qty NEW
- Cost
- Schedule
- Multi-Service
- Inter-Agency
- Alternatives



Likelihood Factors
- # of Manufacturers
- Environmental Issues
- Safety
- Alternative Materials
- Stockpile Levels
- Market Forces
- DoD Market Share

BACKUPS

Energetic Material Case Studies
Ammonium Perchlorate (AP)

- Background
  - American Pacific is the sole U.S. supplier of Mil-Spec AP
  - AP is used in virtually all of DoD's missile systems
  - Demand for AP has dramatically declined in last 5 years as NASA Shuttle program and AF MM III Propulsion Replacement Program have ended
    - Roughly 12M lbs in 2005 to less than 3 M lbs in 2011 (Capacity 30M lbs)
    - DoD and NASA demand 30M lbs in 1995 – declining since then
  - Stringent "no production process change" clauses in AP production contracts to preclude system requalification
  - American Pacific Cedar City, UT facility has approximately $50M fixed costs
- Impact
  - Demand decline has resulted in significant cost increase (Feb 09 $7.40/lb vs. Nov 10 $17.56/lb)
    - Industrial Base: AMPAC perilously close to ceasing production (must have $50M sales)
  - PMs forced to consider alternative sources to reduce costs
  - If American Pacific exits the market, requalification costs for all our systems will easily exceed $100M (Trident II D5 Missile cost alone would be $60M)
  - Potential schedule slips as programs work to requalify systems (requalifying all our systems would take years)
  - Risk that foreign source capacity not adequate, quality not as good, and could raise prices once American Pacific exits the market
- Mitigation Plan
  - SNPE/SME in France can provide, but has limited production capacity (most capacity supports Arianne 5)
  - Work with AMPAC for supply issues
  - Consider establishing a DoD Policy to protect domestic suppliers of energetic materials
    - Possibly apply Section 806 to protect National Technology Industrial Base (NTIB)

Energetic Material Case Studies
Lead Azide

- Background
  - 2 types of Lead Azide used in U.S. Munitions – RD-1333 and Special Purpose Lead Azide (SPLA)
  - Vietnam era stockpile of existing material is dwindling and quality deteriorating (crystal growth)
  - Projections are that existing stockpile of RD-1333 will last 2-5 years
  - No current US manufacturer on-line
- Impact
  - Most commonly used primary explosive would involve a large number of weapon systems
- Mitigation Plan
  - Picatinny Arsenal developed an On-Demand Lead Azide (ODLA) process for manufacture of RD-1333.
  - Stresau Laboratory, Inc. is working with a German manufacturer to make RD-1333.
  - Technical Ordinance (Chem Ring) has invested in a new facility to make RD-1333, SPLA, and Dextrinated LA
  - Other materials, including lead-free alternatives are being investigated. Some are promising, but significant work remains

Energetic Material Case Studies
Hydroxyl-Terminated Polybutadiene (HTPB)

- Background
  - HTPB is a polymer used by DoD, NASA, and commercial space for solid rocket motor propellants and munitions
  - Sartomer considered moving SRM business offshore in 2005
    - Sole Source domestic producer of HTPB
    - Impending EPA regulations
    - $7-15M needed in capital investments to meet EPA requirements and efficiency improvements
    - Market Forces (DoD requirements less than 5% of business base)
- Impact
  - Would require DoD/NASA to incur substantial re-qualify costs with new supplier
    - Using DoD 5000.60-H re-qualification costs likely to exceed $100M
    - Schedule increases of at least 18 months per program (but years to complete all requalifications)
  - Possible redesigns of SRM propellants due to incompatibility
  - Reduced surge production capability for tactical missiles and Navy munitions
- Mitigation Plan Options
  - Allow prime contractor to develop solution
  - DoD to fund necessary capital investment to meet EPA
    - Establish HTPB surcharge
  - Establish Title III program
  - Modify SRM requalification requirements
  - Govt acquire HTPB production