Overview of U. S. Manufacturing Capabilities for Critical Insensitive Munitions / Energetic Materials Ingredients & Products

2013 Insensitive Munitions & Energetic Material Technology Symposium

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Briefing Outline

• Challenges Facing the U.S. Defense Industry
• Overview of U. S. Manufacturing Capabilities for IM / EM Ingredients
• Areas of Active Investment and Expanded Capabilities for IM / EM Ingredients
• Conclusions
Overview of U. S. Industrial Base for IM / EM Materials

Focus:
- Manufacturing Capabilities for IM / EM Products
- Explosive and Propellant Formulations
- List Not Exhaustive

Manufacturers to be Discussed:
- Aerojet - Rocketdyne
- Alliant Techsystems
- BAE Systems Ordnance Systems
- General Dynamics
Aerojet - Rocketdyne

Manufacturing Facilities:
- Sacramento, CA
- Orange, VA
- Redmond, WA

Capabilities:
- Propulsion Systems: "Every rocket motor launched contains some A-R motors and technology"
- Rocket Propellant Formulations
- Liquid Propellants: "Heavy Lift" Motors
- Energetic & Critical Material Synthesis (Pilot Scale)
- Propellant and Energetic Materials Development
Manufacturing Facilities:
• Utah (Promontory and Bacchus Facilities)
• Elkton, MD
• Rocket Center, West VA (Allegany Ballistics Laboratory)

Capabilities:
• Propulsion Systems: Multi-faceted
• Propellant Formulations for Tactical Motors
• Space and Intercontinental Missiles
• Small Rocket Motor (Guidance)
• Manufacturing Capabilities for Energetic Polymers and Select Explosive Ingredients (CL-20)
• Custom Grinding Capabilities for Energetic Materials (FEM, Hammermill)
• Commercial Smokeless Powder
• Propellant and Energetic Materials Research
BAE Systems Ordnance Systems

Manufacturing Facilities:
- Holston Army Ammunition Plant (Kingsport, TN)
- Radford Army Ammunition Plant (Radford, VA)

Capabilities:
- Legacy Energetic Materials for Explosives & Propellants: RDX, HMX, NC, NG
- Insensitive Munitions Ingredients: NTO, DNAN, TATB, High Bulk Density NQ, Energetic Plasticizers
- Industry Critical Ingredients: DMDNB, Strong Nitric Acid
- Rocket Propellant and Extruded Rocket Grains
- Gun Propellants
- Full Range of Explosive Formulations: Pressable, Melt-cast, Premix for Cast-cure PBX
- Energetic Materials R&D with a “Production Mentality” (Grams to Millions of Pounds)
General Dynamics

Manufacturing Facilities:
• Valleyfield Site (Canada)
• Saint Marks Powder (Florida)

Capabilities:
• Manufactures over 120 Types of Propellant
• Ball Powder for Small Arms Applications
• Ball Powder for Mortar Applications
• Propellant for Artillery Propelling Charges
• Modular Artillery Charge Systems (MACS)
• Some Manufacturing Capabilities for Legacy Explosive Formulations (Comp B, Comp A-5, etc) for Canada
• Commercial Smokeless Powder
• Energetic Materials R&D
Positive Developments in IM / EM Segment of the Industry

- Still Significant Investment in IM / EM Manufacturing Infrastructure (Government & Industry)
- Focus on Technology
- Focus on Cost Control and Improved Production Efficiencies
- New Production Capabilities
- Strong Platform for Expansion and Implementation of IM Technologies in the Future
- Examples: Radford and Holston Army Ammunition Plants
Holston AAP Modernization Overview

- Steam Plant EPA Compliance
- Nitric Acid / Ammonium Nitrate Modernization
- R&D Explosives & Propellants Center of Excellence
- Fluid Energy Mill
- Casting Facility
- Blending Facility
- Acid Recovery Modernization
- Area A Relocation
- Risk Management Facility
- Wastewater Treatment For RDX Removal
- IM Explosive NOx Scrubber & Flex Facility
- RDX Nitration
- Pump House Modernization

Plant Wide Projects:
- Water Distribution Phase 1
- Electrical Infrastructure Phase 1
- Apron and Dike Rehab
- Material Handling Transporters
Radford AAP Modernization Overview

- Plant Wide Projects:
  - Water distribution improvements
  - Perimeter security upgrades
  - Lightning protection
  - Street and building lighting
  - Footprint reduction

- NGMA facility
- Rolled powder upgrades
- New powerhouse
- Acid sewer
- New NC facility
- New AOP
- Incinerator upgrades
- NACSAC upgrades
- Water distro upgrades
- Solvent recovery
- Industrial sewer
- NG slurry upgrades

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Six General Categories of Investment

1. Upgrade of Basic Infrastructure
   - Utilities: steam, water, air, & electrical distribution systems
   - Buildings (roofs, etc), bridges, roads, etc

2. New Technology / Capability
   - Production-scale FEM systems
   - Benziger TATB manufacturing facility (HSAAP Agile Plant)

3. Expanded or Modernized Production Capacity
   - Nitrocellulose manufacturing facility at RFAAP
   - IM ingredients facility (HSAAP Bldg G-8)
   - New melt-cast explosives facility (HSAAP Bldg M-4)
Six General Categories of Investment (Continued)

4. Consolidation / “Right-Sizing” Manufacturing Infrastructure
   • Consolidated Acetic Acid Recovery and Acetic Anhydride Plant (A2B Project) - Dual train system to aid continuous plant operation
     - Reduced plant “footprint” - 112 acre site consolidated to 13 acres
     - Improved process efficiencies plus positive safety / env. impacts

5. Regulatory Compliance
   • Upgraded (HSAAP) or replaced (RFAAP) steam plants
   • Upgraded wastewater treatment facility (IWWTF) to reduce RDX level in water discharge.

6. Demolition
   • Outdated, unusable facilities, equipment, and infrastructure.
Example: IM Ingredients Facility at Holston AAP

**Background:**

- DNAN and NTO are now Key Ingredients in IM Melt-cast Formulations Qualified in U.S. Army Artillery, Mortars, etc.
- Millions of Pounds of IMX Explosives Produced in 2013 with Similar Projections in Future Years.
- DNAN & NTO Currently Produced in Agile Plant, but Capacity is Insufficient to Meet Projected Demand.

**Capabilities:**

- IM Ingredients Facility (Bldg. G-8) Initially Dedicated to DNAN and NTO Production.
- Capacity Expected to Meet Future Requirements for these Products.
- Facility Design Complete.
- Expected Commissioning in February 2015.
- NAC /SAC Facility for HSAAP planned in Conjunction with Increased IMX Requirements.
**Example: Nitrocellulose Facility at Radford AAP**

**Program Summary:**

- NC is Base Ingredient in the Majority of Propellant Formulations
- Capacity of New Facility ≈ 28M Lbs / Year (Surge)
- Commissioning of NC Facility planned in 2016
- Facility Incorporates Several Technology Enhancements
- Projected Capabilities vs. Legacy Plant
  - ≈30% reduction in energy consumption
  - Order to delivery cycle shortened by 35-40%
  - Significant reduction in NOx emissions and discharge of nitrates to IWWTF
  - Good processing efficiency projected
- Multiple Technologies (Cutting, etc) Being Evaluated to Meet Higher Quality Requirements for Customer Applications
Example: New Pilot Facility for Energetic Ingredient Synthesis at Holston AAP

Background:

• Historically, the “Gap” in Holston AAP Manufacturing Infrastructure has been in Pilot Scale Equipment
• The new Pilot Facility is Being Funded by BAE Systems
• Commissioning of the Facility will be Completed by November 2013
• The Facility will Play a Key Role in Support of DOD and DOE Research Programs including JIMTP and FREEDM
• Initial Projects for the Pilot Facility Include a NTO Program (IRAD), DOE Program for the Scale-up of Wet-Aminated TATB, and Other DOD Programs.

Capabilities / Plans:

• Multiple Glass-lined Reactor Vessels to Include 50, 100, and 200 gallon.
• Pressure Washing and Filtration
• Flexible for a Variety of Chemical Synthesis Requirements
Summary

**In the Area of Insensitive Munitions and Energetic Materials, there is Much to Feel Positive About!**

- Significant Transitioning of IM Technologies to our Warfighters
- Demonstrated Commitment of U. S. Government Investment in Manufacturing Technologies & Infrastructure
- Recent, Real Examples of Expanded Capabilities for Energetic Materials within the U. S. Industrial Base