

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

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(Operating Contractor of Holston and Radford Army Ammunition Plants)



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:

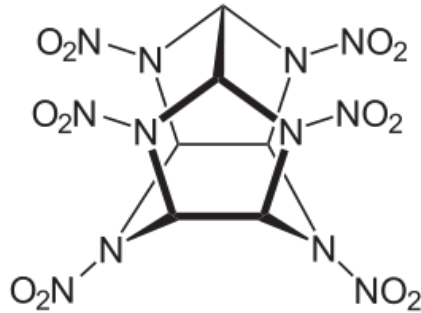
- Sacramento, CA
- Orange, VA
- Redmond, WA

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



Alliant Techsystems (ATK)



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:

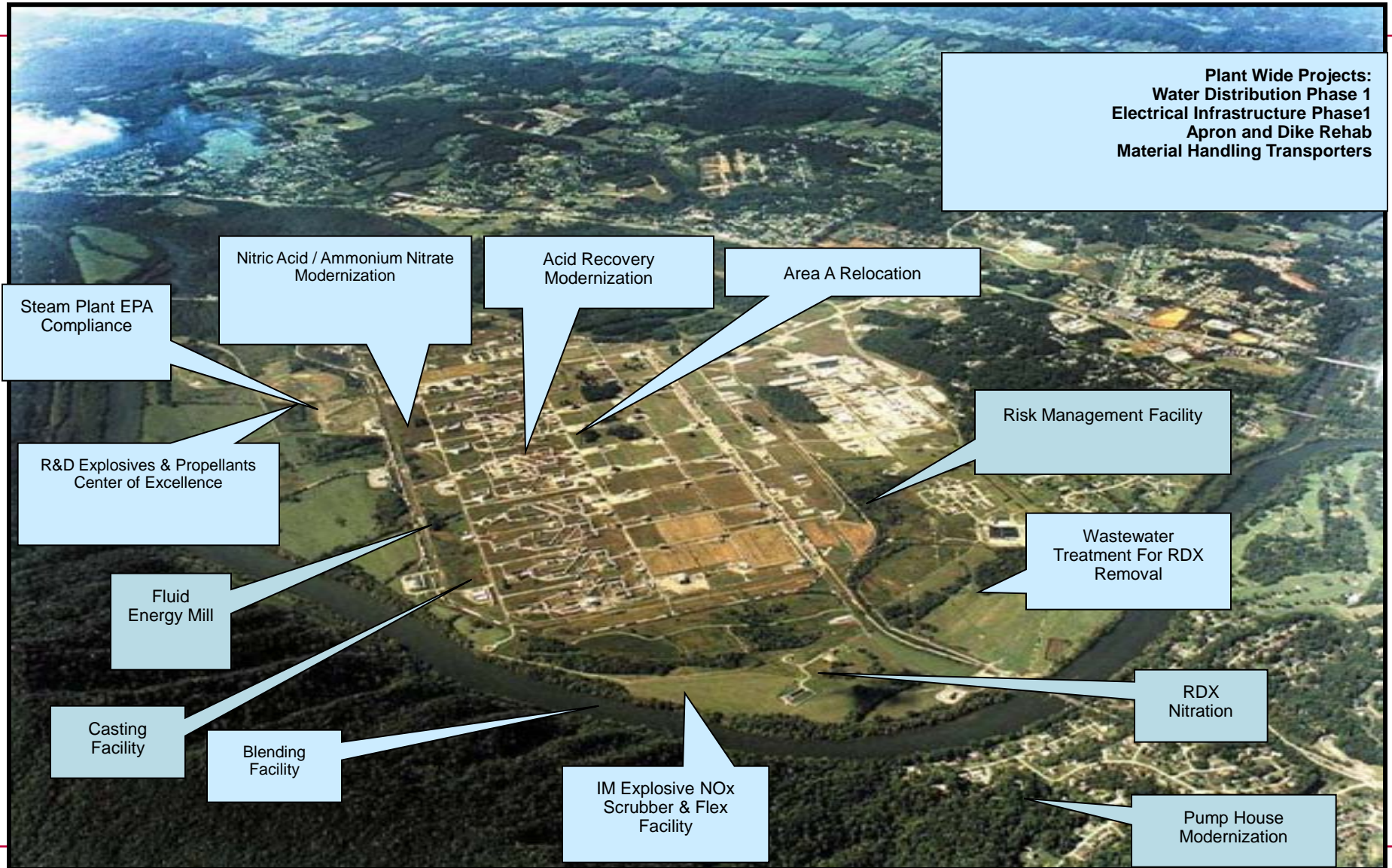
- Manufactures over 120 Types of Propellant
- Ball Powder for Small Arms Applications
- Ball Powder for Mortar Applications
- Propellant for Artillery Propelling Charges
- Modular Artillery Charge Systems (MACS)
- Some Manufacturing Capabilities for Legacy Explosive Formulations (Comp B, Comp A-5, etc) for Canada
- Commercial Smokeless Powder
- Energetic Materials R&D

Positive Developments in IM / EM Segment of the Industry

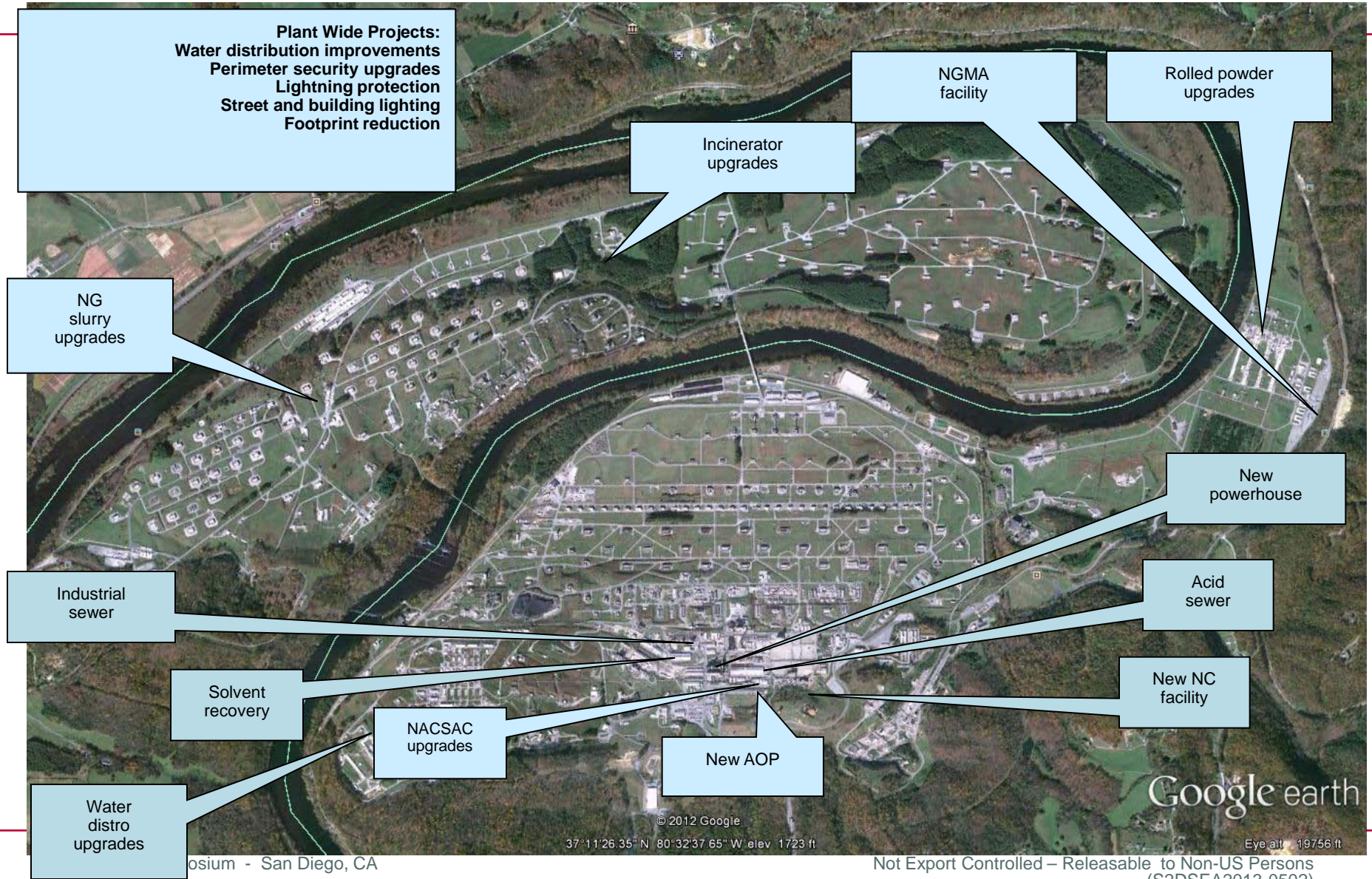
- **Still Significant Investment in IM / EM Manufacturing Infrastructure (Government & Industry)**
- **Focus on Technology**
- **Focus on Cost Control and Improved Production Efficiencies**
- **New Production Capabilities**
- **Strong Platform for Expansion and Implementation of IM Technologies in the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



Holston AAP Modernization Overview



Radford AAP Modernization Overview



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)

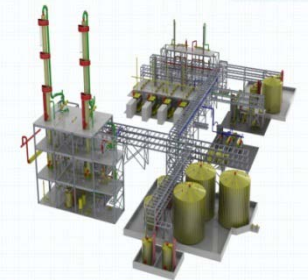
3. Expanded or Modernized Production Capacity

- 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



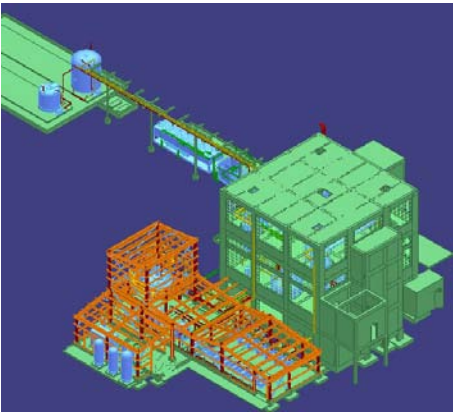
5. Regulatory Compliance

- 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 \approx 28M Lbs / Year (Surge)
- Commissioning of NC Facility planned in 2016
- Facility Incorporates Several Technology Enhancements
- Projected Capabilities vs. Legacy Plant
 - \approx 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**

