NDIA 2012 Joint Armaments Conference
14-17 May 2012
What is PUMA?

- **ONR Future Naval Capabilities (FNC) Program**
  - Demonstrate enabling technologies as an *integrated system solution* for enhanced mortar engagements
    - Precision Guidance
    - Trajectory Shaping
    - Range Extension
  - Lighten the Load for the Warfighter
    - More Stowed Kills
    - Lighter/Smaller Support Equipment
  - Cost Effective Solution
    - Utilization of Novel technologies & COTS products
  - Joint Services, Gov’t Lab Partnership Development Team

**TRL 6 Demonstrations & Transition to Acquisition Program in FY14**
Development Partners & Major Suppliers

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Rockwell Collins
- GPS Receivers

ARDEC (Picatinny)
- Warhead
- Obturator
- Primer/Igniter
- Fuze Setter
- HOB Antenna

ARL (Aberdeen)
- GN&C
- Airframe
- Primer/Igniter

NSWC-Indian Head
- Fuzing
- Propellant

NSWC Dahlgren
- Program Management
- Systems Engineering
- SAL Seeker

ANTCOM
- GPS Antennas

OSI Optoelectronics
- Photodetectors

Yuma Proving Grounds
- Live Fire T&E

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Enabling Technologies

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Evolved VAPP Control System

• Very Affordable Precision Projectile
  – ARL cost effective GN&C demonstrator program
  – 105mm/155m Artillery, 120mm Mortar
• COTS drive actuators
• Reduced navigation state estimation
• PUMA evolution includes deployable canards for increased maneuver authority

Low Cost SAL Seeker (LCSS)

• Strap-Down, Body Fixed Architecture
  – No mirrors, gimbals, or gyros
• STANAG 3733 compliant
  – Compatible with all fielded designators
  – Works with proposed lower pulse energy (20-30 mJ) designators
• Form factor unit performance testing complete
  – Flight Testing this Year
• $1,000/seeker @ 10k production rate
**Enabling Technologies**

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**MEMS S&A Based Fuze**

- Reduces size of PD/PDD Fuze to that of conventional mortar Fuze S&A device
- Based on silicon MEMS chip with integrated micro-detonator
- Connector for external HOB sensor
- Form factor units in testing, live fire in FY13

**Extended Range Mortar Ammunition (ERMA) Propellant**

- Advanced artillery propellant adapted for mortar use
- Increased muzzle velocity
  - Extends PUMA operational range
- Improved cook-off & IM performance
- Lower barrel erosion & fouling
- Already demonstrated on ballistic mortar ammo
Integrated System Solution for Mortar Ammunition

- Guidance Kit Solutions for Mortar Ammo
  - Fuze & Tail replacement kits
  - Modular configurations

- Compatible with existing mortar systems
  - Fire Control
  - Fuze setters
  - Targeting Systems
81mm PUMA<sub>GL</sub>

Direct Connect Programming Interface

ERMA Propellant

Inventory HE Warhead

Inventory Primer/Igniter

Low-Cost SAL Seeker (LCSS)

SAASM GPS (Rockwell Collins)

MEMS Fuze

Super-Caliber Deployable Tail Fins

Command Deployable Canards

<$8k$ AUPC
81mm PUMA<sup>GL</sup> Capability
- Precision Fires (GPS, SAL)
- Consistent CEP @ all ranges
- Trajectory Shaping
- Extended Range
- Reduced Collateral Damage

Current 81mm Capability
- Area Coverage
- Increasing CEP w/ Range
81mm Development

- Airframe Live Fire Tested
  - Maneuver authority expanded to multiples of ballistic delivery accuracy
    - Range Extension capability
  - GPS Guide-to-Hit **PENDING**
    - Ballistic & Extended Ranges

- Advanced Configurations Researched
  - Wind Tunnel/CFD/Simulations of alternative designs
  - Additional maneuver authority available (2x+)
  - 81mm Extended Ranges of up to 9km (Guided)
    - Without use of rocket motor or enhanced launcher
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Alternative 81mm Configurations

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- **81mm PUMA$^G$**
  - GPS Only Guidance
  - EPIAFS Inductive Nose Cone
    - No Tear-away Hood Required
  - Lower cost option than PUMA$^{GL}$

- **81mm PUMA$^{AN}$**
  - AN = Auto-Navigation
    - SAL Only Guidance
    - Precision Fires under true GPS Denial
  - No Fuze Setter Required
    - Fuze Mode & Laser code selector switches on projectile
Now Available in 120mm…

- 120mm PUMA^G
  - Mid-Range, Low-Cost Member of EFSS Family of Munitions
    - Different requirements than other cartridges
  - GPS Precision Guidance to 12 km
  - Direct Reuse of 81mm Guidance Kit
    - Replace SAL Seeker w/ EPIAFS Interface
  - Backwards compatible to M120 Smoothbore Cannon
    - 9km Max Range
  - FY14 Final Demonstration Configuration

<$10k AUPC
Additional Applications

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• UAS Dropped Munitions
  – 81mm Mortars already demonstrated on UAS
    • Precision Air Dropped Guided Mortar (PADGM)
  – 81mm $\text{PUMA}^G\text{L}$ or $\text{PUMA}^A\text{N}$ can provide self-contained engagement capability at low-cost

• Shoulder Launched Munitions
  – PUMA Guidance Kit designs are comparable in size to existing shoulder launched systems
  – Adds precision delivery, range extension, and additional targeting modes
  – New Dimension of Embedded Infantry Fire Support Capabilities
Future Acquisition Flexibility

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• Single Guidance Kit for Multiple Applications
  – 81mm Mortar, 120mm Mortar, 120mm EFSS, 81mm UAS Air Drop, Shoulder Launched...
  – Common Control Section Architecture
    • Upgradeable Fuze and Nose Modules
    • Low-Cost SAL Seeker Already Available
    • Additional Capability Upgrades Already researched

• Joint Services, Multi-Platform Economies of Scale
  – Maximize purchase power in leaner environment
  – Production Line/Inventory Flexibility
  – Upgradable to meet Future Requirements
Conclusions

• Integrated System Solution for Precision Mortar Delivery

• Low-Cost, Modular Architecture

• Guidance Capability Demonstrated on 81mm

• Multi-Platform Capable

• TRL 6 Solution Demonstration in FY14 to support transition to USMC Acquisition POR