Enhanced Expeditionary Engagement Capability

Advanced Capability Extended Range Mortar (ACERM)

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• Last time we were here ... (Baltimore)
  – Presented new 81mm Concept Projectile for USMC Infantry Organic Fires
    • Advanced Capability Extended Range Mortar (ACERM)
    • Maximum Range: 10km (T) – 20km (O)
    • GPS+SAL Guidance: 10m CEP<sub>50</sub> (T), 1m CEP<sub>50</sub> (O)
  – Developed but not Flight Tested
    • Wind Tunnel, Shock Environment, & Hardware-in-the-Loop Only

• As of Today ...
  – Completed 2x Live Fire Flight Tests
  – Survivability & GPS Guided Flight Demonstrated
    • 19.1km Maximum Range
      – 81mm Mortar World Record (unofficial)
    • 13.7km GPS Guide-to-Hit with < 10m CEP<sub>50</sub>

Radical Capability increase for Organic Infantry Fire Support
Catalyst/Enabler for New Warfighting Concepts
**E3C Program**

- **Sponsor:**
  - ONR 30 Fires

- **Objective:**
  - Demonstrate the “Art of the Possible” in fire support technologies for USMC weapons, through an ongoing series of integrated system firing demonstrations

- **Structure:**
  - Demonstrate systems to TRL 5-6
  - Transition Systems and/or Technologies to Acquisition or FNC programs
  - One new caliber every 3-4 years
  - Flexible to meet future stakeholder needs

**First up is 81mm Mortar**
Followed by **155mm Artillery & 60mm Mortar**
**Advanced Capability Extended Range Mortar (ACERM)**

- New 81mm Precision AUR
- Dual Mode GPS + SAL Guidance
- >20km Maximum Range

**Miniature Mission Setter (MMS)**

- <4lb Precision Weapon & Fuze Setter
- Logistic Enabler for Foot Mobile Precision

**Low Cost SAL Seeker (LCSS)**

- Enables 1m CEP50
- Eliminates TLE
- GPS Denied Precision Fires

Precision for Future Infantry Units for both Mounted and Dismounted Operations
Demonstration Schedule


Distribution Statement A

PR# 4841 is Approved for Distribution Statement A: Approved for Public Release; distribution is unlimited.

FY 14

Hardware-in-the-Loop Testing (UTC Aerospace Systems)

Wind Tunnel Testing (NIAR, Wichita State University)

Miniature Mission Setter (MMS) Integration (GD-OTS)

TRL 6 Demonstrations in FY17 @MCWL Coordinated Warfighting Experiment

FY 15

Live Fire Testing (Yuma Proving Grounds)

Live Warhead Testing (Aerojet Rocketdyne)

JTAC-LTD & Skylark I-LE UAS (Elbit Systems of America)

FY 16

Future

FY 17

Future
**ACERM Cartridge**

- **New 81mm AUR**
  - Airframe co-developed by NSWCDD, ARL, & UTC Aerospace

- **Ultra Extended Range**
  - 10 km (T), 20 km (O)
  - Aerodynamics only, No rocket motor

- **Precision Delivery**
  - GPS – 10m CEP_{50} (T), 5m CEP_{50} (O)
  - SAL – 5m CEP_{50} (T), 1m CEP_{50} (O)

- **Cost Effective**
  - $15k/unit (T), $10k/unit (O)
  - Comparable to existing systems

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**Extended Range Minimizes Re-Emplacements, Keeps Pace with Mobile/Dynamic Engagements**

1. Super Caliber Deployable Tail-Fins
2. M299 Ignition Cartridge
3. ERMA Propelling Charges (not shown)
4. Split Ring Obturator (not shown)
5. Enhanced Lethality Warhead
6. Lifting Wing
7. MEMS S&A Fuze (inside shell)
8. Dual Independent Steering Canards
9. Global Positioning System (GPS)
10. Low-Cost SAL Seeker (LCSS)
Glide Architecture Provides >60% of Range Without Need for In-Flight Propulsion

20-22 km Maximum Range Based on Latest Flight Test

Lift + Control = Maneuverability

Enables 81mm Fire Support to participate in Urban/Defilade Engagements at Range

Launch
- Mass
- Velocity
- Launch angle
- Drag
- Apogee Alt

RG - Gliding Flight Range Extension
- Wing area
- Lift
- Drag

RR - Range Reduction
- Target Acquisition
- Terminal Maneuvers
**Low-Cost SAL Seeker (LCSS)**

**LCSS v2**
- STANAG 3733 SAL Targeting Sensor
- 0.5 lb, 6.3 in³
- Capable down to 10 mJ/pulse
- External Projectile Sub-System
- Hardened to 10 kgee’s
- Est. $1k unit @ 10k rate
- 35 prototypes delivered

**LCSS v3**
- LCSS V2 Capabilities +
- 0.3 lb, 4.0 in³
- Internal Projectile Sub-System
  - Optics must be ported
- Embedded Ranging Sensor for Precision HOB
  - 1-20m Selectable w/ 3.5% err.
- 2 prototypes ordered

**LCSS v4**
- LCSS V3 Capabilities +
- 0.3 lb, 4.0 in³
- Guidance Processor
- Inertial Sensor Suite
- Additional I/O for CAS, Fuze, and Other Guided Projectile Subsystems

**Future Development Will Yield LCSS v2 Capabilities in **80% Smaller** Form Factor**
Miniature Mission Setter (MMS)

**Current MMS Features:**
- Android Tablet (8” Screen)
- Embedded SAASM GPS
- Crypto Storage/Handling
- Rugged Weapon Connector
- High Power Battery
- Two-Wire/Tac-Link Modem

**Man Portable System**
- Enables smaller PGMs and Foot Mobile Precision
- Weight < 4lbs
- Leverages 8” Tablet Computer from Target Handoff System (THS)

**Improved Power Efficiency**
- Direct Contact Interface
- Environmentally Rugged Connector Developed

**Android Open Architecture Touchscreen Interface**
- Intuitive and familiar
- Minimal User Input Required
- Expansion to Host Additional apps (Mapping, Force tracking, Mission Planning, Intel)

**EPIAFS Backwards Compatibility**
- Already generates same data message format
- Inductive setter output through Legacy Compatibility Kit

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**PLUMSS:** 40 lbm, 3120 in³

**MMS:** <4 lbm, 100 in³

Partnering with MARCORSYSCOM to Mature MMS as logistic enhancement for Expeditionary Fire Control System (EFCS)
Flight Test #1 (FT1)

• ACERM Survivability & Roll Control (6 Rounds)
  – Survivability of Key Sub-Systems
  – Validation of Wind Tunnel Aerodynamic Data
  – Active Roll Control Demonstrated
  – Validated IMU Capabilities
  – LCSS Track on Designated Target (Ride-Along)
    • Using GLTD II
  – Precision Delivery – 3,200m Target
    • 10-20m Miss Distances using C/A GPS

• ERMA Propellant (10 Rounds)
  – ACERM Ballistic Slugs
  – Charge weight assessment & validation
  – Achieved 292.5m/s on 13.5lbm fly away mass

Groundwork Laid for Extended Range 81mm Flight Testing
Flight Test #3 (FT3)

- ACERM Extended Range and Closed Loop Precision Guidance (8 Rounds)
  - Full ACERM Configuration
    - Diagnostic Telemetry Module (DTM) Warhead Surrogate
    - C/A GPS in DTM, C/A GPS (L3) in GNC
  - Validation of Full Airframe Design
    - Outperformed Predictions,
  - Combined Test Objectives with unfunded FT2
    - Open Loop Guided Flight

- Results
  - 19.1km Maximum Range Glide
    - GPS Navigation to Hold Line-of-Fire, ERMA Propellant (290m/s)
    - Unofficial Record for 81mm Maximum Range
    - 22km Maximum Range possible w/o any changes
  - GPS Guide-to-Hit at 13.7km
    - 1.7m and 5.3m miss distances
    - ERMA Propellant – Reduced Charge (243 m/s)
  - LCSS track on Designated Target (Ride-Along)
    - Using AN/PEQ15 JTAC-LTD

FT4 Test Scheduled for Oct/Nov ’16
SAL Guidance Against Static & Moving Targets
Range vs. Altitude

1.7m Miss @ 13.7km target – Reduced Launching Charge (243m/s)
(Target altitude below gun position)
FT3 GPS Guide-to-Hit Video

Unclassified

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• 120mm ACERM
  – 24km (M120) to 33km (M327) Maximum Range
  – GPS+SAL Precision Guidance
  – Already designed and under test through IR&D effort

• Air Dropped (ACERM Air)
  – Small form factor “SDB-Style” capability for UAS
  – Minimal Changes to Fuzing required
  – Engage targets within radius = 6x Altitude

• eXtreme Performance Configuration (ACERM-X)
  – 40 – 60 km Maximum Range
  – TOF to 15 km reduced to <120 sec

• Naval ACERM
  – Readily adaptable to Navy 5-Inch and other gun systems
  – 81mm mortar can be installed directly on small/intermediate class ships
  – Low-Cost fire Support capability for Littoral/Riverine operations
Current Fires vs. ACERM

Light Weight, Portable Precision
Enabled by New Ammunition Technologies
Conclusions

- **ACERM can expand Infantry Fire Support Envelope with Organic Assets**
  - 81mm Precision Fires to >20 km
  - Can keep pace with dynamic/mobile engagements
  - Cost Comparable to Existing Precision Fire Support

- **As Part of E3C System**
  - Urban Terrain Engagements
  - Continued Operations During GPS Denial
  - Foot Mobile Precision

- **Future ACERM Capabilities**
  - 120mm Variant
  - Air-Dropped Variant for UAS with SDB Style Capabilities
  - Ultra Extended Range (>40 km)
  - Naval Fire Support
• Questions?