ENHANCED EXPEDITIONARY

ENGAGEMENT CAPABILITY

Advanced Capability Extended Range Mortar (ACERM)
2015 NDIA Armament Systems Forum

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BLUF

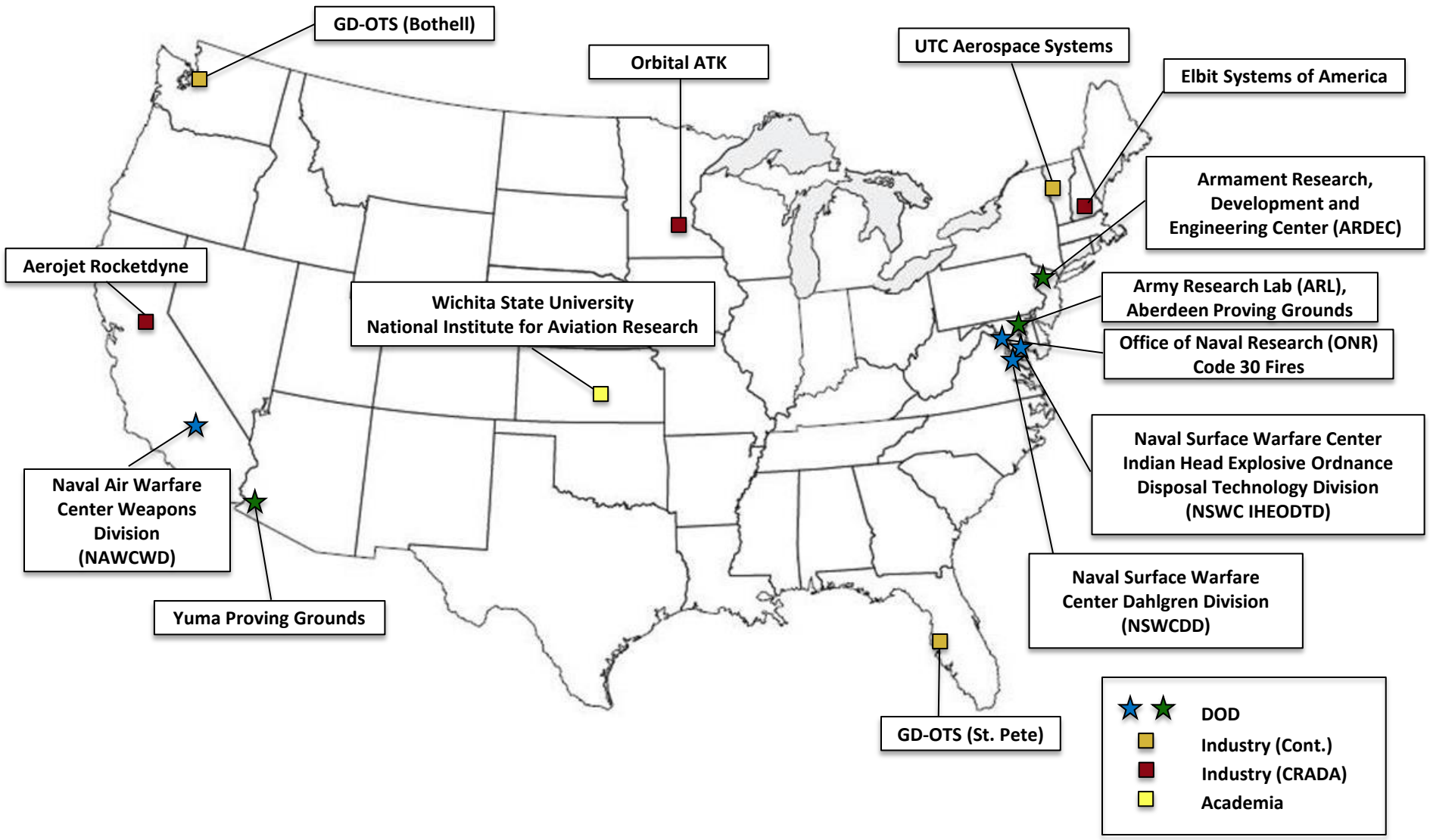
- ACERM is a new precision 81mm mortar cartridge intended for USMC Infantry Battalions
  - Compatible with US Army mortars
- Infantry Fire Support envelope can be expanded to full operating area with Organic Assets
  - 81mm Precision Fires to > 15 km
  - Can keep pace with dynamic/mobile engagements
  - Cost comparable to existing precision fire support
- Key enabling technologies afford additional capabilities
  - Urban Target Engagement
  - Foot Mobile Precision Fires
  - Continued Operations During GPS Denial

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 83mm Shoulder Launched & 60mm Mortar

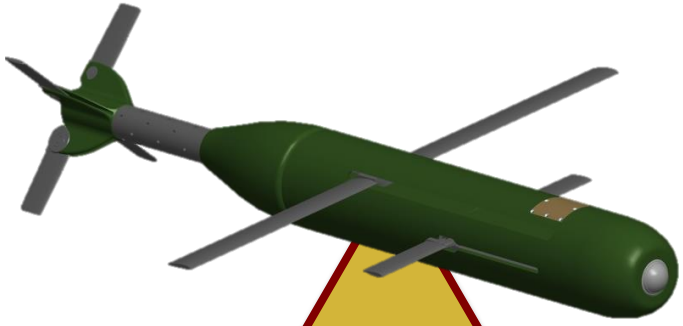
E3C Development Team



E3C System

Advanced Capability Extended Range Mortar (ACERM)

- ***New 81mm Precision AUR***
- ***Dual Mode GPS + SAL Guidance***
- ***>15km Maximum Range***



Precision for Future Infantry Units for both Mounted and Dismounted Operations

Miniature Mission Setter (MMS)

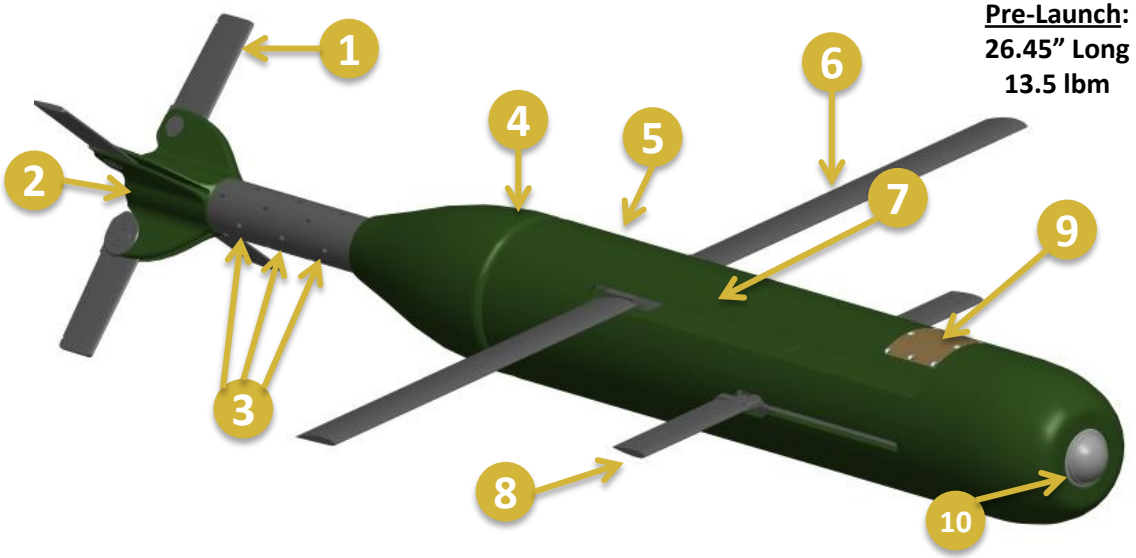
- ***2lb Precision Weapon & Fuze Setter***
- ***Logistic Enabler for Foot Mobile Precision***

Low Cost SAL Seeker (LCSS)

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

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



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)

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

Making Range

1

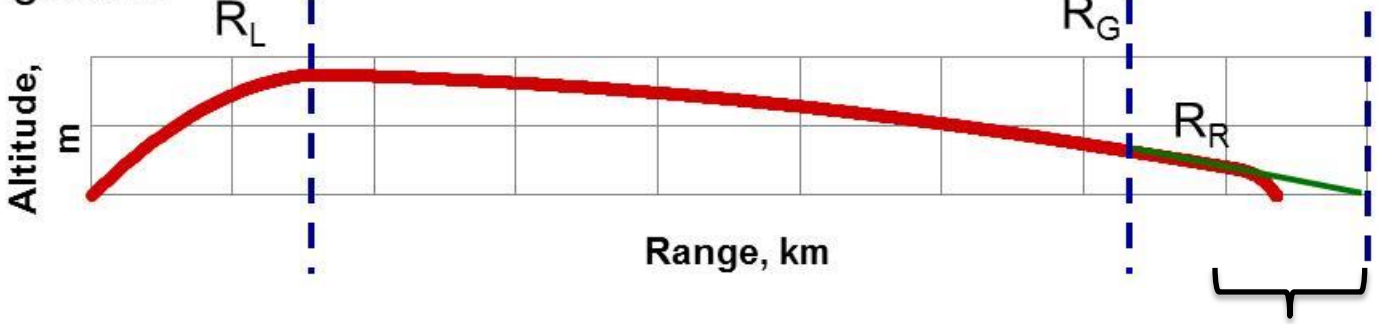
Launch
- Mass
- Velocity
- Launch angle
- Drag
- Apogee Alt

2

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

3

R_R Range Reduction
- Target Acquisition
- Terminal Maneuvers

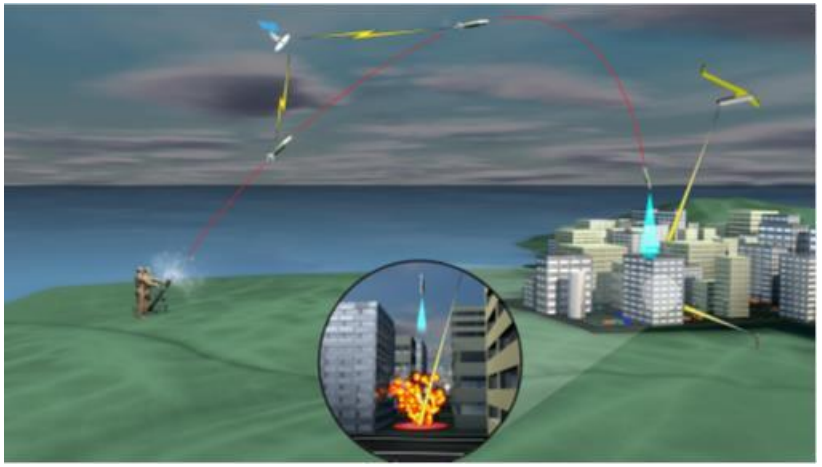


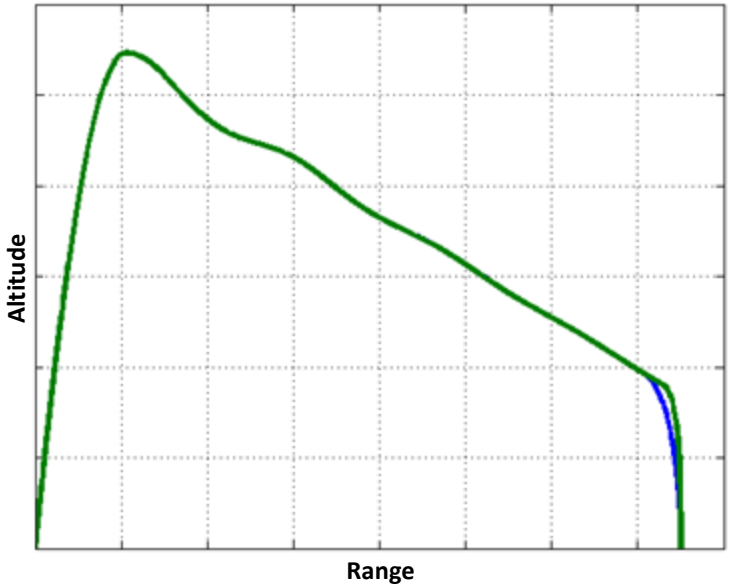
18-21 km Maximum Range
Based on Latest Wind Tunnel Test

Glide Architecture Provides >60% of Range Without Need for Supplemental In-Flight Propulsion

Urban Target Engagement

- Structures no longer prohibitive to mortar fires
  - Trajectories shaped for Vertical Insertion
    - Byproduct of lift required for extended range
    - More than sufficient capability for Defilade
  - GPS Guidance (10m CEP50) for Open Spaces
    - Courtyards, Intersections, …
  - SAL Guidance (1m CEP50) for Tight Spaces
    - Streets, Tall buildings, Alleys, …
    - Airborne platforms provide best designation geometry
- ACERM is agnostic to terrain type
  - Works in Urban, Mountain, Canyon, & Defilade

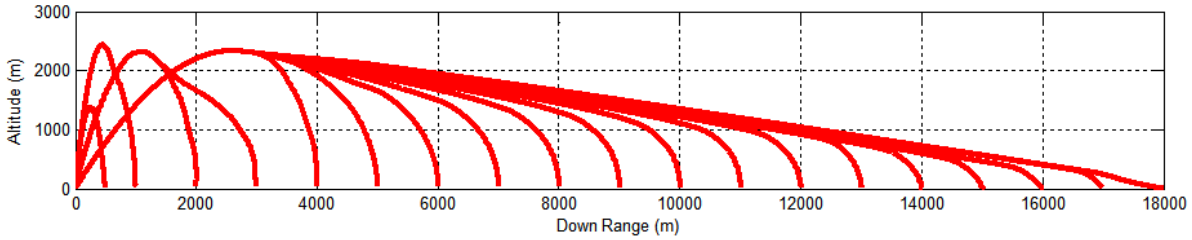




Allows 81mm Mortar Fire Support to return to Engagements in Urban Terrain

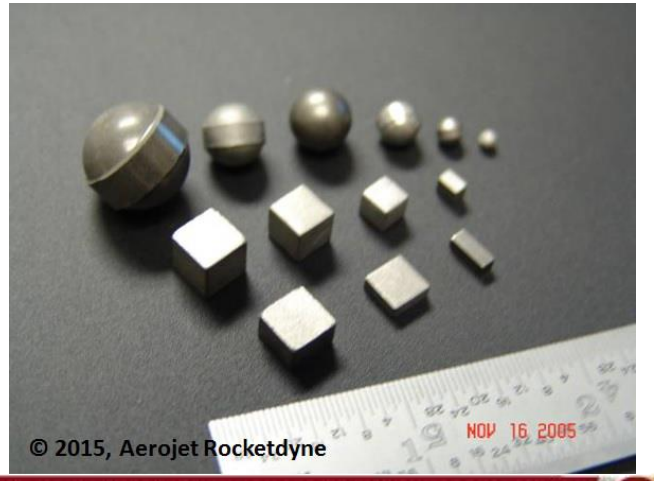
Enhanced Effectiveness

- Precision + Flight Path Control + Advanced Warhead Technology = *Expanded Target Set*
  - <10m CEP50 reduces need for large warhead
    - Reduced Collateral Damage
  - Vertical flight path at detonation
    - Optimal warhead orientation relative to target



  - Increases ECR with less HE than M821/889
    - High Density Pre-Formed Fragments
    - Tuned for delivery accuracy and target set
    - Optional upgrade to Reactive Materials

81mm Organic Assets Can Service Targets Originally Relegated to Larger Artillery Calibers



GPS Denied Operations

- Capability beyond traditional GPS Anti-Jam
  - SAL Guidance Mode
    - Any STANAG 3733 designator system
      - PLDR, JTAC-LTD, Fixed Wing, Rotary, UAS, …
  - Standard 81mm Ranges (< 6km)
    - Mortar aimed for traditional ballistic intercept
    - Future upgrade for extended ranges
      - Upgraded IMU required
  - Even during an MMS Casualty
    - No electronic systems required at mortar to conduct precision missions

Joint Terminal Attack Controller
Lightweight Target Designator
JTAC-LTD (AN/PEQ-19)

Precision Organic Infantry Fires Possible Even During Periods of Full GPS Denial

Low-Cost SAL Seeker (LCSS)

Now → **FY 16** → **FY 18**

Coming Soon

LCSS v2

- STANAG 3733 SAL Targeting Sensor
- 0.5 lb, 6.3 in^3
- Capable down to 10 mJ/pulse
- External Projectile Sub-System
- Hardened to 10 kgee's
- Est. $1k unit @ 10k rate
- 19 prototypes delivered

LCSS v3

- LCSS V2 Capabilities +
- 0.3 lb, 4.0 in^3
- Internal Projectile Sub-System
  - Optics must be ported
- Embedded Ranging Sensor for Precision HOB
  - 1-20m Selectable w/ 3.5% err.

LCSS v4

- LCSS V3 Capabilities +
- 0.3 lb, 4.0 in^3
- 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)

- Man Portable System
  - Enables smaller PGMs and Foot Mobile Precision
  - Weight < 2lbs
  - Originally sized to fit in USMC cargo pocket
- Improved Power Efficiency
  - Direct Contact Interface
  - New Environmentally rugged connector under development
- Android Interface
  - Intuitive and familiar
  - Minimal input required from users.
  - 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 Compatibly Kit

Lightens the Load & Enables Foot Mobile Precision Fires

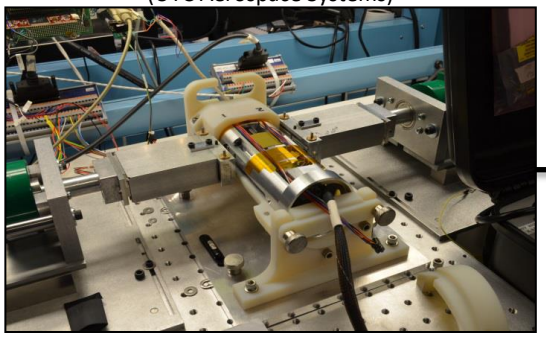
PLUMSS: 40 lbm, 3120 in^3

MMS: 2 lbm, 50 in^3

Current MMS Components:
- Android Handheld
- Embedded SAASM GPS
- Crypto Storage/Handling
- Rugged Round Connector
- High Power Battery
- Radio (optional)

Demonstration Schedule

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



Live Fire Testing
(Yuma Proving Grounds)

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

FY 14 | **FY 15** | **FY 16** | **Future**

Wind Tunnel Testing
(NIAR, Wichita State University)

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

Live Warhead Testing
(Aerojet Rocketdyne)

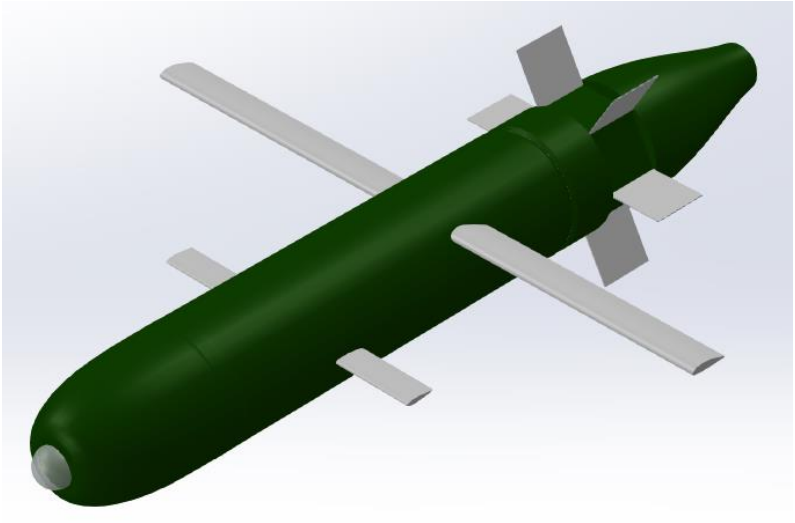
TRL 6 Demonstrations in FY16

- Minimal Update to Become UAS Dropped Munition
  - Fuze Arming Environments
  - Fuze Setter Interface → Aircraft Umbilical
  - Remove Launch Energetics

- Creates SDB style capability for UAS
  - 10 – 20 km glide range (altitude dependent)
  - 1m CEP_{50} Precision
    - Using onboard SAL Targeting
  - Maintenance of ISR orbit while engaging targets
  - Airborne designation CONOPS for ground launched ACERM

End-to-End Engagement Capability on Single Platform

- eXtreme Performance Configuration
  - 40 – 60 km Maximum Range
    - Long Range Precision from low cost portable launcher
  - TOF to 15 km reduced to 120 sec
    - Increased responsiveness for Organic Infantry Fire Support
  - Multiple Round Simultaneous Impact (MRSI) & Firing Patterns
    - From single 81mm mortar tube
  - Moving/Maneuvering Targets
    - More responsive to dynamic engagements



- Key Enabling Technologies
  - Supplemental in-flight propulsion
    - Rocket Motor
  - Discarding Launch Propulsion
    - Improves aerodynamic contour
    - Enables simpler rocket motor nozzle geometry
  - Enhanced GNC & Fire Control
    - Onboard ACERM and MMS

Looking for Additional Industry Input through DOTC Topic ENT-16-01

Conclusions

- ACERM can expand Infantry Fire Support Envelope with Organic Assets
  - 81mm Precision Fires to >15 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

TRL 6 Capability Demonstrations in FY 16

- Future ACERM Capabilities
  - Air-Dropped Variant for UAS with SDB Style Capabilities
  - Ultra Extended Range (>40 km)
  - Moving Targets
  - MRSI Fires

- Questions?