NAVSEA WARFARE CENTERS DAHLGREN

Office of Naval Research ONR Science & Technology

ARL

ENHANCED EXPEDITIONARY E3C ENGAGEMENT CAPABILITY

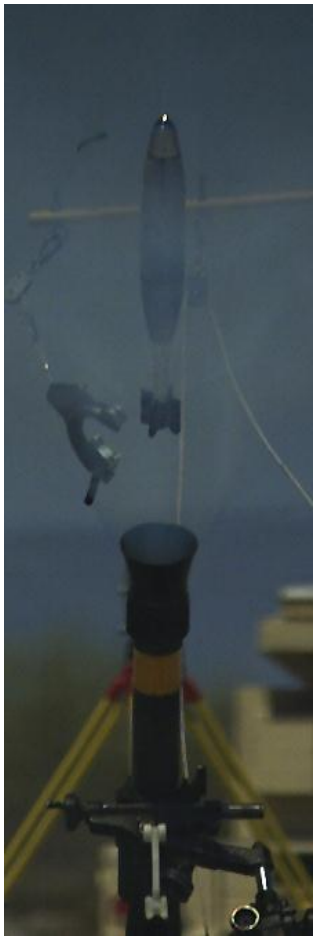
Advanced Capability Extended Range Mortar (ACERM)

2014 NDIA Joint Armaments Conference

S. L. Steelman, III

12-15 May 2014

- 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



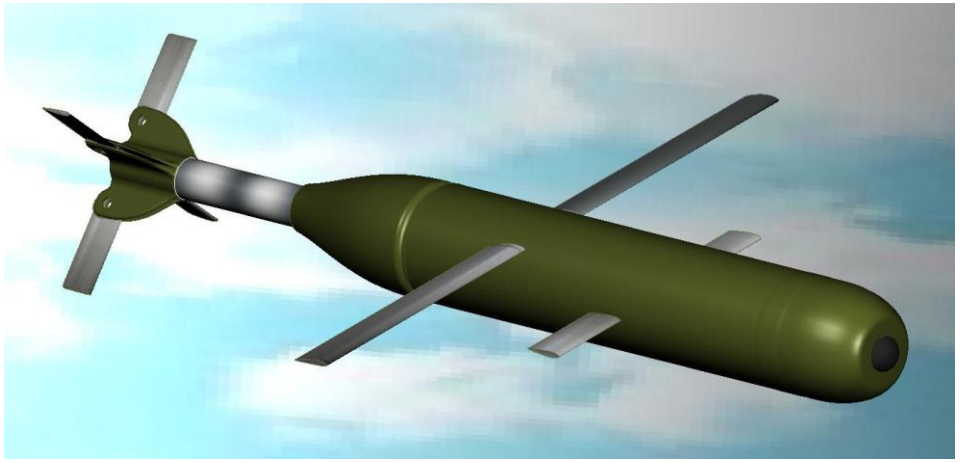
First up is 81mm Mortar
Followed by 83mm Shoulder Launched & 60mm Mortar

- Radical improvements over existing conventional & developmental 81mm precision systems

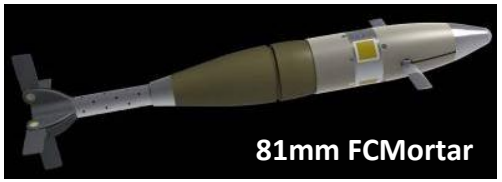
	Today	Challenge
Maximum Range Increase	10%	100-200%
Precision Delivery	10m CEP_{50}	1m CEP_{50}
Target Set	Maintain Existing	Expand into 120mm

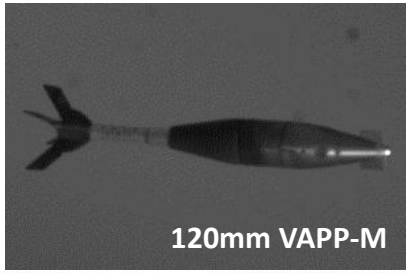
All while maintaining cost at or below systems of comparable capability

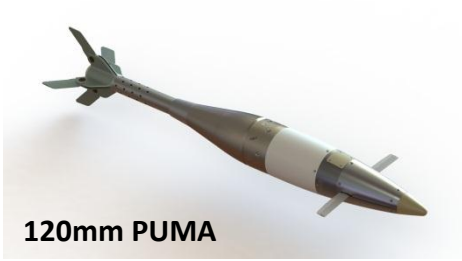
- Advanced Capability Extended Range Mortar



- New All Up Cartridge for 81mm
- GPS & SAL Precision Delivery
- >10km Maximum Range
- Active Flight Path Management
- Advanced Warhead
- Proven Technology Pedigree
- VAPP, FCMortar, PUMA, and UTAS 120mm







ACERM Team

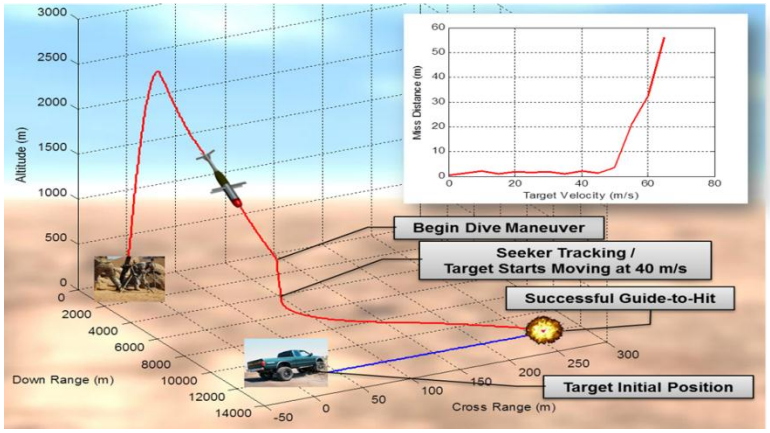
Government	
NSWCDD	Program Management, Systems Engineering, Airframe, SAL Seeker
ARL (Aberdeen)	Airframe, GN&C, Telemetry, Tail-Fins
NSWCIHEODTD	Propellant, Fuzing, Warhead
ARDEC (Picatinny)	Obturator, Primer/Igniter, Rocket Motor Development
NAWCWD	Warhead
ATEC (Yuma)	Live Fire Test & Evaluation

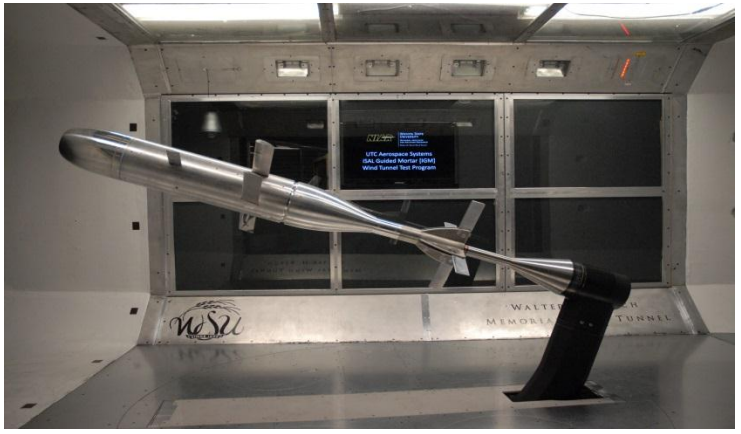
Contractor/Academia	
UTC Aerospace Systems	Airframe, CAS, GN&C, GEU
GD-OTS	Miniaturized Mission Setter
Rockwell Collins	GPS Receiver
Elbit Systems of America (CRADA)	JTAC-LTD, Skylark UAS
Wichita State University	Wind Tunnel Test Facility

More Team Members Pending Contract & CRADA Awards

Aerodynamic Range Extension

- 100%+ Increase in Maximum Range w/o in-flight propulsion
  - Generate > 5:1 Lift/Drag by adding deployable lifting surface
    - Validated by ARL Wind Tunnel Experiment Series
    - 8:1 and Higher is possible
  - Leverage Airframe Design from ongoing UTAS 120mm mortar program
    - UTAS 120mm validated L/D of > 7:1 and extreme terminal engagement maneuverability





Minimizes Cost Per Additional Kilometer of Maximum Range

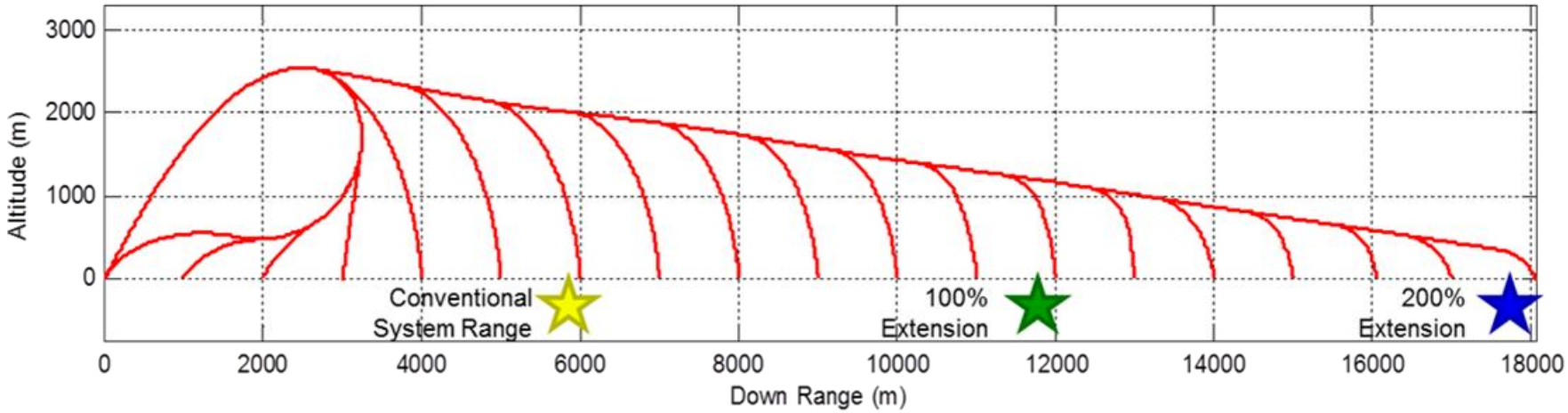
Dual-Mode Navigation

- Global Positioning System (GPS)
  - Mid-Course and Terminal Navigation
  - 10m CEP_{50} Delivery Accuracy
  - Range Extension, Shaped Trajectories
  - Rockwell Collins NavFire™

- Semi-Active Laser (SAL)
  - Terminal Navigation Sensor
  - 1m CEP_{50} Delivery Accuracy (objective)
  - Precision Delivery During GPS Denial & Fuze Setter Casualty Conditions
  - NSWCDD Low Cost SAL Seeker (LCSS)
    - Integral HOB variant under development

Flight Path Management System

- High Maneuverability + GPS Navigation + Fire Control =
  - Shaped Trajectories
    - Range Extension
    - Off-Axis
  - Terrain Topology Avoidance
    - Urban Insertion
    - Defilade
  - Terminal Angle of Fall Control
    - Optimized Delivery Angles for Warhead
  - Relaxed Aiming Requirements
    - Less work between shots



Enhanced System Effectiveness

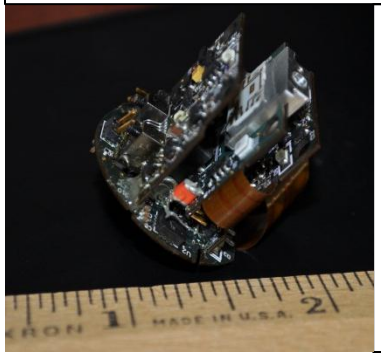
- New Purpose Built Warhead
  - Optimized to ACERM's precision & managed flight path capabilities
    - First round effects on target
    - Expanded Target Set
- Direct Hit Capability with SAL Targeting via LCSS
  - Harder Targets
  - Reduced Collateral Damage

Complete More Missions With Less Ammunition

Key Enabling Technologies

- Low Cost SAL Seeker (LCSS)
  - Body Fixed, Strap Down, STANAG 3733 SAL Seeker
  - Estimated production cost $1k/unit @ 10k unit purchase
  - Compatible with Laser Markers down to 10mJ/pulse
  - 11 prototypes delivered to Government & Industry for testing
  - Integral Height of Burst (HOB) Sensor development underway

- Extended Range Mortar Ammunition (ERMA) Propellant
  - Advanced artillery propellant adapted for mortar use
  - Maintains Launch velocity with up to 30% more mass
  - Already Demonstrated on M821 and PUMA



- 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

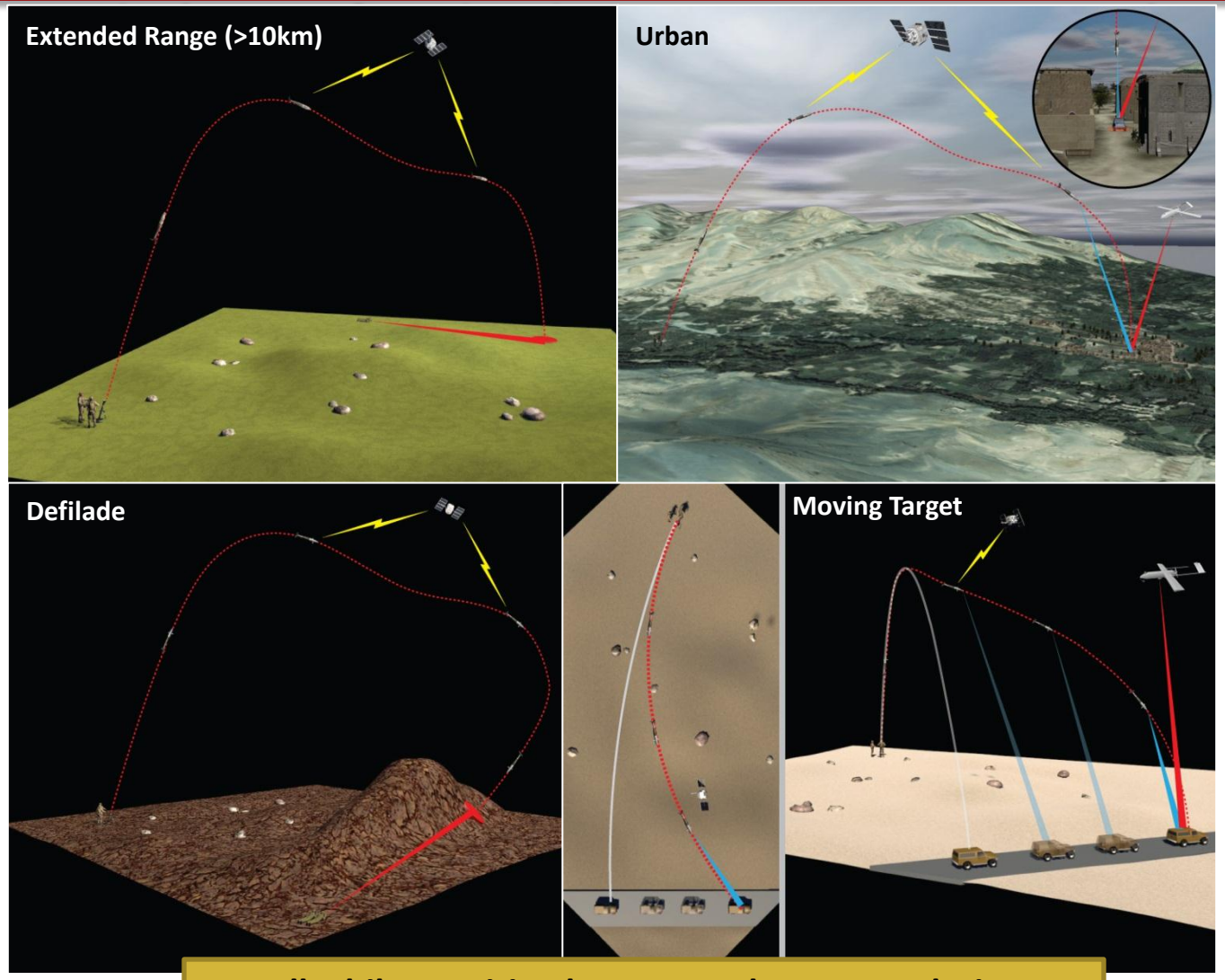
Key Enabling Systems

- Miniaturized Mission Setter (MMS)
  - Reduces EPIAFS/LHMBC down to <2lb Handheld Device
  - Maintains Man Portability of Precision 81mm
  - Android OS allows future multi-function device
    - DAGR, Mission Planning, Digital Call for Fire, Intel Display

- Joint Terminal Attack Controller – Laser Target Designator (JTAC-LTD, AN/PEQ-19)
  - 3.9 lb Target Designator w/ Pointer & Day/Night Optic
  - Enables Foot-Mobile Laser Targeting
  - Performance Testing with LCSS Underway

- Skylark I-LE Block 2 UAS
  - Hand Launched SUAS
  - Upgraded with Micro-Designator Marker (MDM) for Airborne Laser Targeting
  - Surrogate UAS Targeting Platform for Final Demo
    - Provided under CRADA with Elbit Systems of America

Future 81mm CONOPS



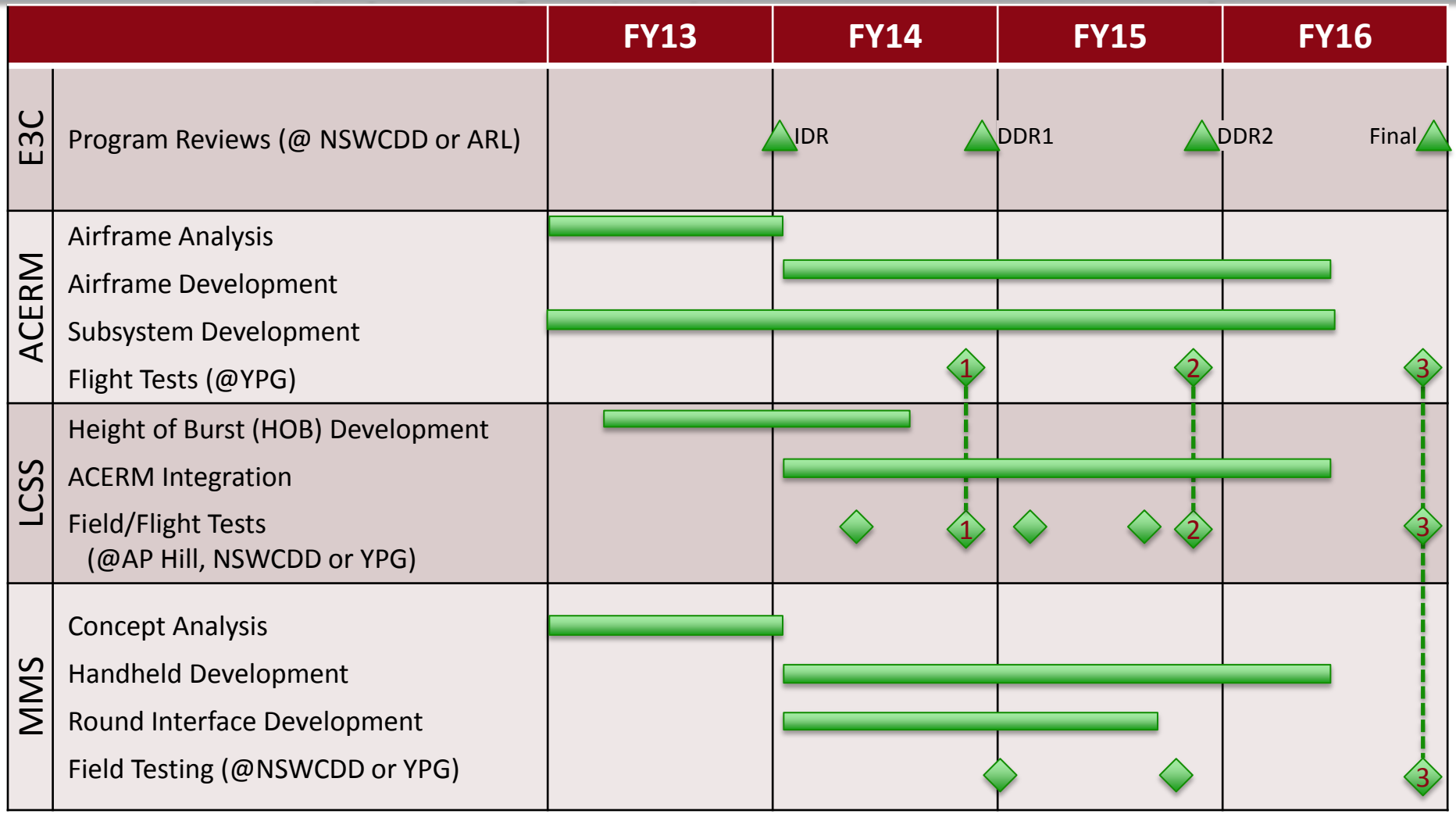
All while requiring less re-emplacements during dynamic engagements

- Discarding Propulsion
  - Tail boom discards or combusts during launch event
  - Allows full optimization of mortar afterbody
    - Lower Drag → More Range (>2 km)
  - Enables Center Nozzle Rocket Motor

- Rocket Motor
  - In-flight propulsion restores lost velocity & increases altitude
  - Combines with high lift to increase max range to 20-25km
  - Two solutions under investigation
    - Annular Nozzle – Compatible with existing fixed tail boom
    - Center Nozzle – Higher performance, requires discarding boom

Inclusion Dependent on Transition Stakeholder Requirements & Funding

Development Schedule



Flight Tests:	**#1: Roll Control** **#2: Wing Control** **#3: Closed Loop Guidance**

ACERM:	Advanced Capability Extended Range Mortar
E3C:	Enhanced Expeditionary Engagement Capability
LCSS:	Low Cost Semi Active Laser Seeker
MMS:	Munition Mission Section

Conclusions

- Demonstrate the "Art of the Possible" in fire support technologies for USMC weapons…
  - Beginning with 81mm ACERM
  - >10km Maximum Range w/ GPS + SAL Precision
  - Expanding Target Set to that of Conventional 120mm
- …through an ongoing series of integrated system firing demonstrations
  - First Live Fire Test Scheduled for End of FY14
  - Final Demonstration by End of FY16
- Transition System/Component technologies to FNC, Acquisition Program of Record, or other S&T Applications (i.e. 60mm, 83mm rocket)