



# U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT, & ENGINEERING CENTER (ARDEC)



## Project Overview - Precision Air Dropped Guided Munition (PADGM)



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

**NDIA, 46<sup>th</sup> Annual Gun & Missile Systems  
Conference & Exhibition, Miami, FL  
14 April 2011**

Asad Khan  
ARDEC Project Officer  
U.S. Army RDECOM-ARDEC  
RDAR-MEM-S  
Picatinny Arsenal, NJ 07806  
973-724-5075  
asad.khan@us.army.mil



# AGENDA



- ARDEC Overview
- PADGM Project Objective
- System Description
- Warfighter Payoff
- Accomplishments to date
- Summary





# Armament Research, Development & Engineering Center



## Research



## Development



## Production



## Field Support



## Demilitarization



## Vision:

Innovative Armaments Solutions for Today and Tomorrow

## Mission:

To develop and maintain a customer focused, world-class workforce that will execute, manage and continuously improve integrated life cycle engineering processes required for the research, development, production, field support and demilitarization of munitions, weapons, fire control and associated items.

Advanced Weapons – line of sight/beyond line of sight fire; non line of sight fire; scalable effects; non-lethal; directed energy; autonomous weapons

Ammunition – small, medium, large caliber; propellants; explosives; pyrotechnics; warheads; insensitive munitions; logistics; packaging; fuzes; environmental technologies and explosive ordnance disposal

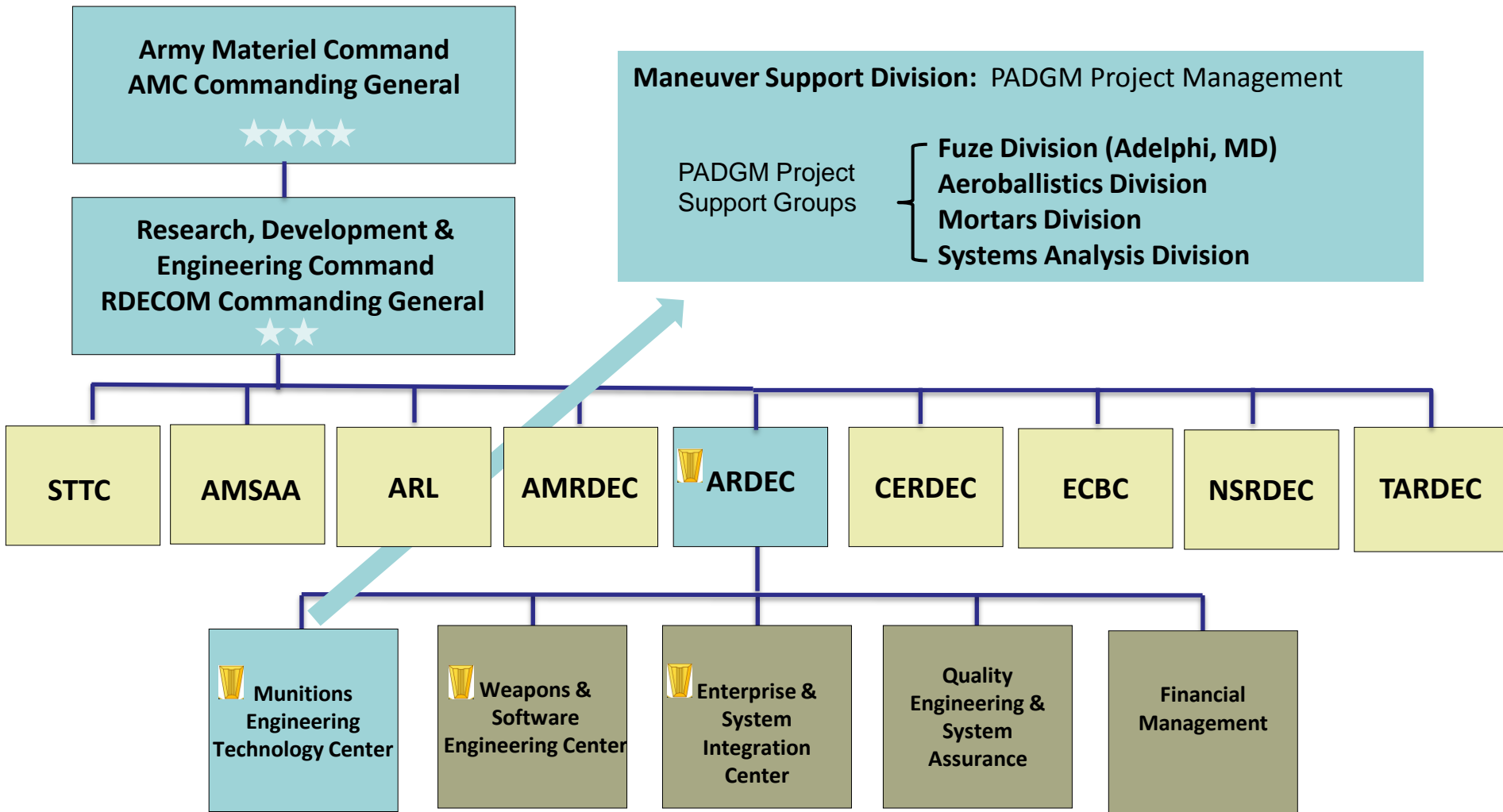
Fire Control – battlefield digitization; embedded system software; aero ballistics and telemetry

**ARDEC provides the Technology for Over 90% of the Army's lethality; Significant support to other services' lethality**





# ARDEC Organization - Chain of Command





# Precision Air Dropped Guided Munition (PADGM)

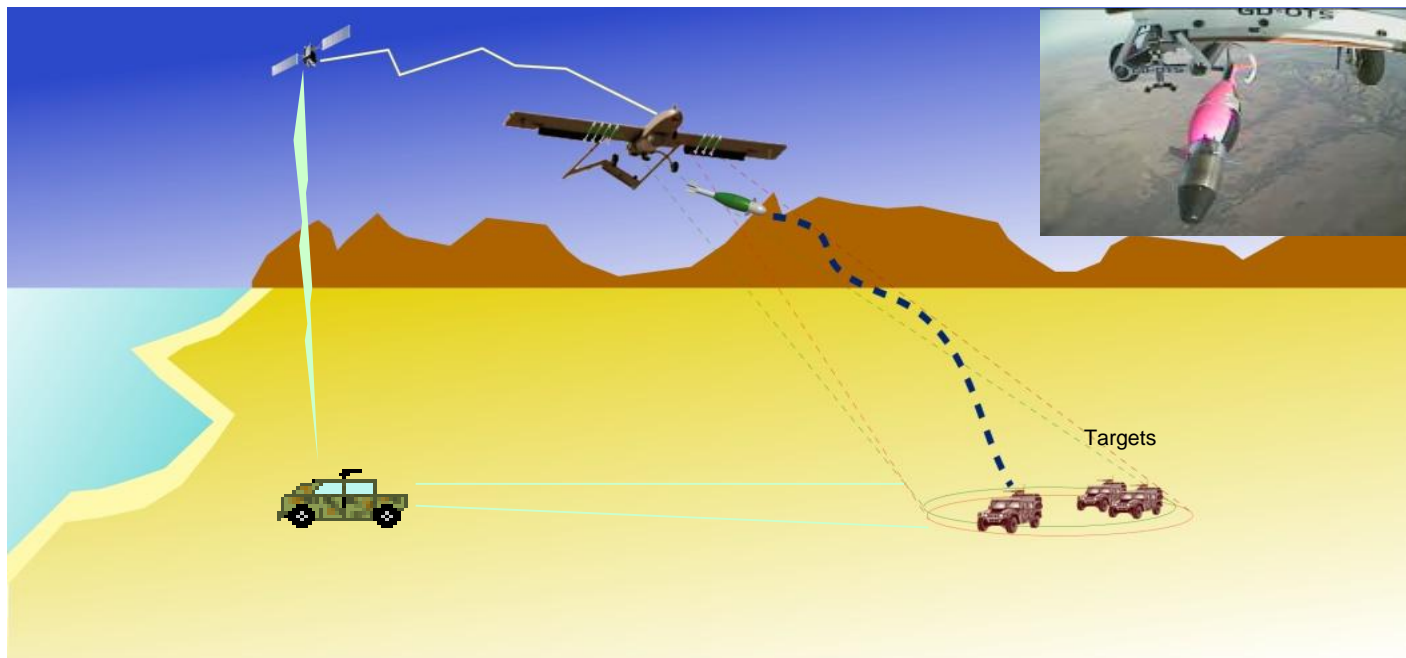


## Objectives

- Provide a low cost, small, light weight and near term precision strike weapon capability for unmanned (and manned) aircraft systems
- Modify the 81mm mortar ammunition by replacing the standard fuze with a nose kit that includes GPS based Guidance, Navigation & Control (GN&C) elements including a fuze designed for air drop applications
  - Partner with General Dynamics – Ordnance Tactical Systems (GD-OTS) for development of the GN&C system, including their innovative Roll Controlled Fixed Canard (RCFC) technology
  - Design, develop and integrate an electronic proximity fuzing system to address air dropped environments – considered critical path item to rapid fielding



# Notional Concept of Operation for PADGM System



Aircraft positioned above targets of interest determines GPS coordinates, fed from ground/air observers, and passes to mortar round via umbilical data link which once released is guided by the on board GN&C system to target. The control concept utilizes a unique braking system to reorient fixed canted canards to provide the necessary maneuvers to the mortar round in flight for precision target engagement

*Reduced sensor to shooter timeline. 'See it, Kill it' capability.*





# 81mm mortar round comparison Standard vs. Air Drop

for

**81 mm  
Mortar  
Ammunition**

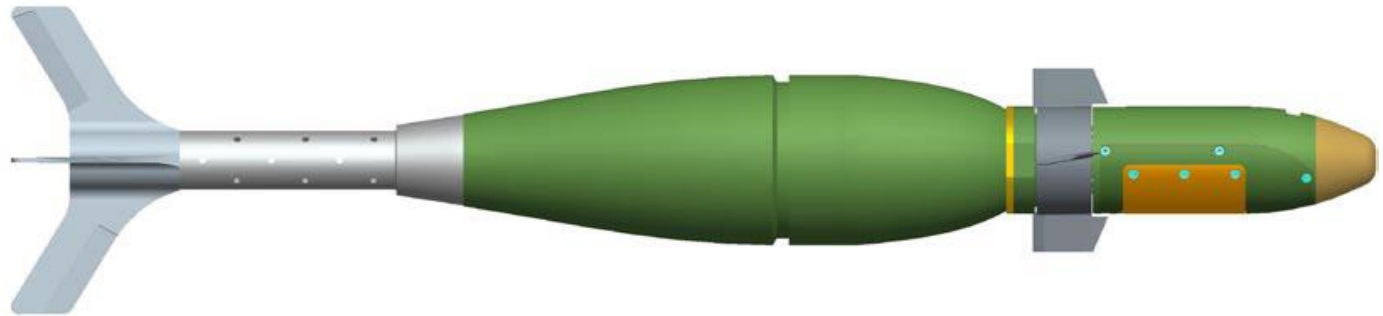


Fin

Body Assembly

Fuze

**Tactical Air  
Drop Round**



**Modified Tail Fin  
for Extended Range**

**Existing M821 HE Warhead**

**Modified Nose with  
Guidance Kit  
& integrated  
Electronic Fuzing**





# Why PADGM?



- Low cost – GPS based precision munition capability
- Small and Light Weight – suitable for Shadow class UAS platforms
- Soft Release of kill munition from aircraft – dropped vs. launched
- Reduced collateral damage and soldier exposure – near vertical and precision engagement
- Reversible arming capability – electronic fuze disarms if round misguides
- No warhead development – proven lethality
- Warhead – high weight ratio vs. total weight
- Reduced logistics burden – lethal effectiveness with fewer rounds
- Effective engagement against stationary soft targets sets – light vehicles, dismounted enemy personnel
- Future warhead enhancement capability – Mortar Anti-personnel Anti-Material (MAPAM)

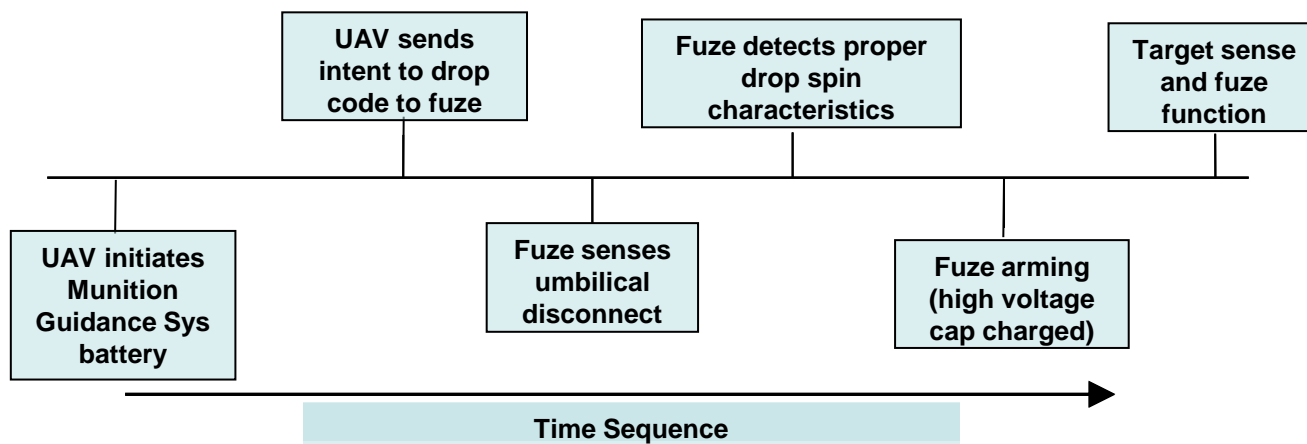
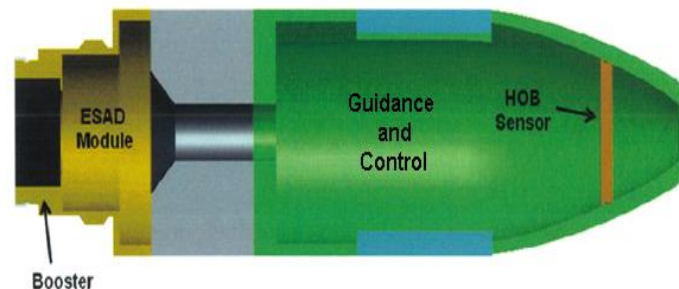




# PADGM Fuzing System



- Electronic Safety and Arming Device (ESAD) and Height of Burst (HOB) sensor integrated with the Guidance and Control System
- ESAD designed to operate independently from the guidance electronics to satisfy the fuze safety requirements
- Three function modes – proximity, impact and delay after impact
- Two independent arming events/environments
  - Time sequenced umbilical release
  - In-flight round spin induced by tail fin cant



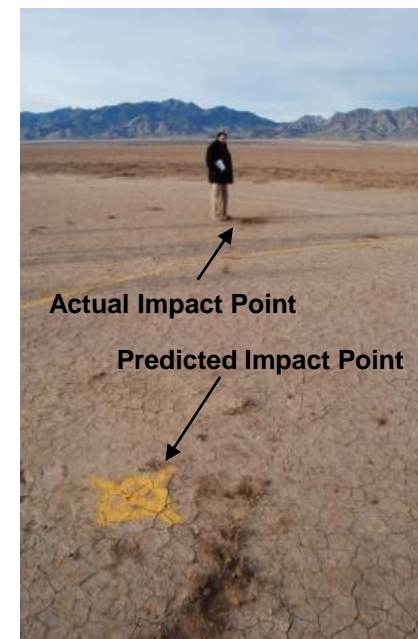
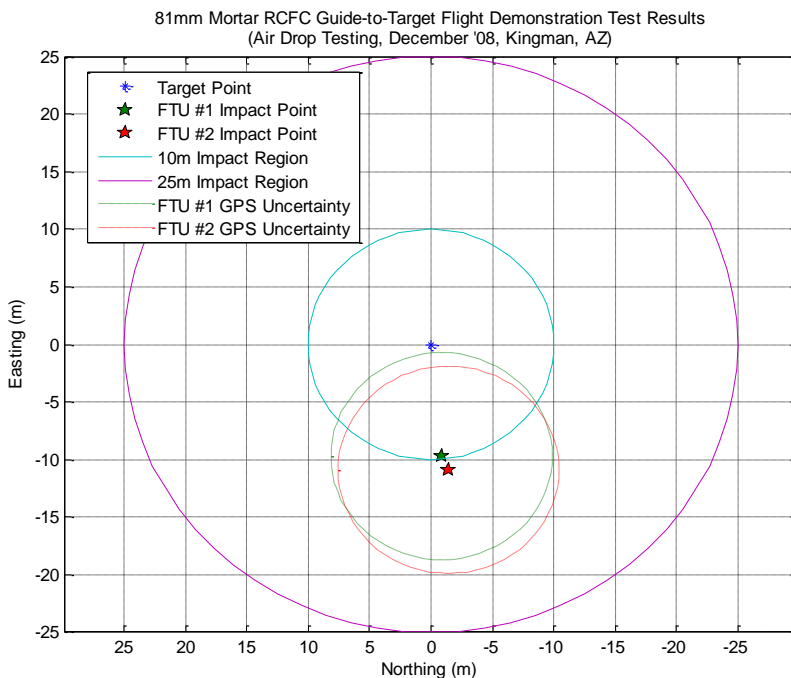


# Guide-to-Target Air Drop Flight Demonstration - Dec 08

- Two Flight Test Units air dropped from C-123
  - FTU #1 impacted ground < 10 meters from intended target
  - FTU #2 impacted ground < 11 meters from intended target
- Demonstrated accuracy within the accuracy of the GPS (9 - 10.5 meters)



Impact Points

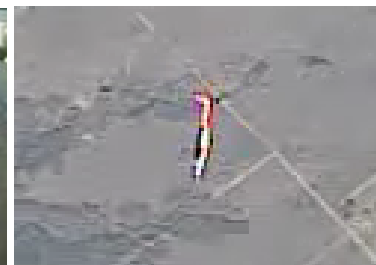


# Guide-to-Target Air Drop Flight Demonstration - Mar 10



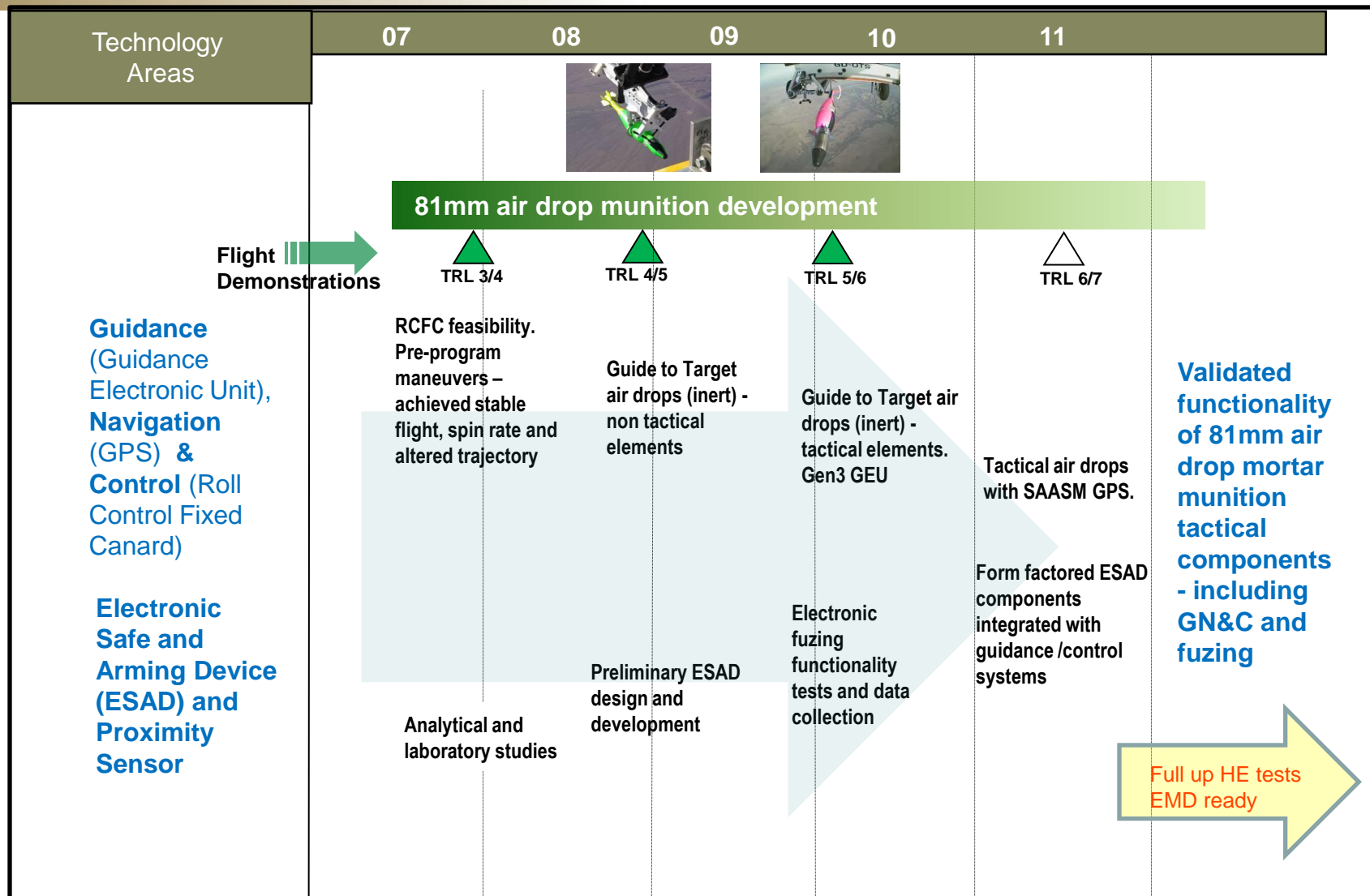
**Tiger Shark UAV with  
81mm Guided Air Drop  
Munition and GD-OTS  
Rack System**

- First ever PADGM air drop demonstration from tactical class Unmanned Aircraft System
- Air drop from 8,000 ft AGL with 75m lateral offset
- Demonstrated 40m range and 80m cross-range correction - **landing within 2m of target**
- Improved algorithms resulted in improved accuracy
- Test validated UAV integration, system functionality and aero coefficients





# PADGM Technology Roadmap





# Summary



- **ARDEC initiative to develop a low cost, small and light weight weapon option for unmanned/manned aircraft platforms**
- **Munition Guidance Kit technology, with ESAD fuze and GN&C components, replaces existing M734A1 mortar round fuze nose for air drop application**
- **Very successful 'guide to target' flight demonstrations**
- **Path forward - mature 81mm air drop munition to a fully integrated tactical configuration and conduct live fire flight demonstrations**







# Questions?

