XM1156 Precision Guidance Kit (PGK)

Information Briefing for
52nd Annual Fuze Conference

"Smart Fuzing - Adding Intelligence to Fuzing Solutions"

13 – 15 May 2008

Pete Burke
OPM Combat Ammunition Systems
Email: peter.j.burke@us.army.mil
Phone: 973-724-5802

Tony Pergolizzi
US AFMO
Email: anthony.pergolizzi@us.army.mil
Phone: 973-724-2361

Agenda

- System Overview
- Operational Concept
- Warfighter Benefits
- Requirements
- Schedule
- Hardware Description
- Future Advancements in Fuzing
- Summary

Bottom Line Up Front

- **XM1156 Precision Guidance Kit (PGK) is a GPS Guidance Kit with Fuzing Functions to Reduce Ballistic Dispersion of Artillery Projectiles**
  - Increment 1: ≤ 50m CEP for 155mm High Explosive (HE) projectiles
  - Future Increments will develop compatibility for 105mm projectiles, cargo projectiles, and future artillery platforms

- **PGK completed a competitive 155mm Technology Development (TD) phase, exceeding the TD Exit Criteria by achieving a less than 50m CEP (based on 18 round demo of the M549A1)**

- **Alliant Techsystems (ATK, Plymouth, Minnesota) was awarded the Increment 1 System Development and Demonstration (SDD) option on 17 May 2007**

- **PGK is scheduled to begin production in 2Q US Fiscal Year 2009, and be fielded in 2Q US Fiscal Year 2010**

Technology Demonstration Firings

PGK Projectiles & Platforms

PGK Projectiles with M109A6 (Paladin)

M777A2

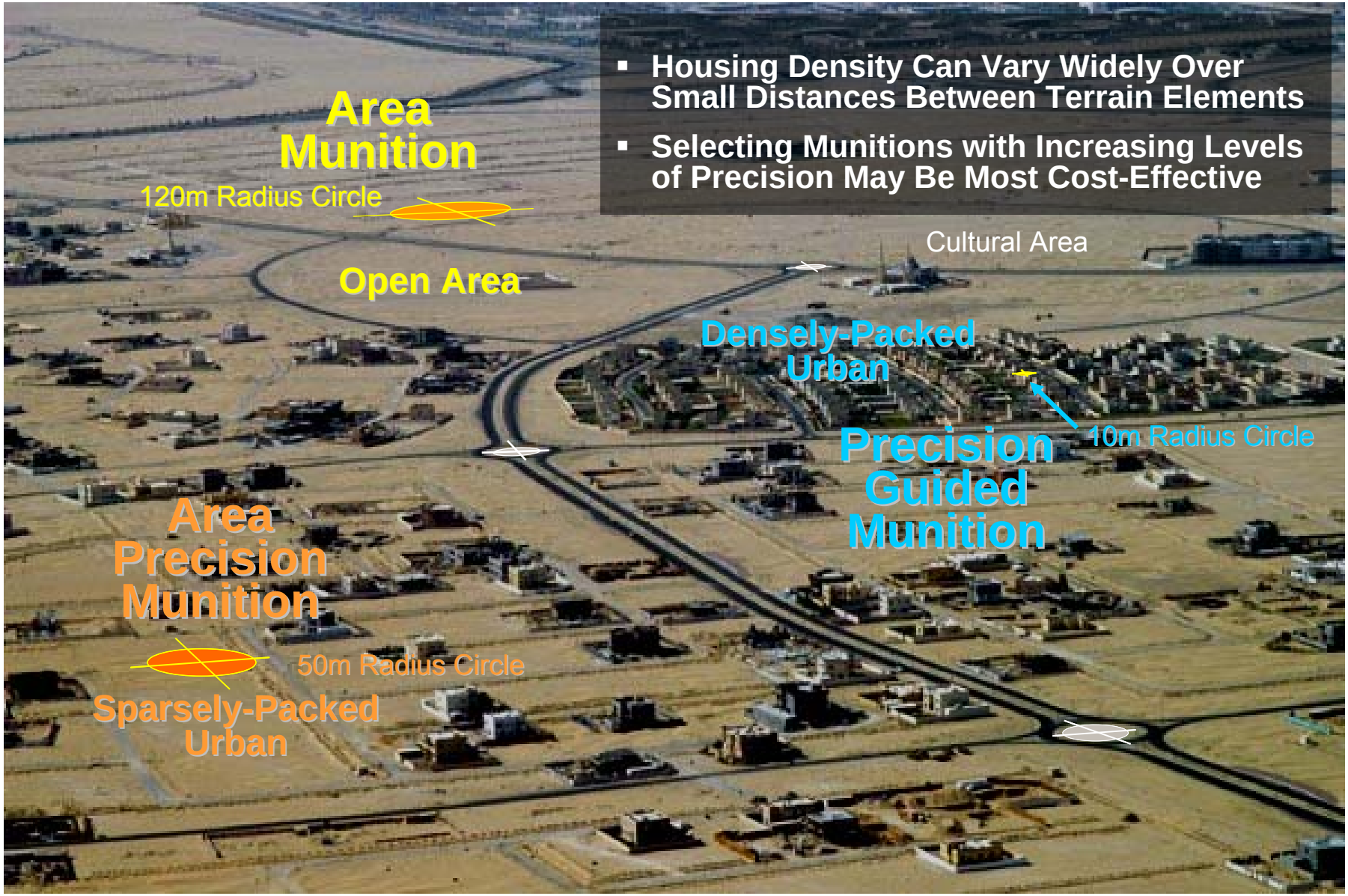
<u>M107</u>
- 95 lbs
- Max Range* 17.5Km
- Warhead 15 lbs

<u>M549/A1</u>
- 96 lbs
- Max Range* 30Km
- Rocket Assisted
- Warhead 15 lbs

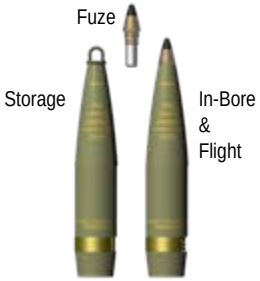
<u>M795</u>
- 103 lbs
- Max Range 22.5Km
- Warhead 23.8 lbs

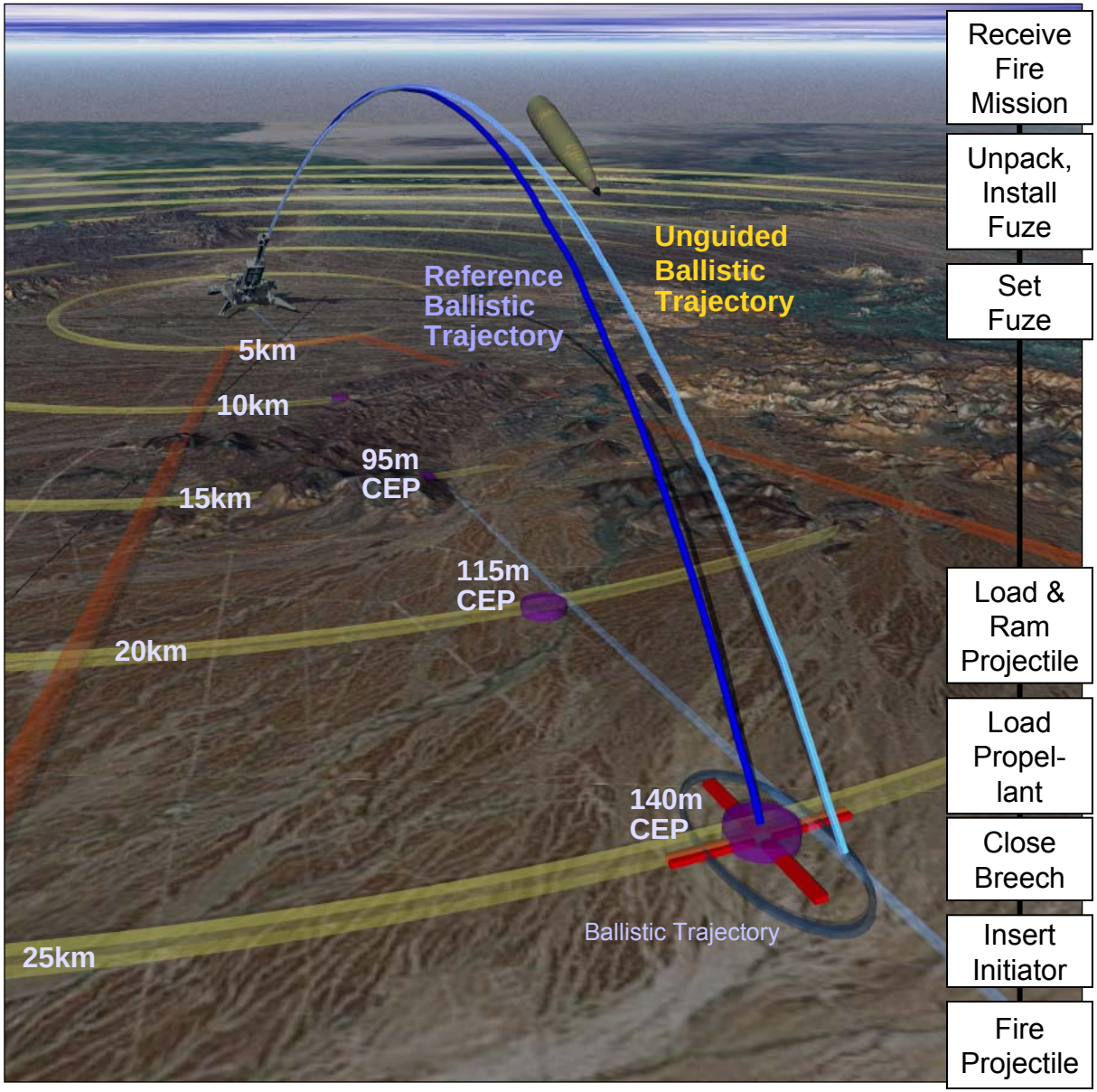
* Maximum Range without PGK shown. Max Range will be reduced by no more than 10% with PGK

What Level of Precision is Needed?



Non-Precision Conventional Mission





Receive Fire Mission

Unpack, Install Fuze

Set Fuze

Load & Ram Projectile

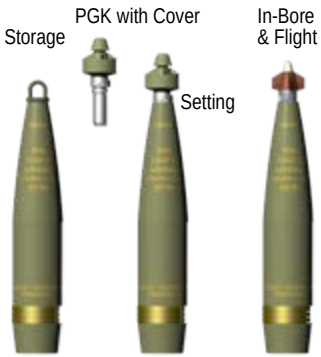
Load Propel-lant

Close Breech

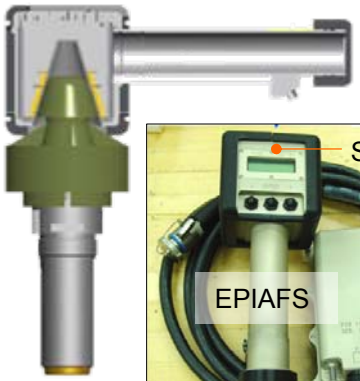
Insert Initiator

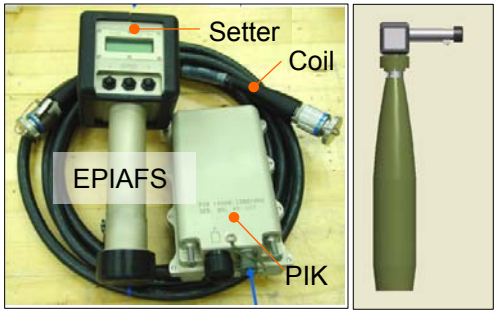
Fire Projectile

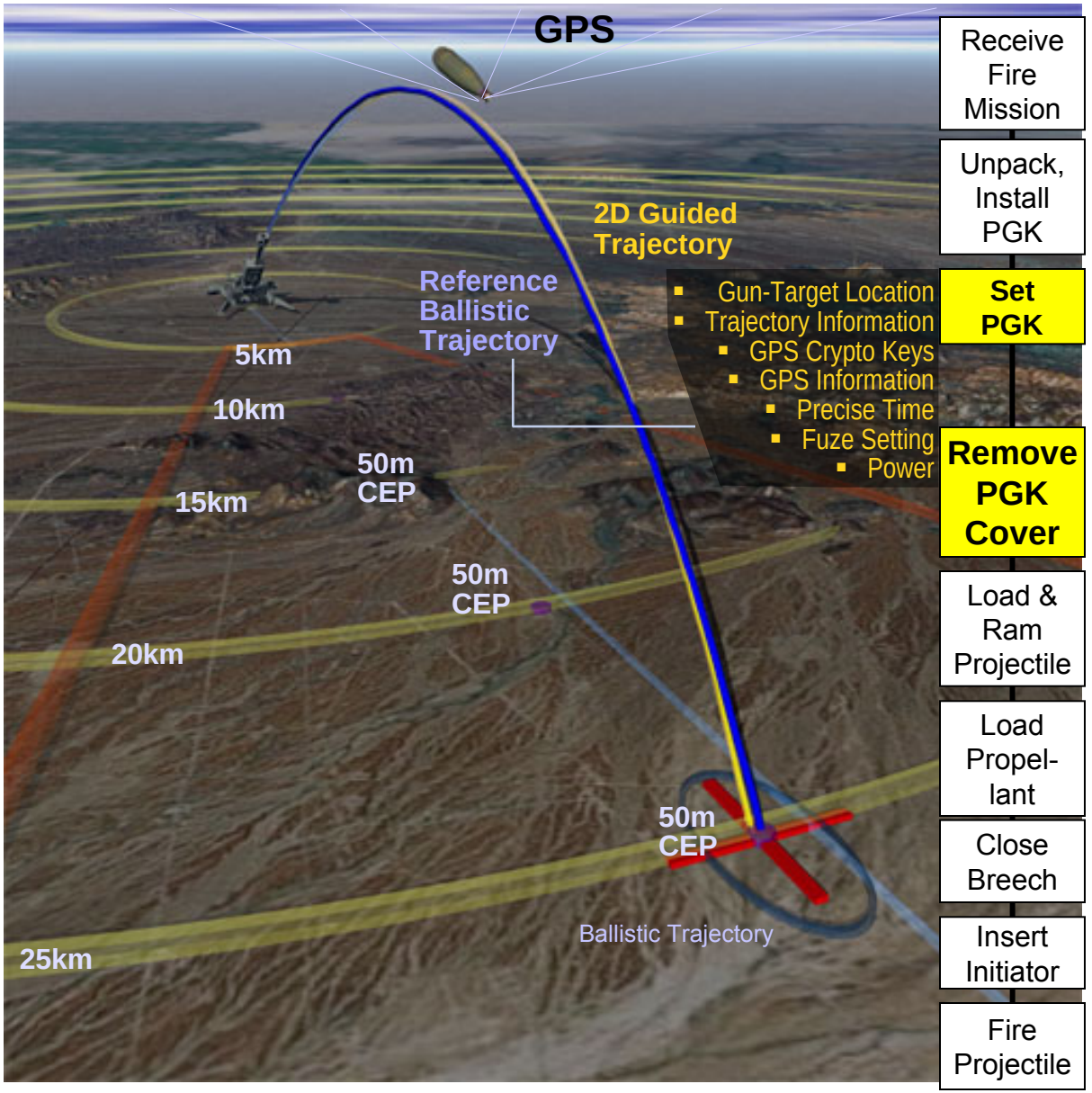
Precision PGK Mission



Planning the PGK Mission







Receive Fire Mission

Unpack, Install PGK

Set PGK

Remove PGK Cover

Load & Ram Projectile

Load Propel-lant

Close Breech

Insert Initiator

Fire Projectile

Comparative 155mm Projectile Accuracies

The Most Cost-Effective Munition Will Be Chosen Based on Mission Need:

- Target Defeat Capability
- Collateral Damage Risk

M549A1 with PGK

M549A1

15 km — 50 m

20 km — 50 m

25 km — 50 m

30 km — 50 m

94 m

125 m

150 m

267 m

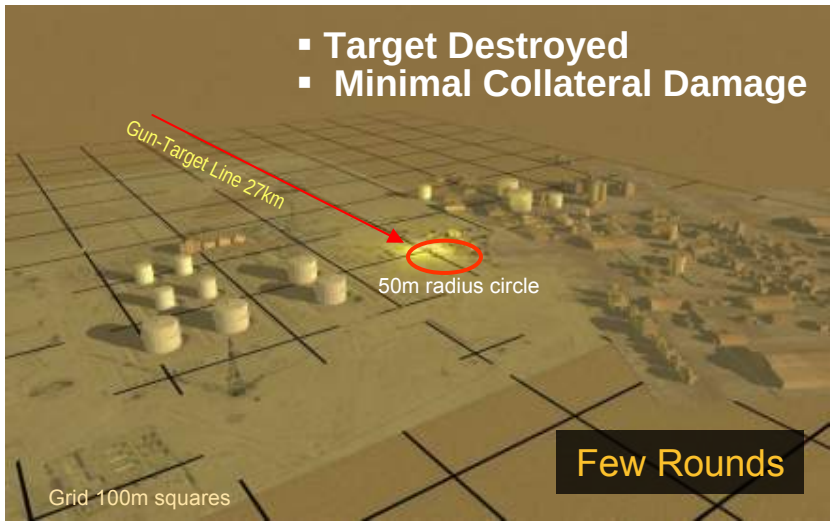
All using 1/2 hour old Meteorological data

Circles represent accuracy in terms of CEP (Circular Error Probable) at different operational ranges from the firing platform

Operational Benefits

Today's Capability: 183m CEP*

PGK: ≤50m CEP



* **M109A6 (Paladin) at 27km: 155mm (HE) M549A1**

- **Improves Munition Accuracy**
- **Increases Effectiveness & Efficiency of Cannon Fires**
- **Increases Number of Kills per Basic Load of Ammunition**
- **Greatly Reduces Possibility of Collateral Damage**

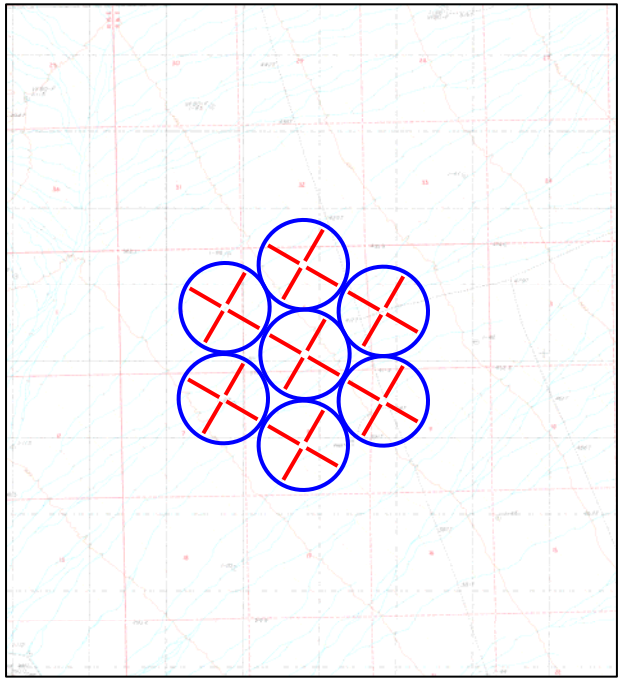
PGK Requirements

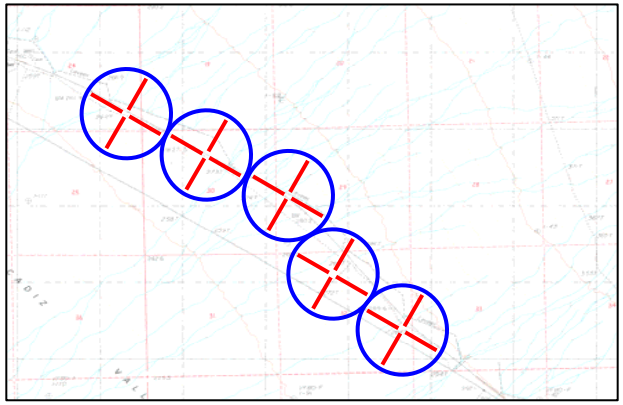
JROC Approved (Increment 1) 22 Jan 2007

	Increment 1 IOC FY10	Increment 2 IOC FY13	Increment 3 IOC FY16
Key Performance Parameters			
1. Net Ready	→	→	→
2. Reliability	92% (T); 97% (O)	→	→
3. Accuracy	≤ 50m CEP (T); ≤ 30m CEP (O)	≤ 30m CEP (T=O)	≤ 30m CEP (T); ≤ 20m CEP (O)
Attributes			
Munition Type	155mm HE (M107, M795, M549A1)	Adds 105mm HE (T); 105/155mm HE & Cargo (O)	155mm HE (T); 105/155mm HE & Cargo (O)
Platform Types	M777A2, Paladin	Adds M119A3 (105mm) (T); NLOS-C (O)	Adds NLOS-C (T); Paladin, M777A2, M119A3 (O)
Fuzing Function	PD, Proximity	Adds Delay & Time (O)	→

T: Threshold Requirement
O: Objective Requirement

PGK Missions





PGK performs the same missions as conventional 155mm HE munitions, but with better effectiveness consistent with a 50m CEP accuracy.

Enhanced Portable Inductive Artillery Fuze Setter (EPIAFS) and Platform Integration Kit (PIK)

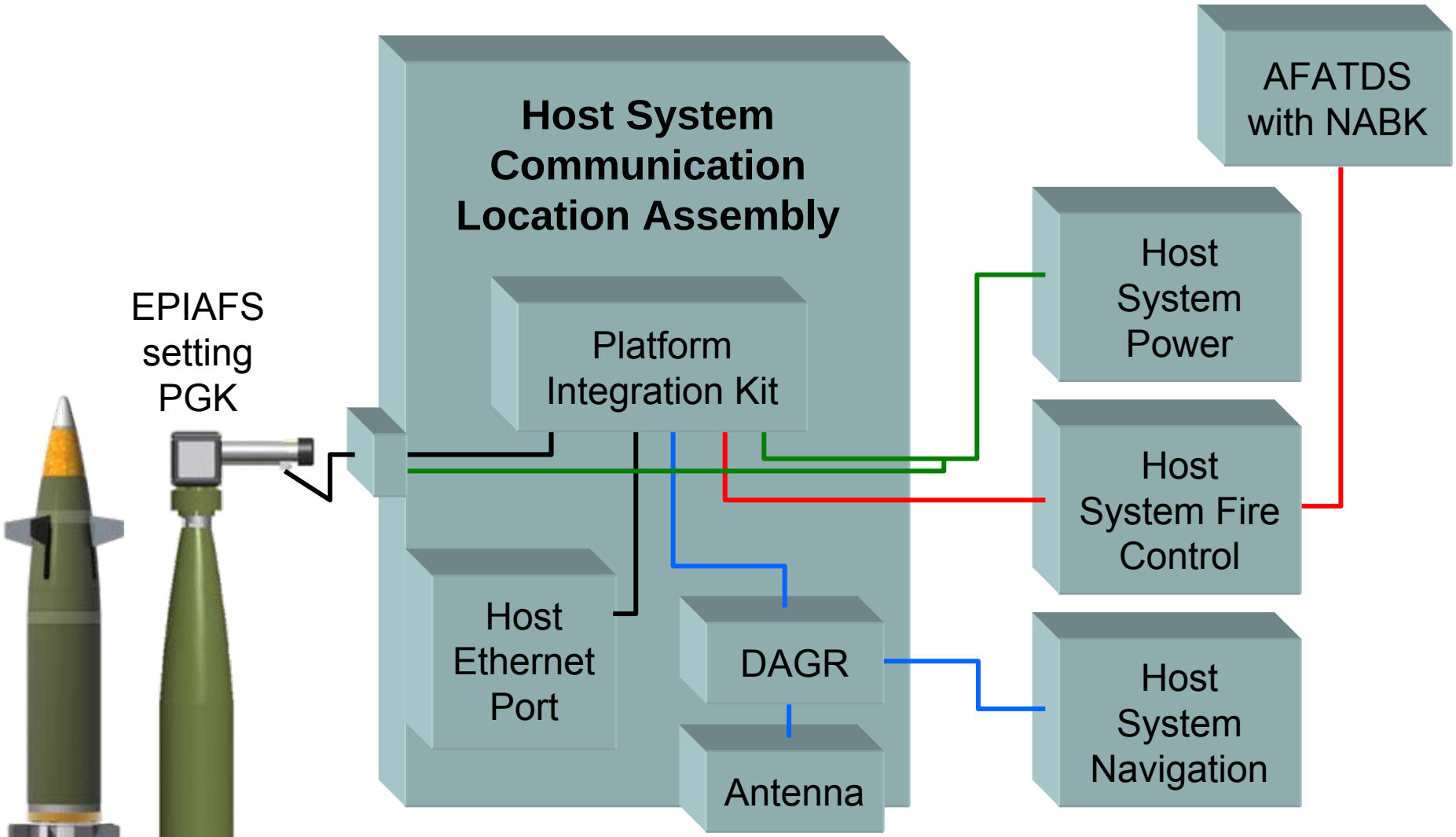
DAGR

- EPIAFS:
  - Conventional Fuze & Excalibur/PGK Setter
  - Programs Excalibur & PGK with mission information
- Platform Integration Kit
  - Interface circuit from platform fire control systems, DAGR (GPS receiver) to EPIAFS

PIK in M109A6 (Paladin)

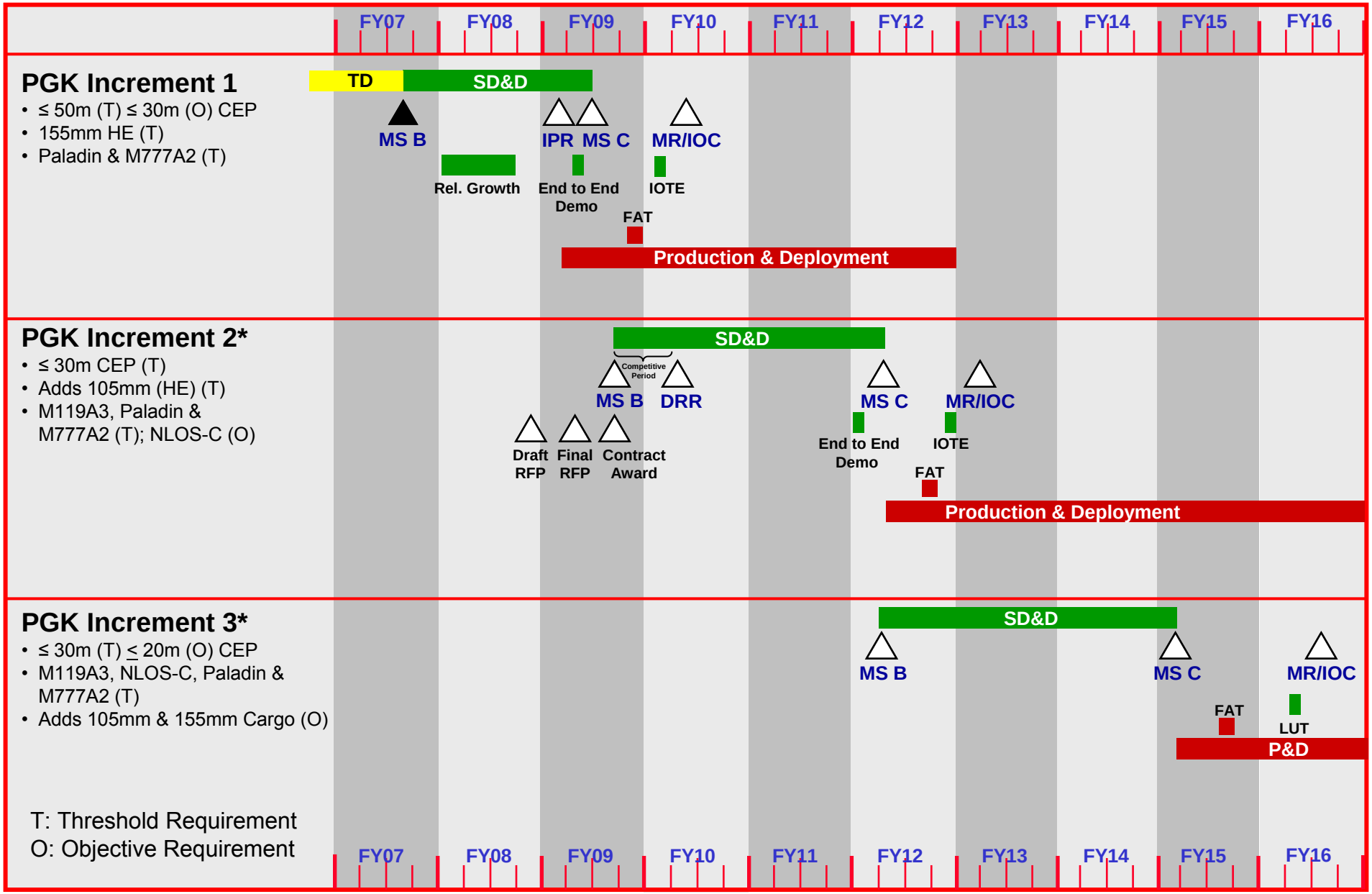
PIK on M777A2

EPIAFS Interface & Host System Support



Compatible with Excalibur & PGK

PGK Incremental Schedule

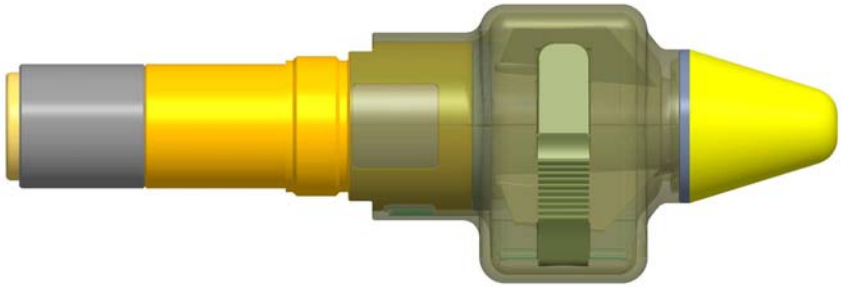


*Future Programs

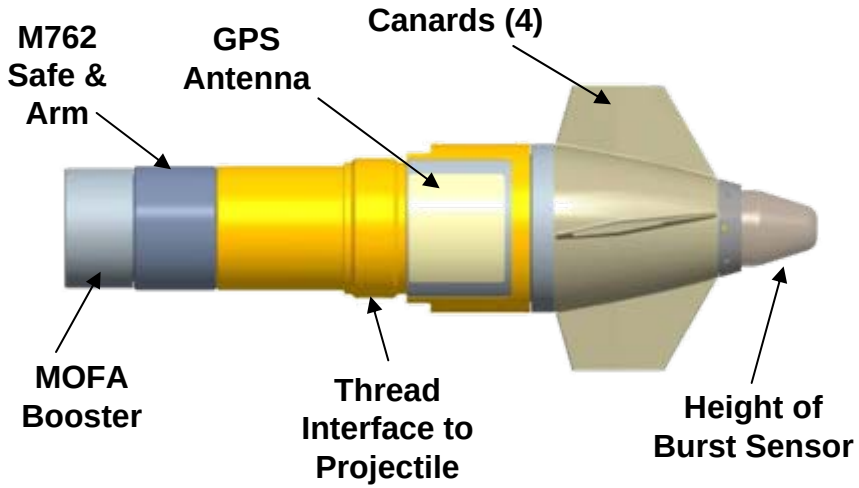
PGK Design Description

PGK With Cover

Cover Provides Environmental Protection & Interface to Fuze Setter

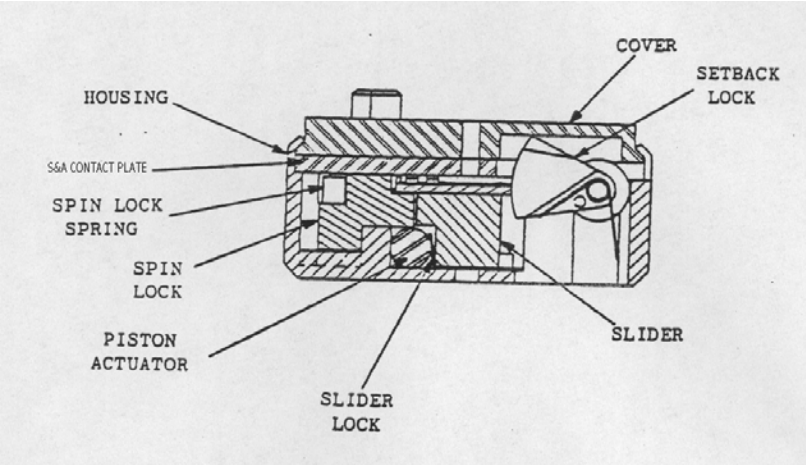


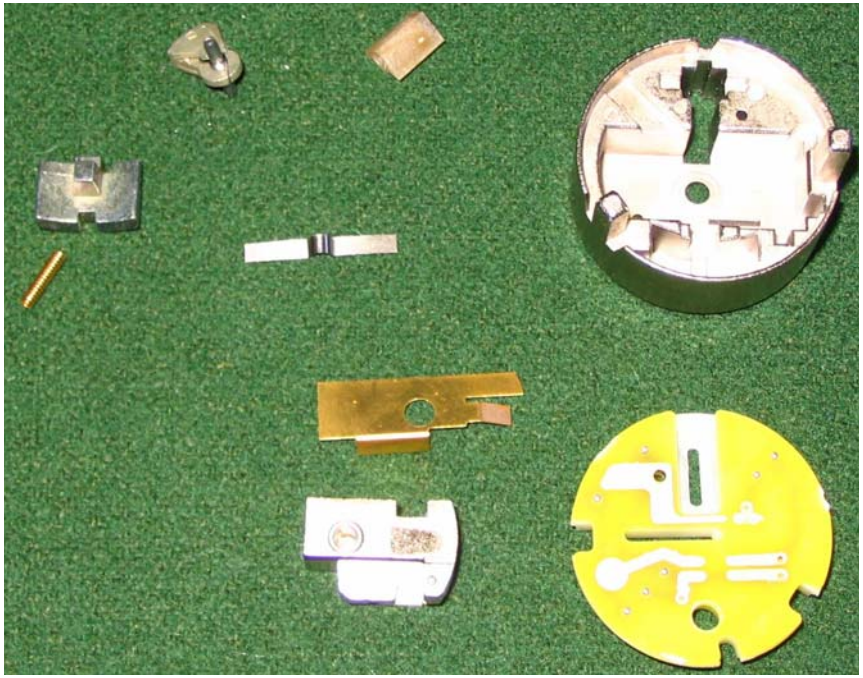
PGK with Cover Removed

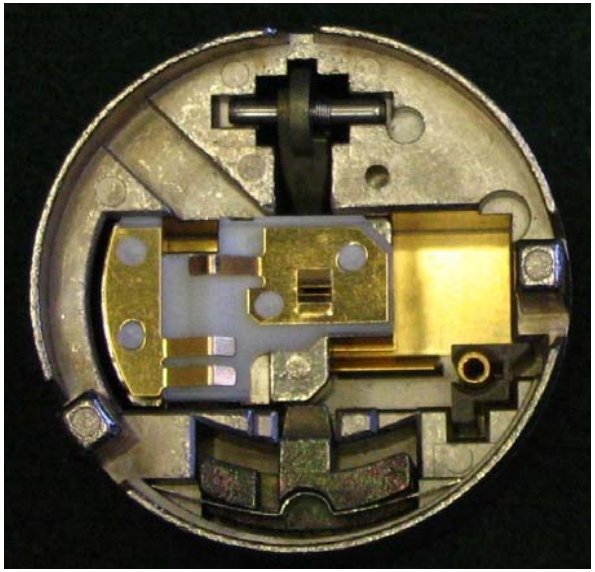


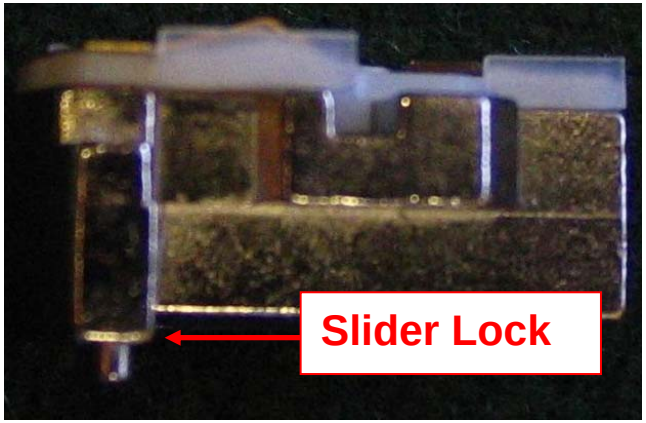
- **Fits In Std 155mm HE Artillery Projectile Fuze Wells (Deep Intrusion)**
- **GPS Guidance (With SAASM)**
- **20 Year Storage Life (No Battery)**
- **Proximity & Point Detonating Fuzing**

M767A1 Safe & Arm (S&A) Mechanism



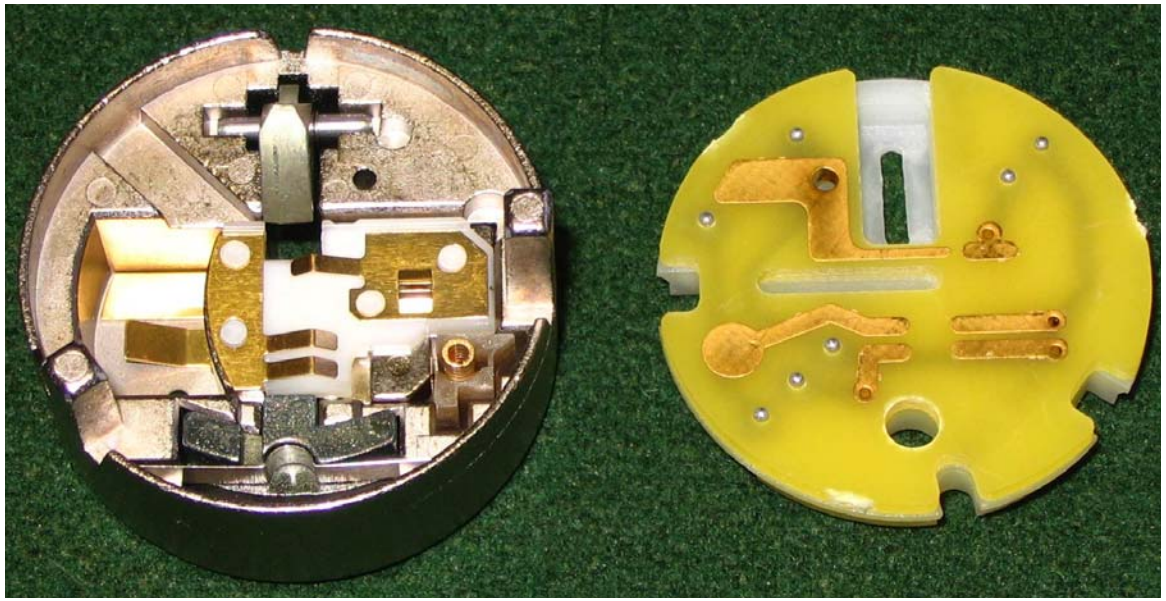


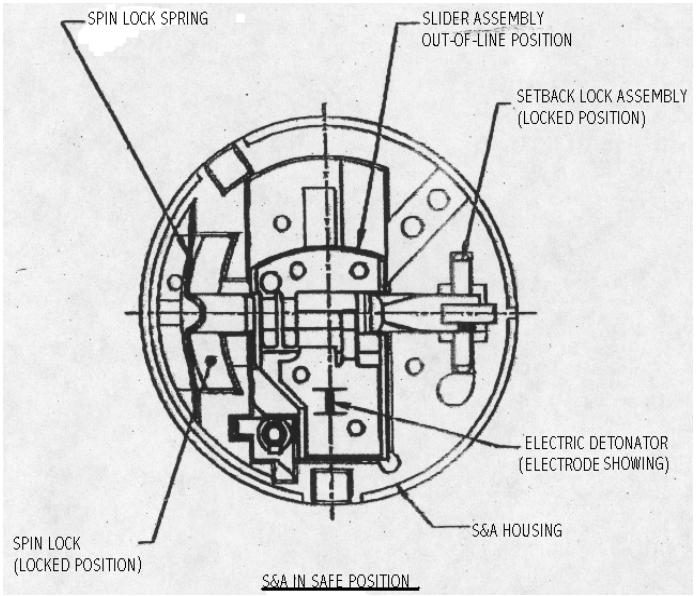




Safe Position

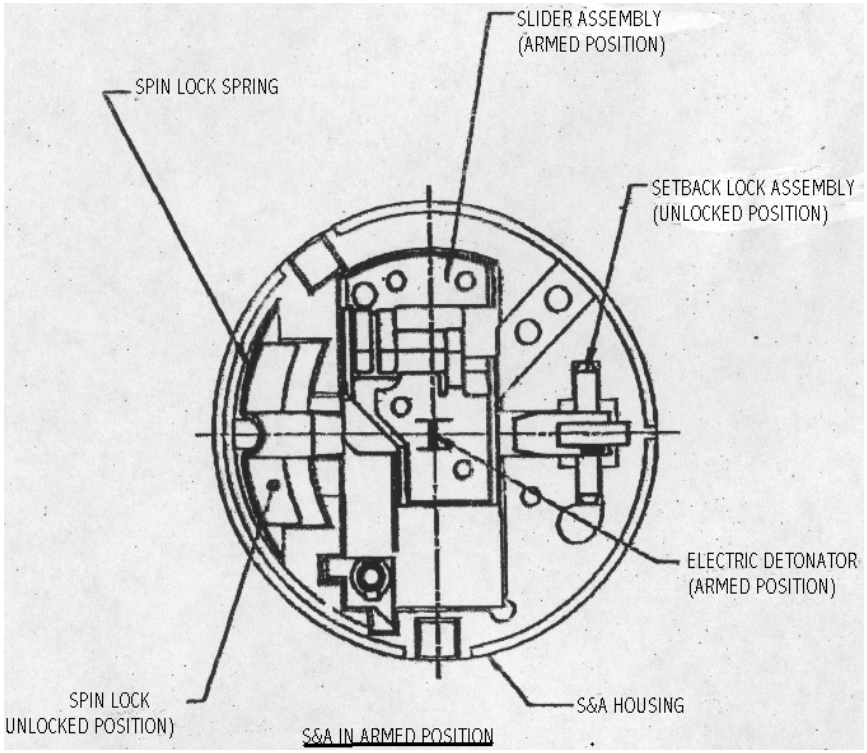
- Setback weight up
- Spin lock pushed in

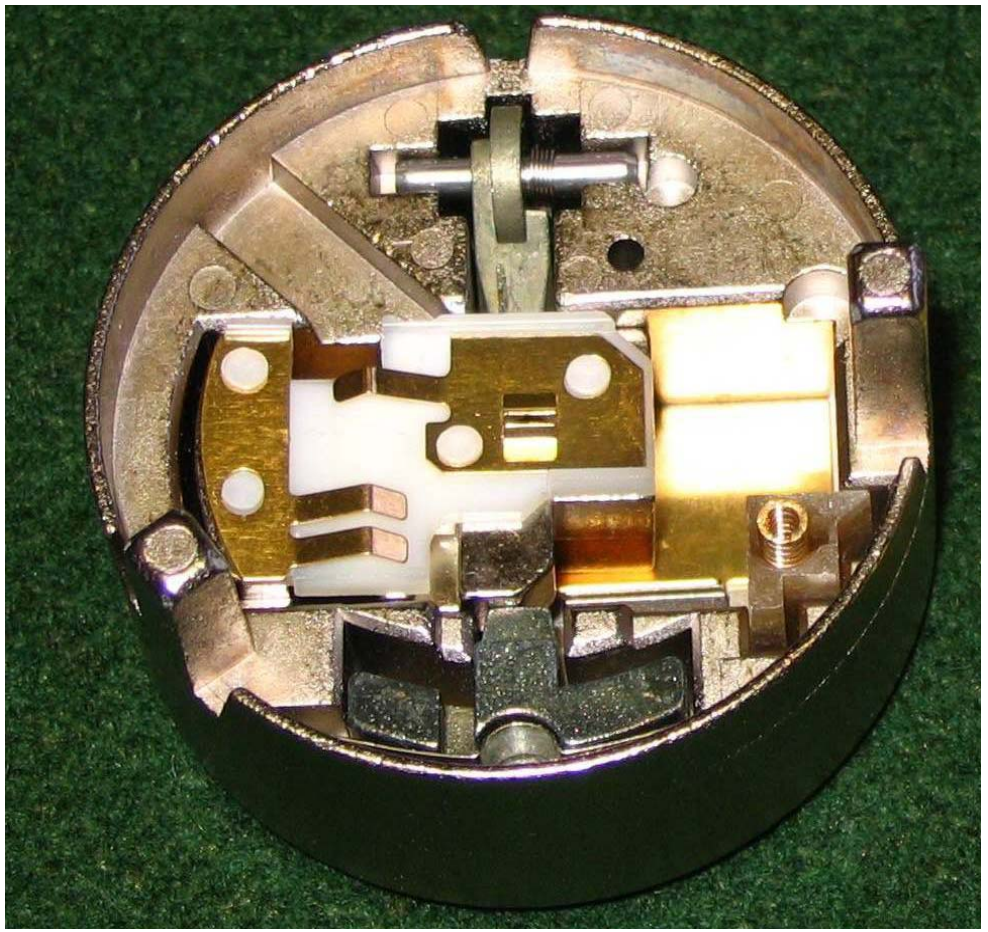




Armed Position

- Setback weight down
- Spin lock pushed out



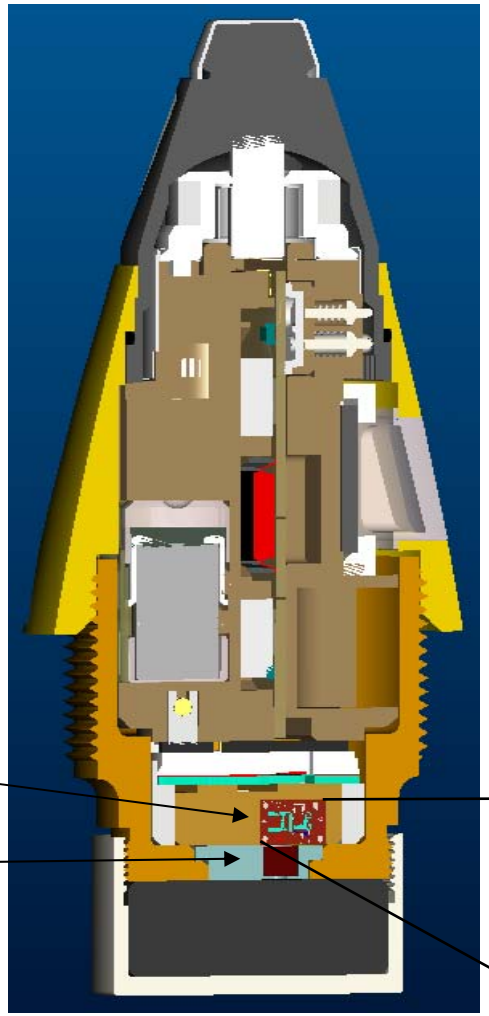


Future Advancements in Fuzing

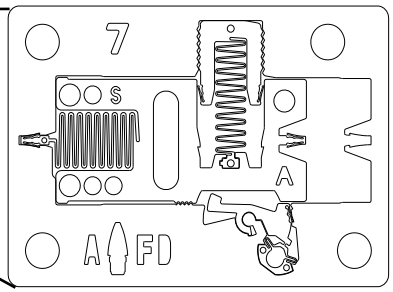
Micro-Electro Mechanical Systems (MEMS) S&A Development

Fuze Section Views

M762A1/M767A1



MEMS Integrated

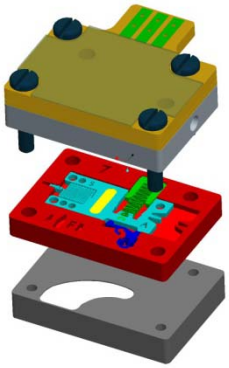


M762A1 Fuze Used To Evaluate MEMS S&A Performance For Artillery

- Improved MEMS Design
- Suitable For High and Low Propellant Charges
- Command-To-Arm Feature
- ***S&A Volumetric Savings = 95%***

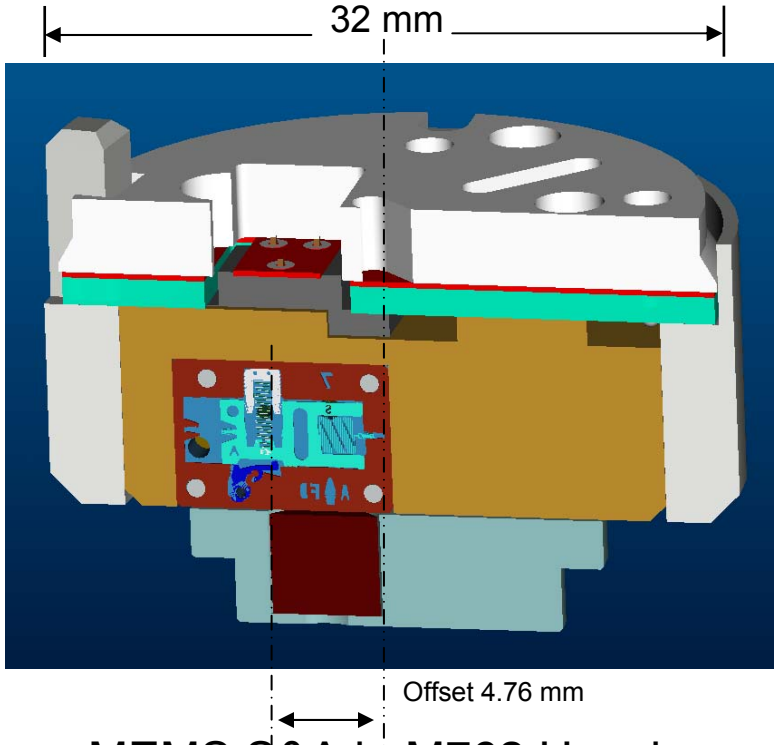
21

MEMS S&A Development



MEMS S&A Device

Approx. 10 x 7 x 6.5 mm

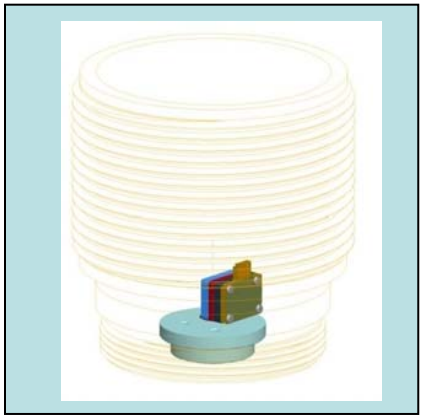


MEMS S&A in M762 Housing

M762 Fuze Minimum Launch (MACS 1):

- Redesigned Springs For Low Charge (Reduced Setback) Actuation
- Offset MEMS S&A 4.76-mm From Spin Axis to Attain Req Centrifugal Forces
- New Disk For Offset Lead Charge

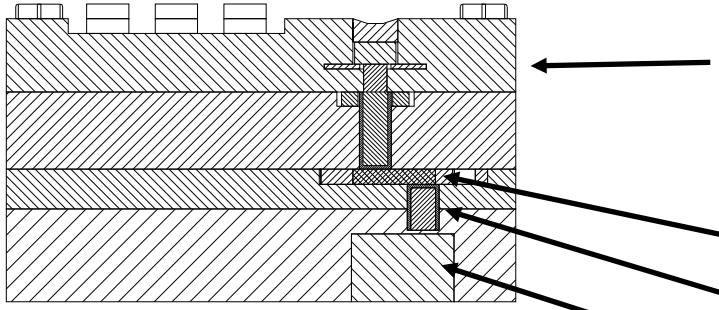
Results: 40 Assemblies Tested and All Functioned M762 Lead Explosive



End Cap, Lead Disk and MEMS S&A

Micro-Scale Firetrain (MSF)

U.S. Patents 7055437 and 7069861



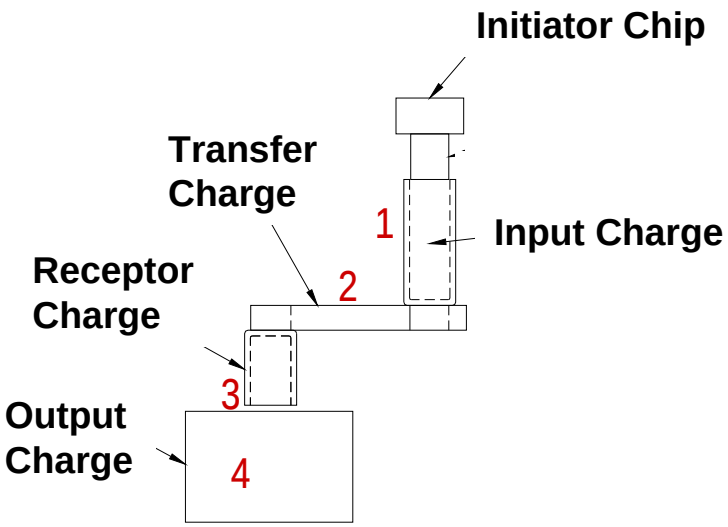
Cross-section, MEMS S&A Assembly

Initiator Board

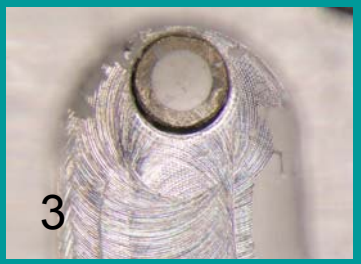
Transfer Charge

Receptor Charge

Output Charge



Barrier Safety



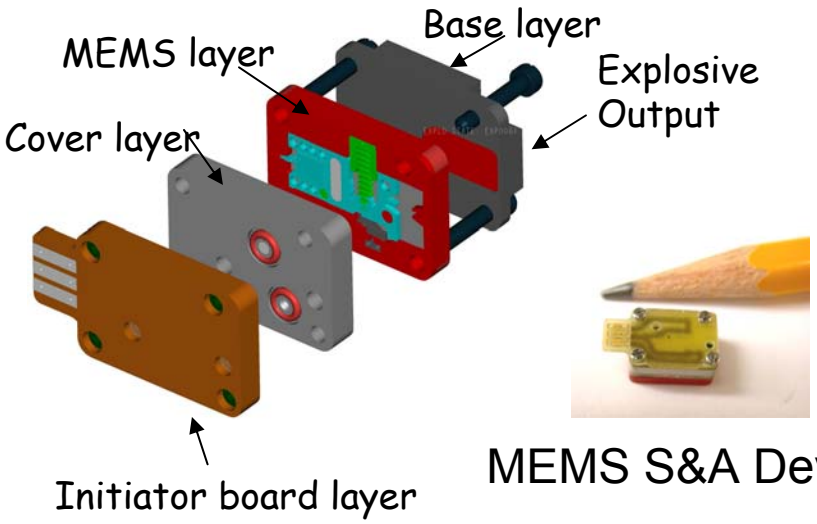
Charge 1 Function
Charge 2 (Transfer) Safe

Charge 3 (Receptor) Safe
Charge 4 (Output) Safe

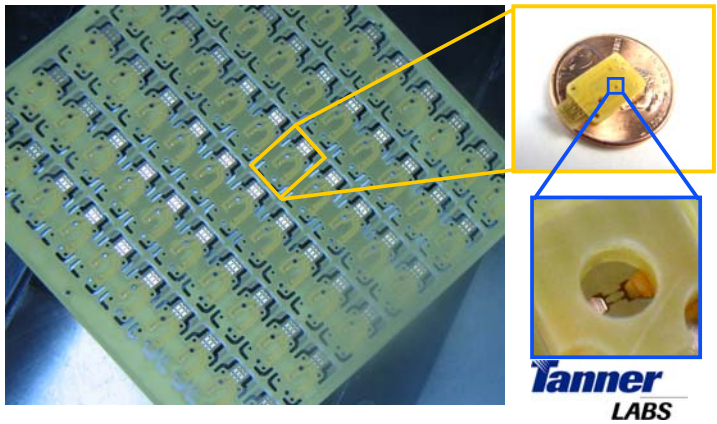
MEMS S&A Development

MEMS S&A For Gun Launched Large Caliber Application:

- Accomplishments:
  - MEMS Fabrication
  - Energetic Output Tests
  - Setback / Spin Tests
- Upcoming Events:
  - Airgun Tests – May 08
  - YPG 155 mm Testing – July 08



MEMS S&A Device



Micro-scale initiators on a PC-board substrate

Summary

- PGK (Increment 1) will provide the warfighter with ≤ 50m (CEP) accuracy for 155mm High Explosive Projectiles
  - Future Increments will increase usage for 105mm & 155mm Projectiles

- PGK Design Leverages Existing Technology (High Maturity)

- Warfighter benefits Include:
  - Improves Munition Accuracy
  - Improves Munition Efficiency
  - Increased number of Stowed Kills (Reduces Logistics Burden)
  - Greatly Reduces Possibility of Collateral Damage

- PGK Increment 1 Fielding Planned in early US Fiscal Year 2010