Precision Guidance Kit (PGK)

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Overview

PGK Concept Description

Challenges in Developing PGK

- Packaging
- Physics
- Do More without More

Results

POC information

Legacy Artillery Capability and Inventory

50m Threshold, 30m Objective CEP at max range

- **Reduced Dispersion**
- **Improved Efficiency**
- **Greater Effectiveness**

PGK Program Objectives

Replace standard fuze with GPS guidance kit

- Desire compatibility with all current US artillery inventory
- Significantly increase accuracy of current conventional artillery rounds
- Maintain current fuzing functions

Insert Guidance Fuze Here

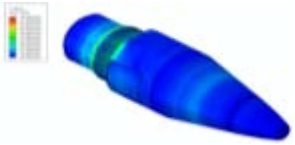
Requirement: Meet accuracy requirement of 50m (T) / 30m (O) CEP

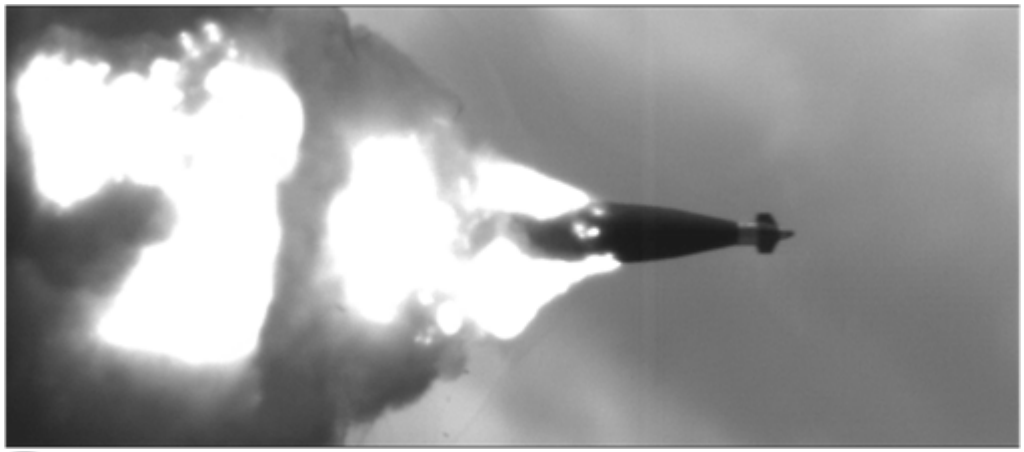
- CEP (Circular Error Probable – radius of a circle centered at the target that contains one-half (1/2) of the projectiles fired

Packaging – Primary Challenge for PGK

Packaging Drivers

- Structural Survivability
  - Maximize Packaging Volume
- Electrical Design – Power Management
  - Extensive Use of Simulation
- DFA/DFM
  - Reduce Size & Maintain Producibility





And Then We Do This!

Complexity Comparison

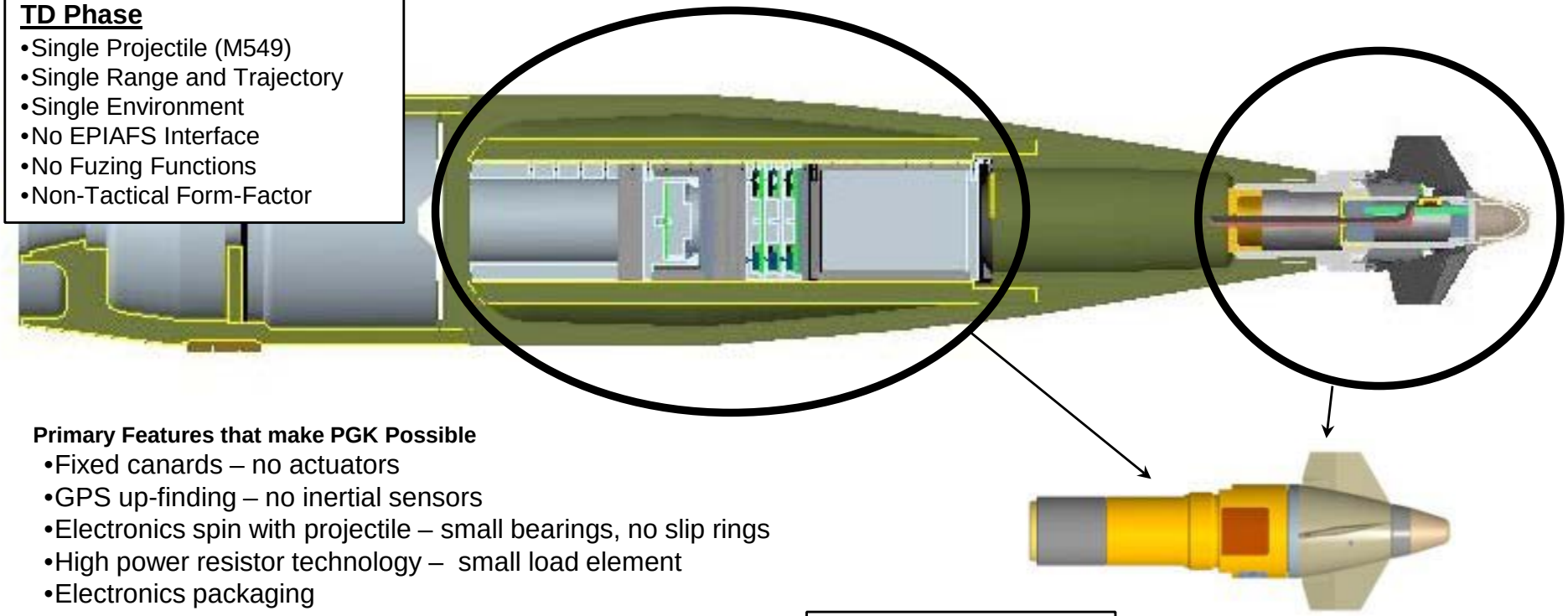
Approx 100 Parts
30 Metal Parts, 25 Plastic Parts
~50 Electronics Boards/Assy's

LG WM2233HD Front Load Washing Machine with SenseClean System for intelligent fabric care

PGK

Packaging – Primary Challenge for PGK

TD Phase
- Single Projectile (M549)
- Single Range and Trajectory
- Single Environment
- No EPIAFS Interface
- No Fuzing Functions
- Non-Tactical Form-Factor



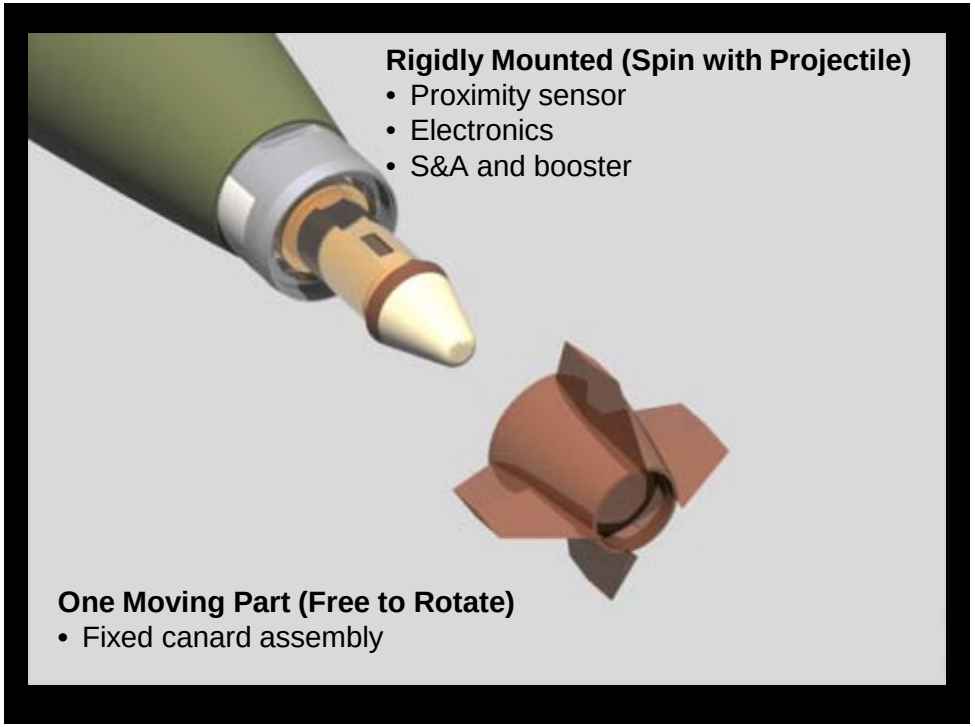
Primary Features that make PGK Possible
- Fixed canards – no actuators
- GPS up-finding – no inertial sensors
- Electronics spin with projectile – small bearings, no slip rings
- High power resistor technology – small load element
- Electronics packaging

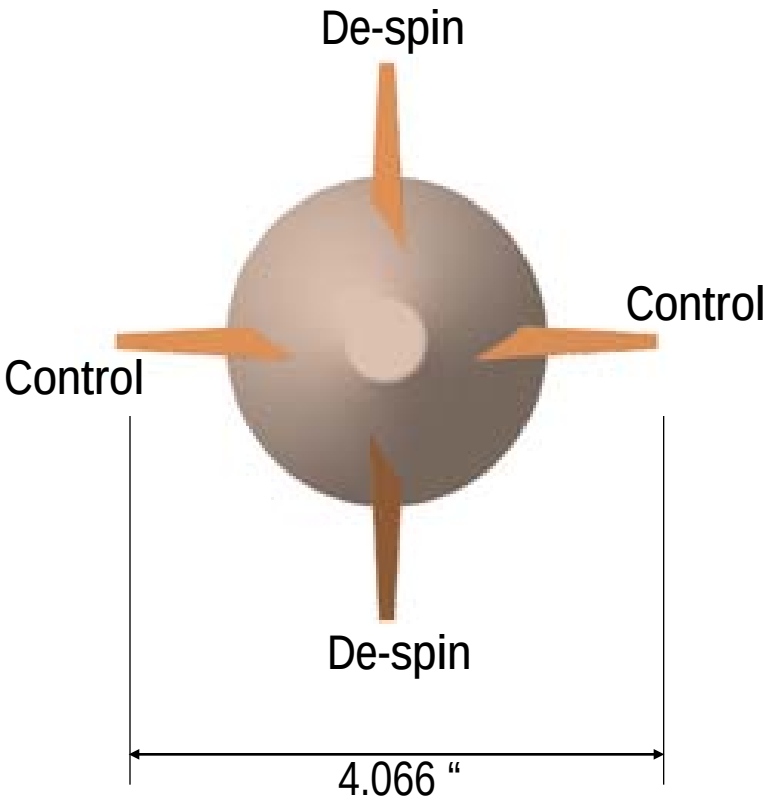
Other Unique Features
- Super capacitor and alternator power – no battery required
- Innovative and simple G&C algorithms
- Small GPS Receiver with very fast acquisition
- Small patch GPS Antenna
- Built-in telemetry function

EMD Phase
- Two Projectiles
- All Ranges
- All Environments
- EPIAFS Interface
- All Fuzing Functions
- Tactical Form-Factor

Design Verification Testing
Aug 2011
48 PGK Units Fired
100% Safe
All accuracy and range requirements met

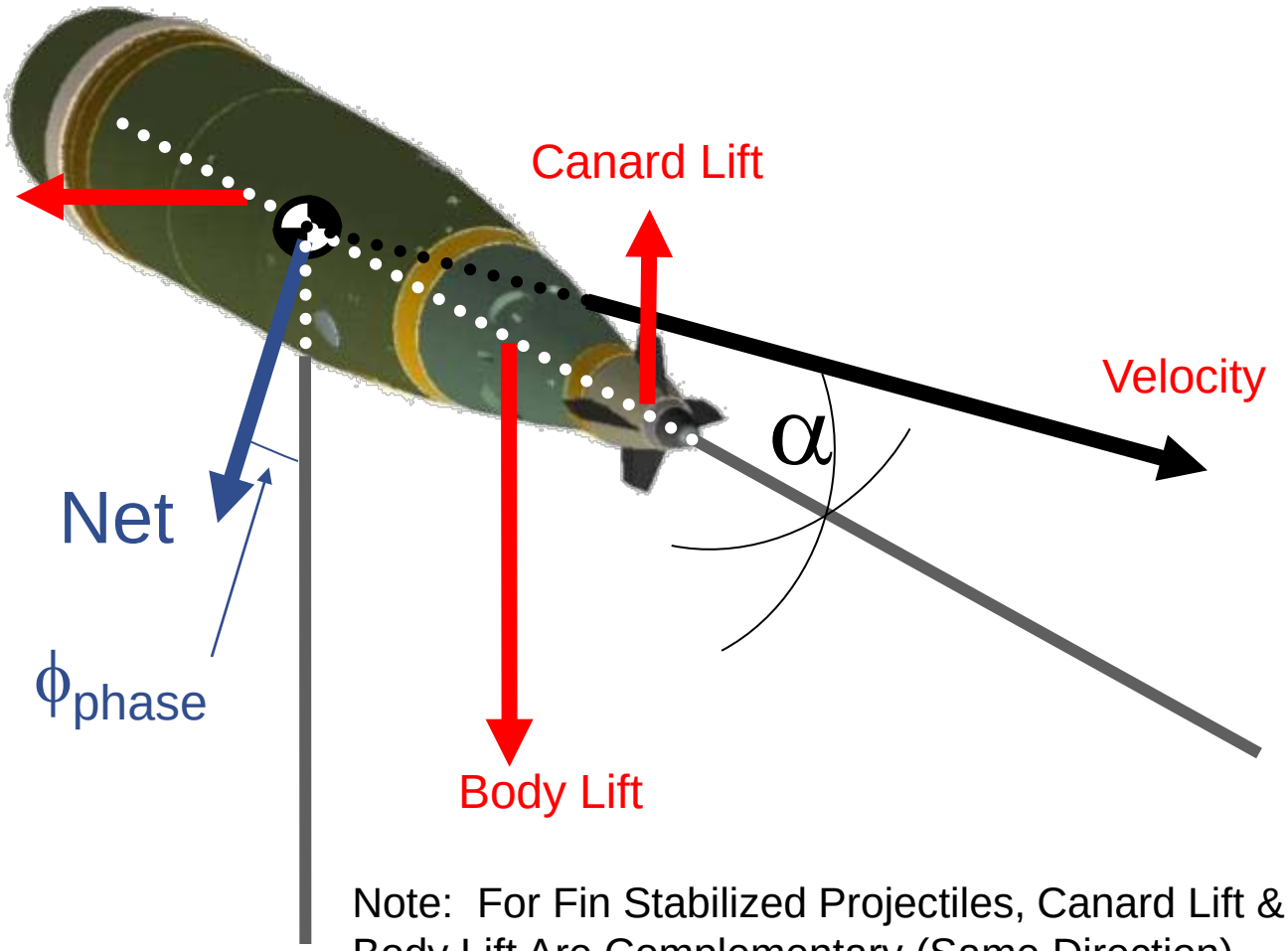
PGK – The Physics





Fixed Canard Assembly Produces Nose Lift and Counter-Rotation Torque

PGK Controlled Flight



Maneuver magnitude and direction a result of vector addition of:

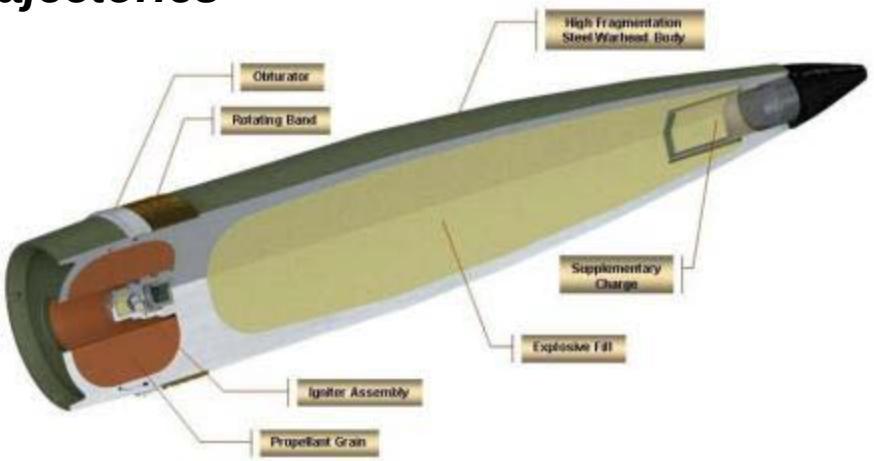
- Canard Lift
- Body Lift
- Magnus

Note: For Fin Stabilized Projectiles, Canard Lift & Body Lift Are Complementary (Same Direction)

Artillery Aerodynamics Are Complex
Once Understood They Are Very Repeatable And Manageable

A Bullet Solution

- ***Approach:*** Fly like a projectile, only make minor corrections to trajectory
- ***Reference Trajectory*** - the predicted ballistic flight path before shooting the round using
  - Expected launch conditions (gun QE, gun AZ, muzzle velocity)
  - Environment predictions (MET, gravity, Coriolis, etc.)
  - Aerodynamic model
- ***Robust solution for all indirect fire trajectories***
  - Artillery or mortar
  - Different zones (muzzle velocities)
  - Different projectiles
  - Different QEs (trajectory shapes)



Successfully Conducted Initial Flight with 155mm XM 1128
- Verified preliminary stability and maneuver authority

Doing More Without More

PGK developed during volatile defense budget environment

PM CAS leading the charge

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ACQUISITION, TECHNOLOGY AND LOGISTICS

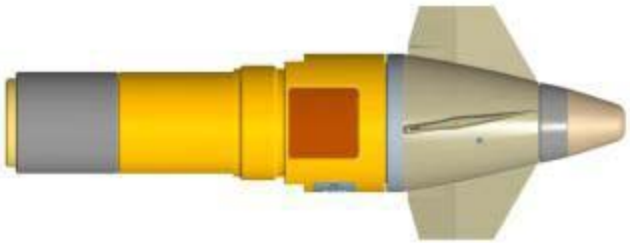
SEP 14 2010

MEMORANDUM FOR ACQUISITION PROFESSIONALS

SUBJECT: Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending

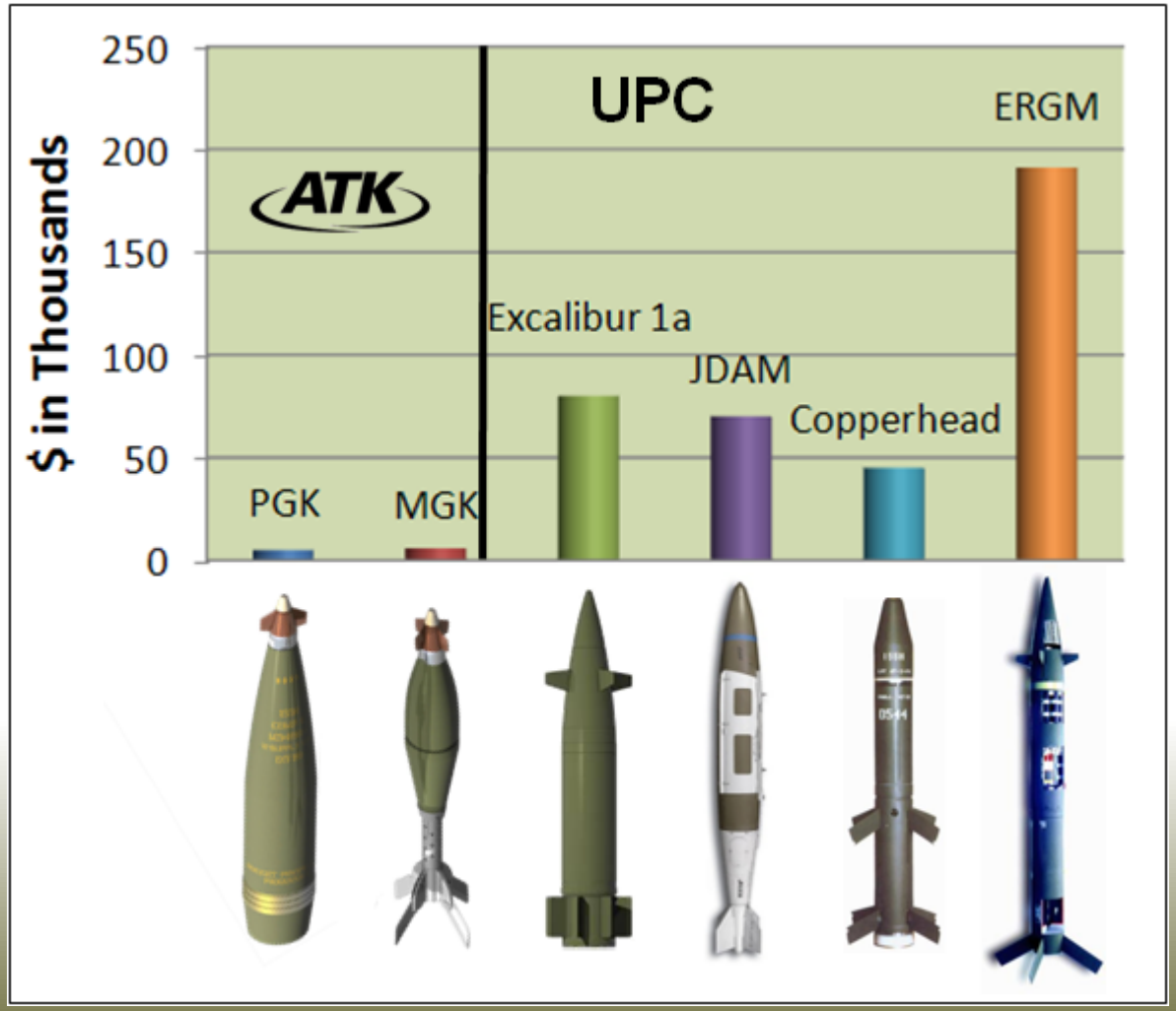
On June 28, I wrote to you describing a mandate to deliver better value to the taxpayer and warfighter by improving the way the Department does business. I emphasized that, next to supporting our forces at war on an urgent basis, this was President Obama's and Secretary Gates' highest priority for the Department's acquisition professionals. To put it bluntly: we have a continuing responsibility to procure the critical goods and services our forces need in the years ahead, but we will not have ever-increasing budgets to pay for them. We must therefore strive to achieve what economists call productivity growth: in simple terms, to DO MORE WITHOUT MORE. This memorandum contains specific Guidance for achieving the June 28 mandate.

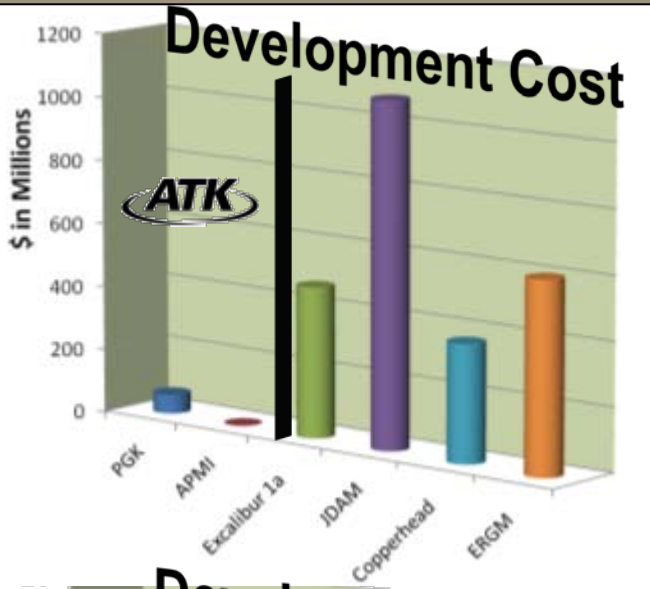
"Do More Without More" – US Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L)

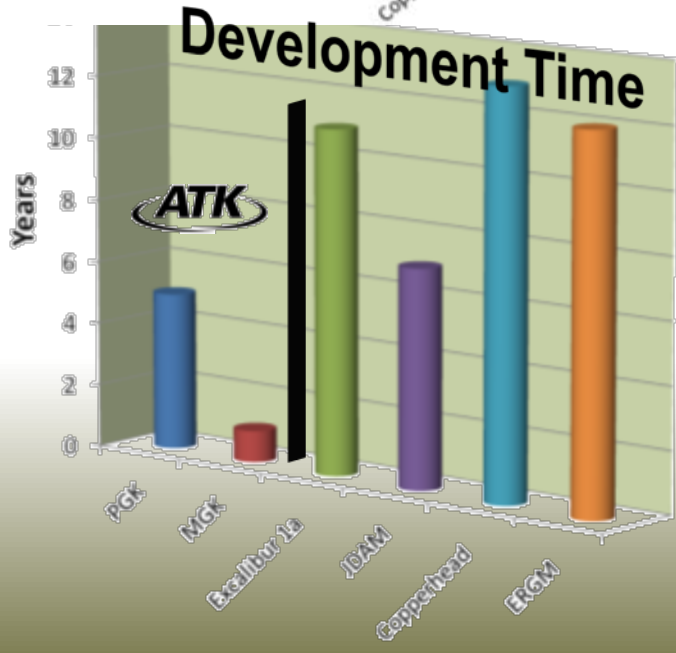


Reduced Cost and Time

Affordable Precision



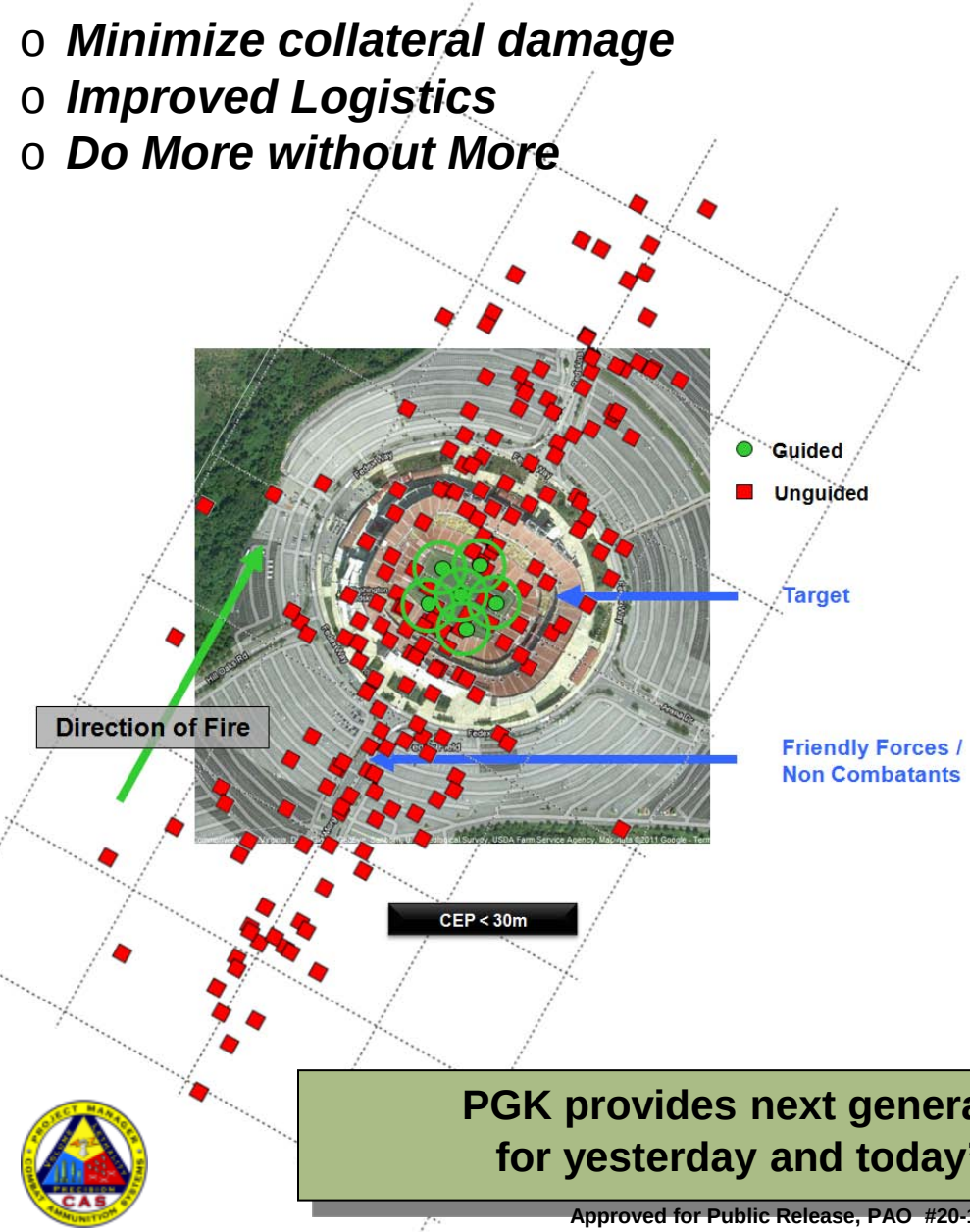




Source: Jane's Defense

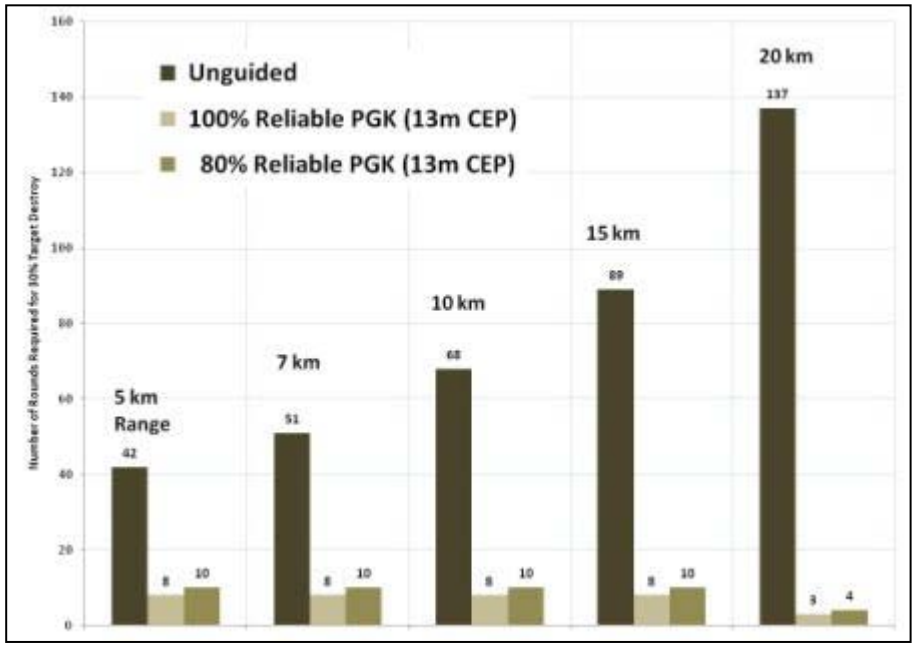
Result

- *Minimize collateral damage*
- *Improved Logistics*
- *Do More without More*



PGK Delivering Accuracy Beyond Expectation

- PGK – Performance on M549A1 and M795 rounds meeting Circular Error Probable (CEP) requirements through Engineering, Manufacturing, Development (EMD) Phase
  - Accuracy Requirement = (T) 50m (O) 30m
  - M549A1 > 200m CEP at max range



Reference: New Vectors, "ATK 155mm Analysis - Individual Round Analysis," October 2007

PGK provides next generation dispersion reduction for yesterday and today's ammunition stockpiles

PGK Applications

155mm Cargo Artillery

155mm High Explosive Artillery

Mortars

105mm Artillery

Navy Rounds

International Markets

Current US programs
Potential applications

Novel Guidance and Control Approach Has Widespread Applicability

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Innovation … Delivered.

Precision Guidance Kit (PGK) for Artillery