Army Electromagnetic (EM) Gun Program

Managing a Technology Opportunity to Revolutionize Firepower

16 June 2004

EM Gun

A Compelling Vision

Why EM?

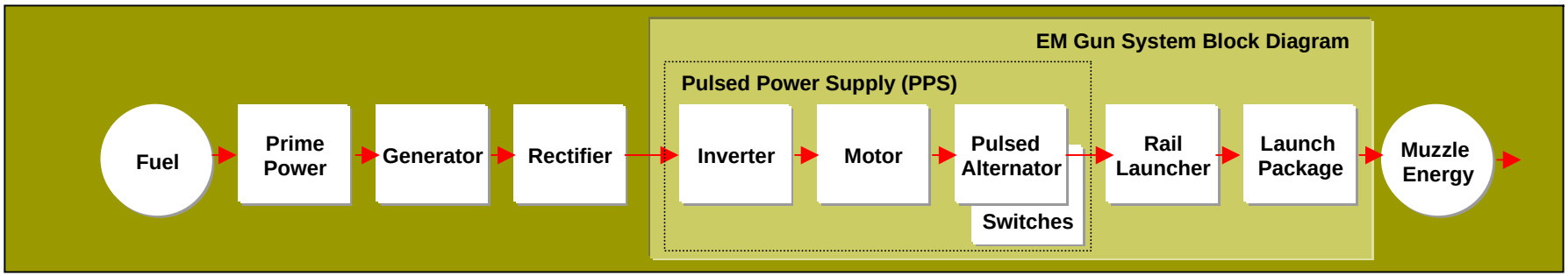
- Increased Lethality
- Improved Deployability & Sustainment
- Enhanced Survivability

Why Now?

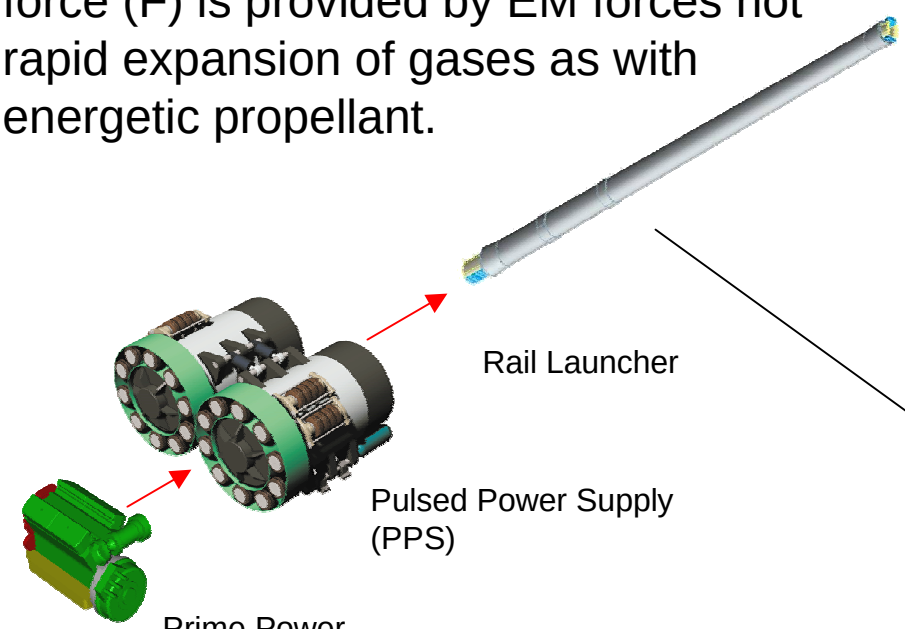
- Advances in Component Technology
- Significant Joint Interest and Potential International Interest
- Synergies with Emerging Power & Energy Thrust
- Leadership Endorsement of an Evolutionary Strategy

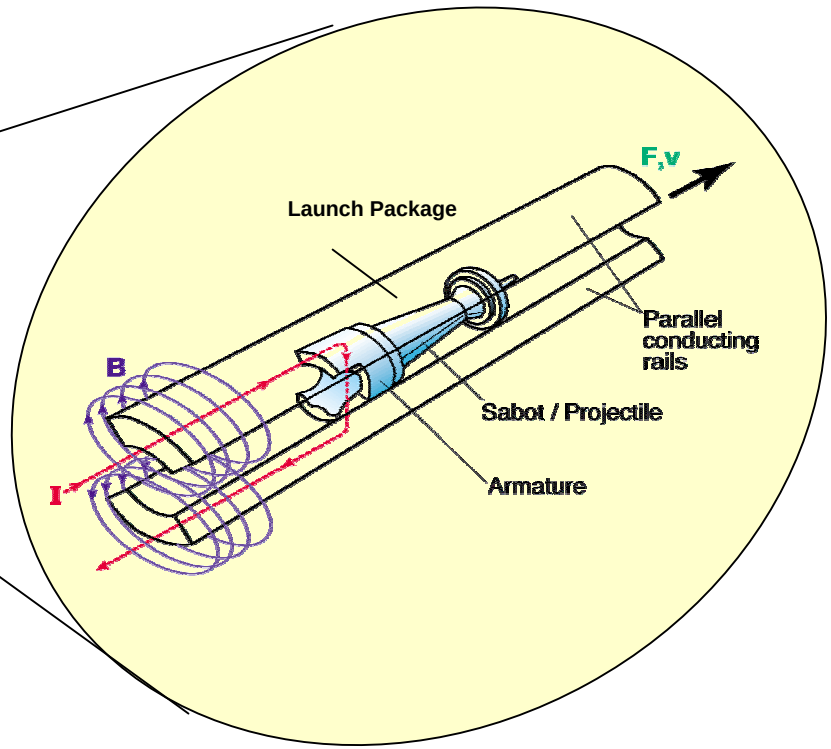
How is EM Gun Different?

EM Railgun Basics

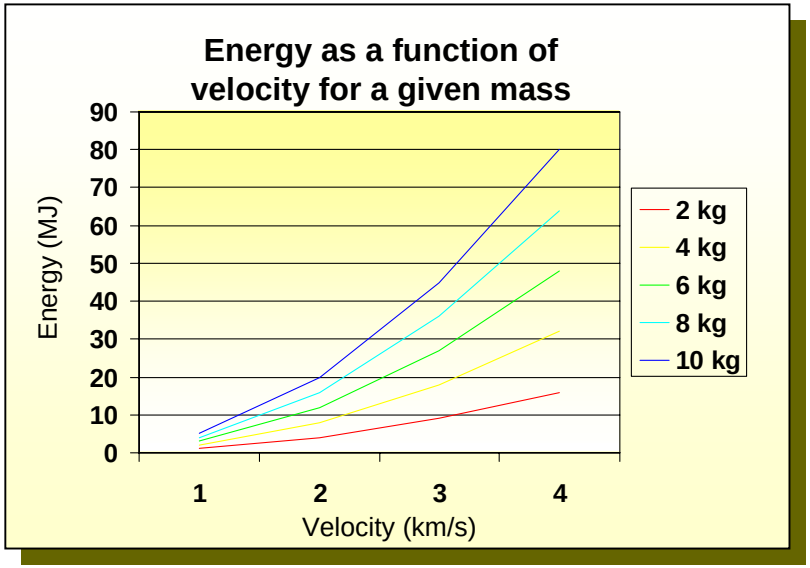


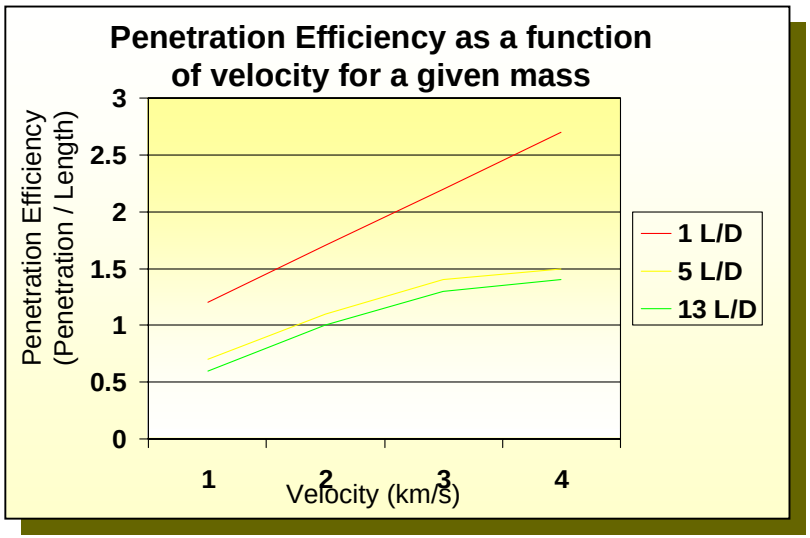
EM guns are fundamentally different than conventional guns - accelerating force (F) is provided by EM forces not rapid expansion of gases as with energetic propellant.





Why EM?
Lethality Efficiency & Growth Potential



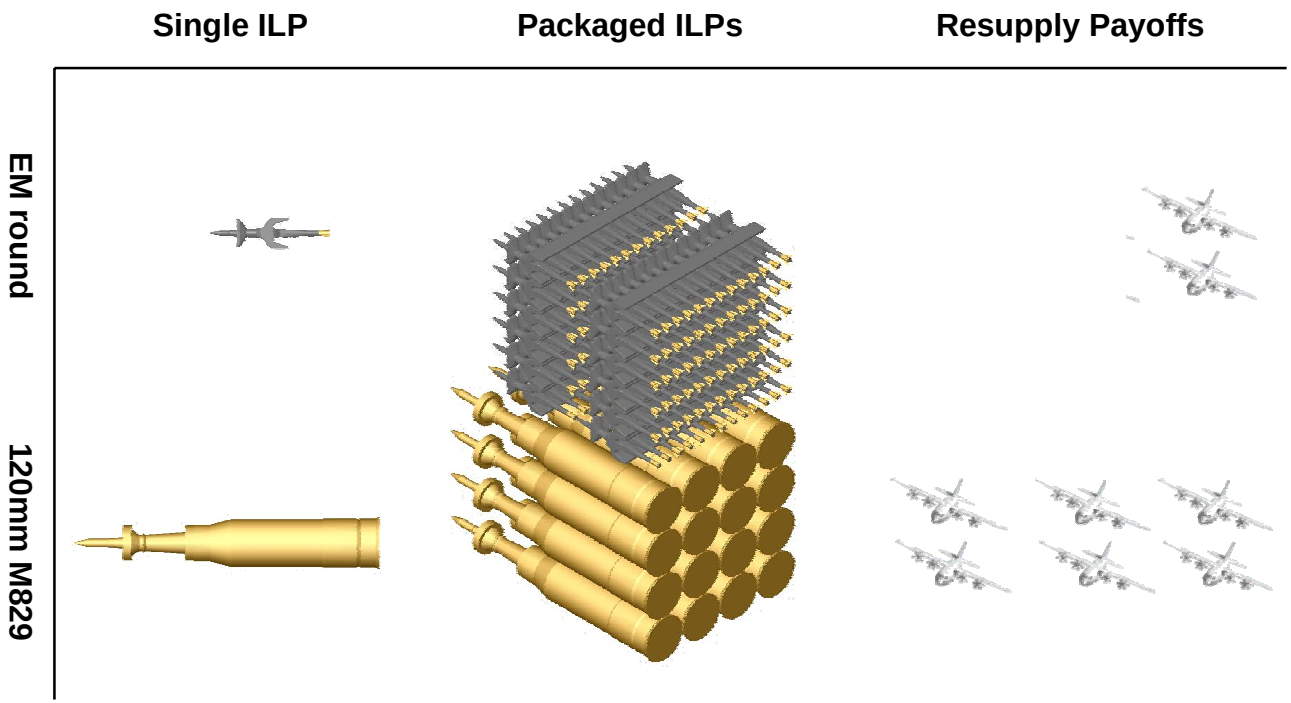


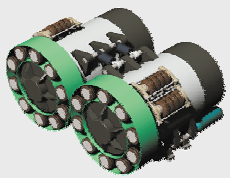
- EM Gun technology enables hypervelocity launch. Hypervelocity is important for two fundamental reasons:
  - Increased Energy:
    Energy is directly proportional to the square of the velocity ($E=1/2mv^2$).
  - Penetration Efficiency:
    For any given energy, Increasing velocity increases penetration efficiency, particularly in novel penetrator designs.

Why EM?
Deployability & Sustainment

- EM Gun Launch Package is much smaller than a conventional round.
  - 1/8th the volume*
  - 1/10th the weight*
- 156 ILPs can be packaged in same space as 16 M829s.
- Smaller Integrated Launch Package payoff is in resupply.
- Fuel and Launch package can be shipped together – on same palette.

*based on anti-armor application





Although the small size of the EM ILPs has clear advantages in resupply, payoffs in stowed rounds onboard a fighting vehicle are not as significant. The smaller ILP is offset by the additional volume required for the onboard Pulsed Power Supply.

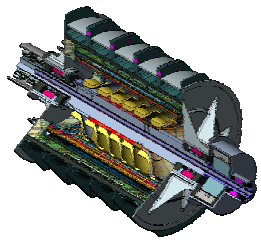
Why EM?
Survivability

- Less likely to be hit due to reduced Launch Signature
  - >1000x reduction in visual and IR signature.
  - 10x reduction in acoustic signature.
- More likely to survive a hit due to less energy onboard released over a longer period of time.
  - 9x less stored energy onboard compared EM gun weapon than M1A1
  - Recent ARL tests show rotor difficult to destroy and disintegrates gracefully (5-10 milliseconds)

Launch Signatures

LOSAT	M1A1	EM Gun Bare Muzzle	EM Gun w/ Muzzle Shunt
			

Stored Energy

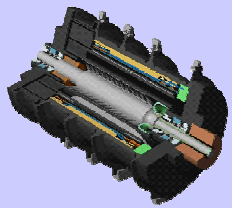
M829A2	E Gun Rotor
	
8.6 kg JA2 Propellant ~ 5000J/g 42 on-board rounds 1,800MJ energy onboard	925 kg 106 J/g 2 on-board rotors 196 MJ energy onboard

State of Technology
Pulsed Power Supply

STO is building state of the art subsystem

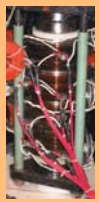
Un-cooled, twin machine, synchronized generation of power consistent with 5MJ muzzle energy.

State-of-the-art subsystem design



Results of component level testing formed the basis for current design which meets requirements of current STO program.

State-of-the-art component testing



Solid State Switch Stack

Split Ring Composite Ring

Component level tests enable improved energy density.

Previous Generation Subsystem Builds

1st Gen

1986

2nd Gen

1993

3nd Gen

1996

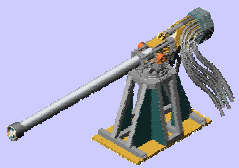
Demonstrated fundamental principles of using rotating machines to deliver pulsed power.

State of Technology
Railgun Launcher

STO is building state of the art subsystem

Lightweight, cantilevered gun with integrated muzzle shunt & active cooling. Launcher life of 200 rounds.

State-of-the-art subsystem design



Results of component level testing formed the basis for current design which meets requirements of current STO program.

State-of-the-art component testing

HV Gouging

1m launcher section

Component level tests enable extended launcher life and reduced size and weight. Muzzle shunts reduce launch signature and improve efficiency.

Previous Generation Subsystem Builds

1st Gen 1991

2nd Gen 1993

3rd Gen 1994

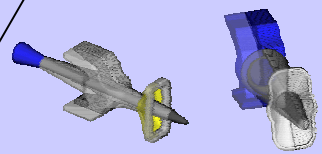
Demonstrated fundamental principles of large caliber railguns.

State of Technology
Integrated Launch Package (ILP)

STO is building state of the art subsystem

Demonstrate full scale terminal ballistics of at least three designs to demonstrate capability to defeat BMP and complex heavy armor, and one multipurpose design.

State-of-the-art subsystem design



Results of component testing formed the basis for current projectile designs which meet requirements of current STO program.

State-of-the-art component testing

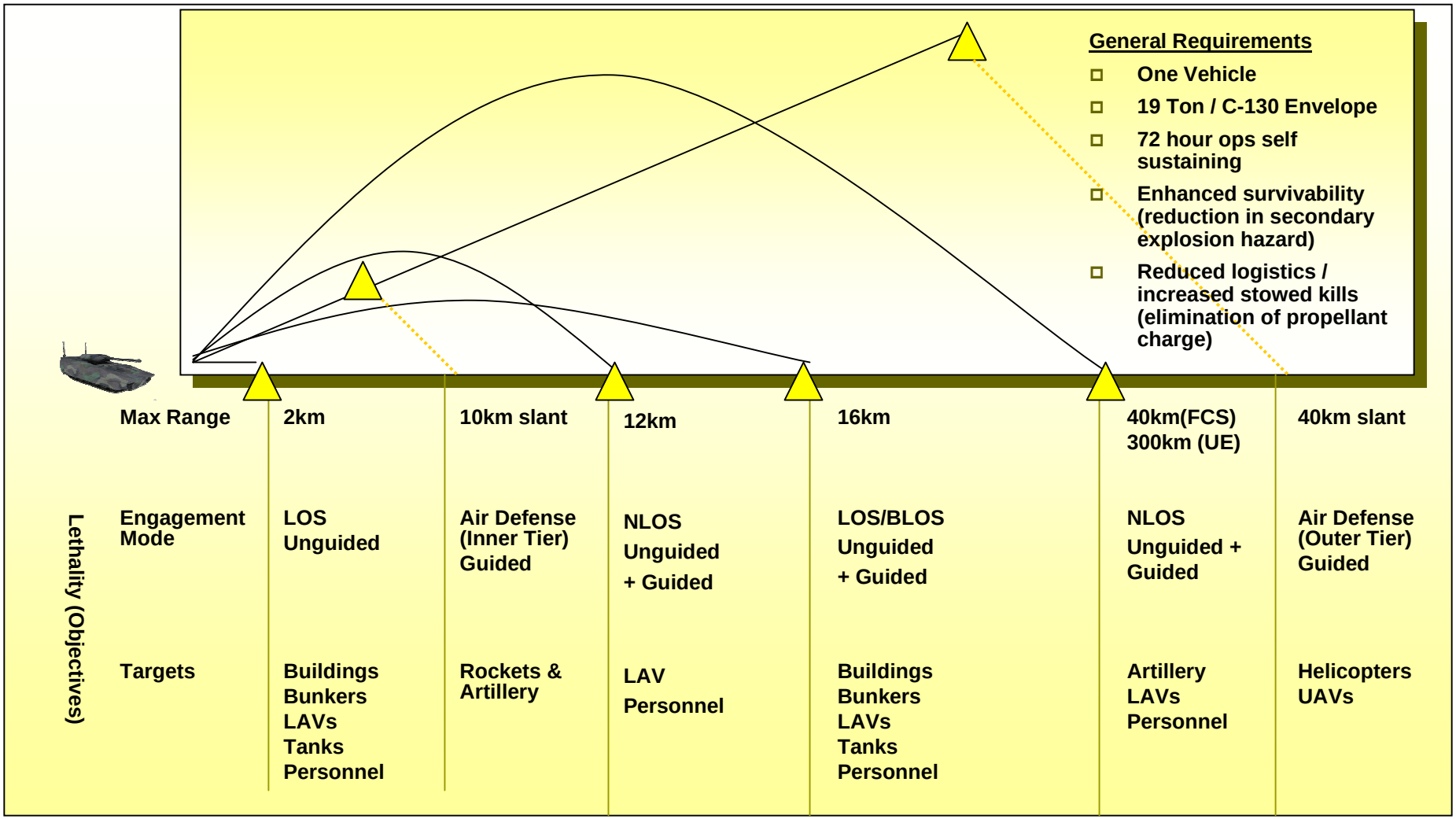
Component level tests enabled novel, high-efficiency ILP and hypervelocity defeat of other targets.

Previous Generation Subsystem Builds

Demonstrated fundamental principles of EM launch of monolithic rods to defeat heavy armor.

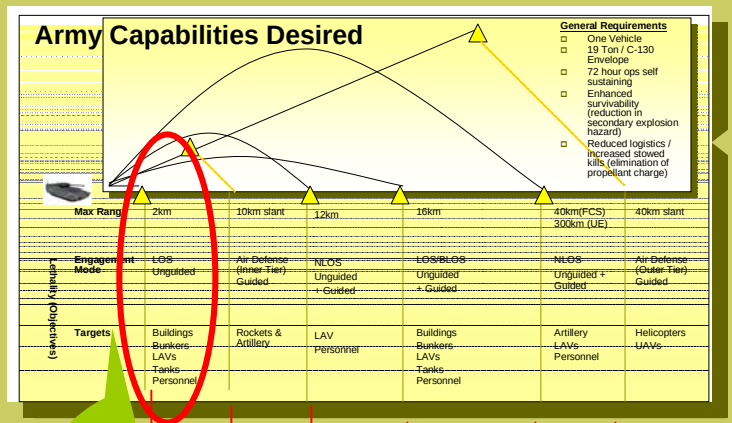
TRADOC HQ

Capabilities Desired

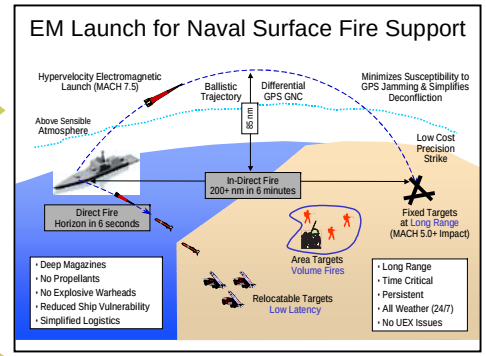


Requirements derived from JROC approved FCS ORD, objective requirements; UE White Paper, & Air Defense Concept (Draft)

Evolutionary Strategy
Balancing Technical Difficulty With Military Utility and Growth Potential Over Time



Diverse Mission Requirements



Opportunities for Collaboration

- Information Exchange
- Enabling Technologies
- Test Facilities

Within State of the Art

PPS: 2-5MJ

Launch Package: Unguided

Near State of the Art

PPS: < 10 MJ

Launch Package: Guided

PPS: >> 10 MJ

Launch Package: Guided.

Beyond State of the Art

PPS: > 10 MJ

Prime Power: Advanced Prime Power Pack

Launch Package: Unguided & Guided

Well Beyond State of Art

PPS: >> 10 MJ

Launch Package: Guided Hypervelocity

Army's Evolutionary Strategy Starts Here

Special ASARC endorsed evolutionary strategy outlined here

Army Program
First EM Technology Spiral

FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13

STO **ATD**

S Special ASARC

1 Full Scale Lethality vs Complex Targets Risk Reduced

IPR POM 08

2 Launcher Life Risk Reduced

A

3 Energy Density Risk Reduced

4 Subsystem Thermal Management Risk Reduced

5 System Integration Risk Reduced

6.2 designs

Proposed Subsystem Designs

Subsystem Models

Full caliber tests

2-5MJ, 5000 kg, uncooled, unruggedized

rectangular bore (60 – 90 mm equiv) fully cantilevered

unguided multipurpose & unguided KE rounds.
unguided KE, terminal ballistics vs. tank @ > 10 MJ ME level

2-5MJ, 5000 kg, cooled, ruggedized

2-5MJ muzzle energy LOS EM Gun system

< 19 ton platform fires burst,

Perforates BMP @ 2km

Multi-burst operation

Full firing chain @ 2-5MJ. Single Shot Externally supplied prime power

Burst firing chain. Integrated prime power. Lethality vs. BMPs, bunkers, buildings, personnel, and other.

6.3 ($M)	18.9	19.3	19.4	-	-	-	-	-	-	-
6.2 ($M)	5.1	5.1	4.9	-	-	-	-	-	-	-
6.1 ($M)	5.7	5.6	5.9	-	-	-	-	-	-	-

Special ASARC approved this ATD approach

Collaboration Opportunities

Organization	Work Focus	Cooperative Mechanism
US Navy – ONR and NAVSEA	EM launch for Naval Surface Fire Support Requirements – Parallel Navy technology program FY04-09.	Congressionally mandated MOA
USMC	Monitor technology development efforts via ONR & Marine Corps Warfighting Lab. Participate in Army reviews.	
DARPA	Proposed EM Tactical Mortar Program.	
DOE – Sandia National Labs	Coil Guns. Capacitor based pulsed power.	MIPR(s) from DARPA
DOE – Oak Ridge National Labs	Power conditioning, power management, switching, energy storage. Rail materials.	MIPR from ARDEC
DOE - Pacific Northwest National Labs	Heavy metal penetrators.	MIPR from ARDEC
United Kingdom	UK lead in test of launchers and launch packages at Kirkcudbright. Full caliber novel penetrator functionality test FY05/FY06 –use their test facility at no cost to US.	PA DOD-MOD-A-01-0087

Summary

- EM Gun is a technology opportunity that could revolutionize firepower.
- Technical barriers are falling and elements of strategic environment are converging.
- STO initiated to demonstrate meaningful technical progress at subsystem level.
- Follow-on ATD and long term evolutionary approach approved, providing program focus and stability.

Thank You