

U.S. Army Armament Research, Development, and Engineering Center (ARDEC) Update

Presented to

***NDIA 42nd Annual Armament
Systems: Guns and Missile
Systems Conference***

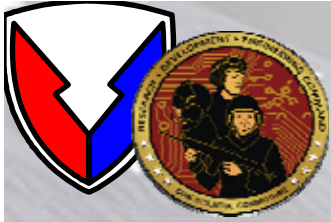
25 April 2007

Anthony J. Sebasto

U.S. Army Armament Research, Development,
and Engineering Center (ARDEC)

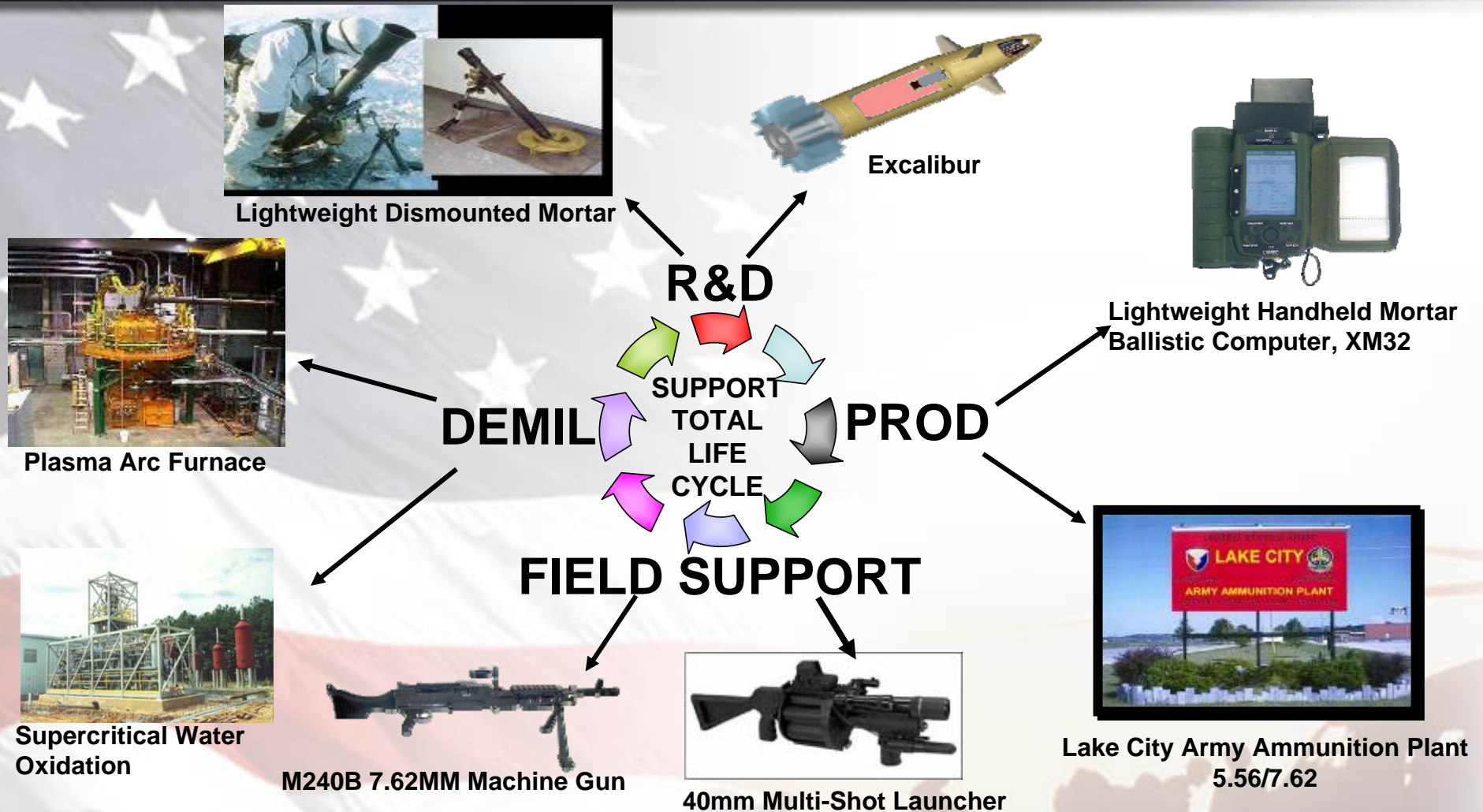
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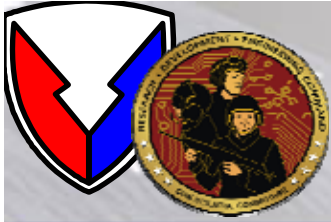


ARDEC Mission

Life Cycle Engineering & Support



...Providing Over 90% of the Army's Lethality



ARDEC at a Glance



- Established “Center of Mass” for Armament Systems and Munitions for Joint Services
- Proven track-record supporting transition of technologies to the field; since early FY 05.....
 - >28 Material Releases (MR) (>40 since early FY03)
 - >34 Urgent MR (>50 since early FY03)
- ARDEC Personnel ~ 3000; ~900 new hires since FY99
- >\$100M invested in “World Class” experimental R&D facilities since mid-90’s; Additional \$75M planned
- Strong partnerships with Industry, Academia, and other Government agencies.
- In-house rapid prototyping initiatives demonstrating new desired capabilities, supporting production prove-out and initial fielding demands
- >\$125M Tech Base portfolio addressing Joint needs



2004 & 2006 Army Large R&D Lab of the Year



R&D and Experimentation Facilities

Major Examples



Davidson Advanced Warhead Development Facility

Opened 1996

\$11.7M



- Maximum 50 TNT equivalent capability
- 100m indoor warhead test range

Precision Armaments Lab

Opened 2000

\$8.8M

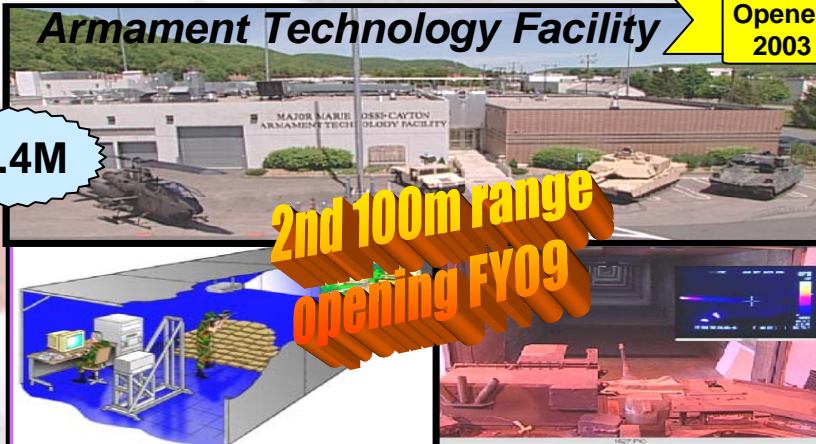


- 2 Lab grade elevators for sensor dev
- 3 Target locations; 150m, 400m, & 1500m

Armament Technology Facility

Opened 2003

\$8.4M



2nd 100m range opening FY09

- 100 & 300m indoor ranges
- Environmental chambers

Armament Software Engineering Cntr

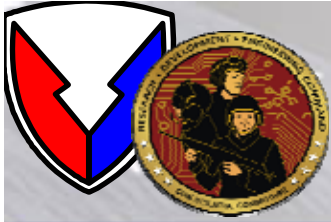
Opened 2005

\$15.5M



Level 5 CMMI Certified

- Integrated S/W & H/W development/integration
- Multi-platform SOSI highbay capability



New Facilities Under Construction

Breaking "Old" Grounds



Soft Recovery System (SRS)

Opening
May
FY07

\$9.0M

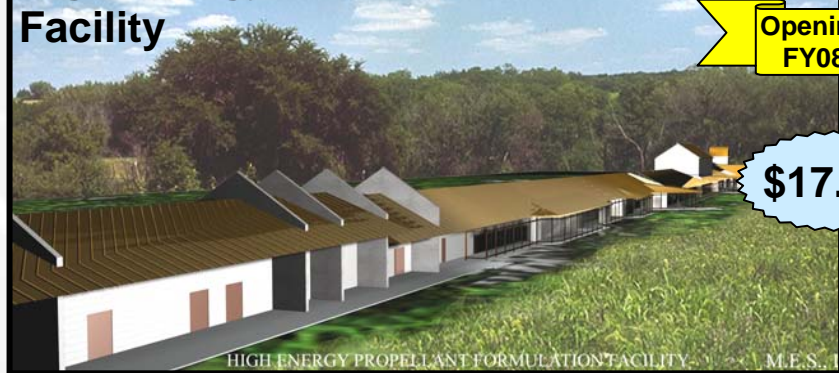


- High-g test Munition/Components to 20K g's
- 155mm capability (current); Only one in existence
- Navy 5", 120mm mortar, and EM Gun planned

High Energy Propellant Formulation Facility

Opening
FY08

\$17.7M

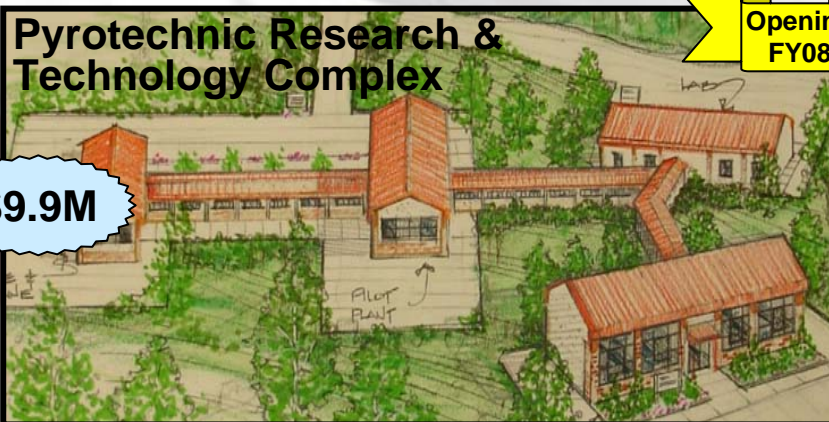


- 45,000 ft² Propellant Pilot Plant
- Characterization Laboratories
- Magazine Storage / Offices

Pyrotechnic Research & Technology Complex

Opening
FY08

\$9.9M



- 33,000 ft² Engineering Offices & Laboratories
- Pilot manufacturing facility
- Energetic stowage

Explosives R&D Loading Facility

Opening
FY09

\$8.0M



- 28,000 ft² Melt Pour Operations & Engineering
- Climate Controlling Machining
- Explosive Pressing, Cast Cure, & X-Ray



Material Releases (MR) & Urgent MRs

FY05 to Present



Matériel Release Items

- Receiver, Radio Firing Device: M17 (Remote Activation Munitions System (RAMS))
- M1028 120mm Tungsten Canister Cartridge
- M278 2.75-inch IR Rocket with Mk66 Mod 4 Rocket Motor
- M232A1 Modular Artillery Charge System (MACS) 155mm Propelling Charge
- M777A1 155mm Medium Towed Howitzer
- M1040 105mm Canister Cartridge
- M782 Multi-Option Fuze Artillery (MOFA)
- Mk7 Mod 2 Anti-Personnel Obstacle Breaching System (APOBS), Tactical
- Mk7 Mod 2 APOBS, Training Aid
- M264 2.75-inch Red Phosphorous Smoke Screening Rocket with Mk66 Mod 3 Rocket Motor
- M720A1 60mm HE Mortar Cartridge with M734A1 Multi-Option Fuze
- M768 60mm HE Mortar Cartridge with M783 PD/DLY Fuze
- Mk243 Mod 0 9mm Jacketed Hollow-Point (JHP) Cartridge
- M255A1 2.75 inch Rocket Flechette Warhead with M439 RS Fuze and Mk66 Mod 4 Rocket Motor
- M111 Improved Position and Azimuth Determining System (IPADS)
- M107 Long Range Sniper Rifle

Urgent MR Items

- XM110 Semi-Automatic Sniper System
- Enhanced M113A2 Rapid Entry Vehicle, Spirals 1 and 2
- USMC GG04 Rubber Ball Grenade (Army XM104)
- Advanced Combat Optical Gunsight (ACOG), Model TA31F (to USASOC, USAREUR, NGB, FORSCOM)
- Mk108 Mod 1 Signal Illumination Kit, Green Star – Pen Flare (30,000 to ARCENT-CFLCC)
- Mk135 Mod 1 Signal Illumination Kit, Various Color – Pen Flare (9,700 to ARCENT-CFLCC)
- Advanced Combat Optical Gunsight (ACOG), Model TA31RCO-M4 with LFU/ARD (to USASOC, USARPAC, NGB, FORSCOM, EUSA)
- M32 Lightweight Handheld Mortar Ballistic Computer (LHMBC) Version 2.1
- M927 105mm High Explosive Rocket Assist (HERA) Cartridge
- M100 Grenade, Rifle Entry Munition (GREM)
- M101 Grenade, Rifle Entry Munition – Target Practice (GREM-TP)
- Mk108 Mod 1 Signal Illumination Kit, Green Star – Pen Flare
- Mk142 Mod 0 Signal Illumination Kit, White Star – Pen Flare
- M1028 120mm Tungsten Canister Cartridge (to FORSCOM)
- XM328 40mm Multi-shot Grenade Launcher (MGL) (89 to ARCENT-CFLCC)
- Enhanced M113 – Rapid Entry Vehicle



Material Releases (MR) & Urgent MRs *FY05 to Present*

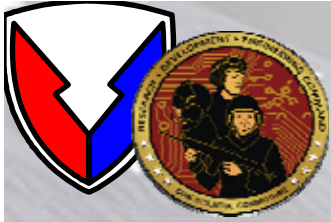


Material Release Items – Con't...

- MK281 Mod 0 40mm Practice Cartridge
- M879 81mm Full Range Practice Mortar Cartridge
- M21 Modernized Demolition Initiator (MDI), Cap, Blasting, Non-Electric
- M192 Lightweight Ground Mount (LWGM)
- Paladin Digital Fire Control System (PDFCS)
- M240H 7.62mm Aviation Machine Gun
- M393A3 High Explosive Plastic with Tracer (HEP-T) 105mm Cartridge
- M467A1 Target Practice with Tracer (TP-T) 105mm Cartridge
- Paladin Software Version 7 for the M109A6 Howitzer Automatic Fire Control System (AFCS)
- Software Version 7.P for the M109A6 Paladin Digital Fire Control System (PDFCS)
- M2 Vehicle Light-Weight Arresting Device (VLAD)
- M85 Trainer, Receiver, Radio Firing Device: M85 (Remote Activation Munitions System (RAMS) Trainer)

Urgent MR Items – Con't...

- XM1092 12 Gauge Extended Range Non-Lethal Marking Munition (ERNLMMs)
- XM1091 40mm Extended Range Non-Lethal Marking Munition (ERNLMMs)
- X26E Tasers, A.T. XP Air Cartridges and Digital Power Magazines
- Mk79 Mod 2 Signal Kit, Personnel Distress: Red Color – Pen Flare
- BBU-35/B Impulse Cartridge
- FN303 Less Lethal Launcher and Associated Equipment
- XM101 Common Remotely Operated Weapon Stations (CROWS)
- M930E1 120mm Illuminating Mortar Cartridge
- M278 2.75-inch IR Rocket with Mk66 Mod 4 Rocket Motor
- Matrix System plus spares
- Platoon-Size Non-Lethal Capabilities Set
- X26E Advanced Taser Weapon and Associated Equipment
- Heckler & Koch MP5-A5 and MP5K-PDW 9mm Submachine Guns
- M107 Long Range Sniper Rifle
- M203 Grenade Launcher Day Night Sight (DNS), Model 1800 Black with Tritium Sights
- Vehicle Lightweight Arresting Device
- Bradley Reactive Armor Tiles “A2” Vehicle Sets to ARCENT
- A2 Bradley Fighting Vehicle System Armor Tile Sets

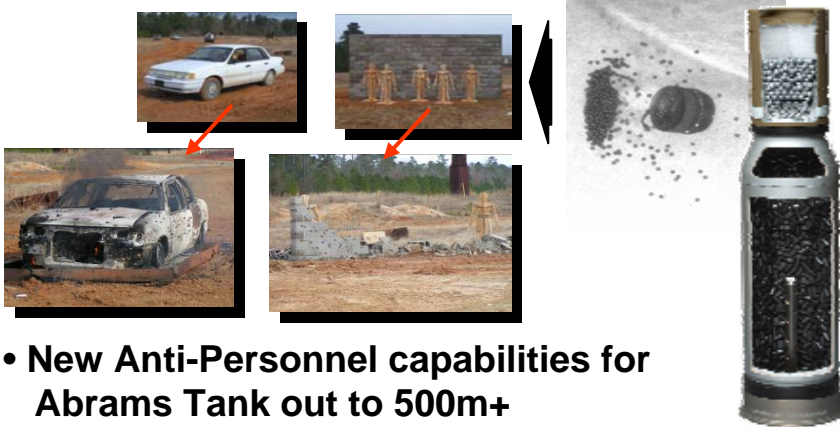


Urgent Material Releases

Some Recent Examples

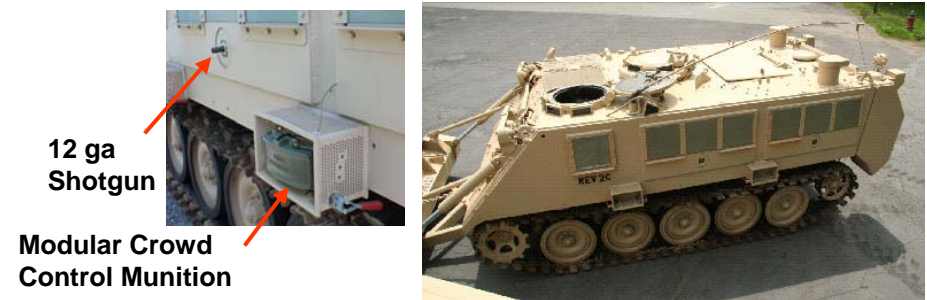


M1028 120mm Canister Cartridge



- New Anti-Personnel capabilities for Abrams Tank out to 500m+
- >15,000 rounds fielded to Army/Marines.

M113A2 Rapid Entry Vehicle (REV)



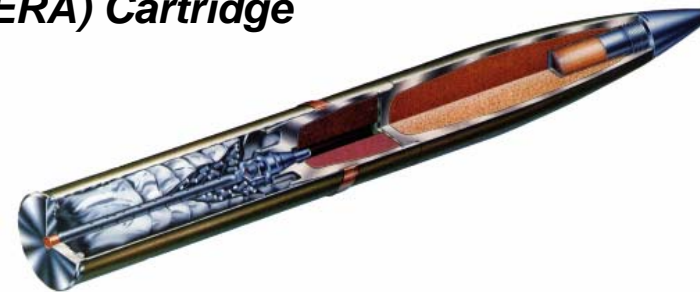
- Non-lethal response under armor with
 - 4 modified M870 shotguns
 - 6 Modular Crowd Control Munitions
- 4 vehicles fielded

M100 Rifle Launched Grenade Munition



- Door Breaching Munition fired from M16A2 and M4 with standard 5.56mm M855 rounds.
- 300 tactical/1250 training rounds fielded

M927 105mm High Explosive Rocket Assist (HERA) Cartridge



- Extended range capability to 16km+ to meet critical mission need
- Combination new production and M913 conversion yielded ~3600 cartridges
- ~700 cartridges fielded



Rapid Prototyping Initiatives

Examples of "Tech Push" for Early User Demo's AND Support to Production Requirements

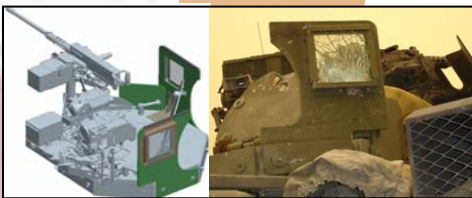


Gunner's Protection Kits (GPKs)



M1114 Objective GPK (O-GPK)

- Concept Demo in 6 Months
- ARDEC Level III TDP
- Depot Production for >15K GPKs



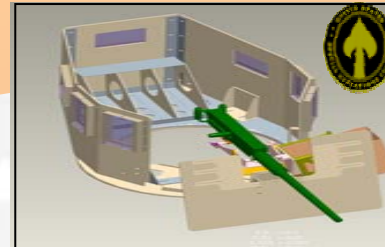
Stryker Cupula Shield

- PM Request
- Concept Demo in 90 days
- ARDEC LRIP to OIF (7 Brigades)



RG31 GPK

- Modified O-GPK
- ARDEC LRIP underway



SOCOM GPK

- Expanded Requirements
- ARDEC LRIP underway



Sculpted Transparent Armor

- Curved Transparent Armor
- Enhanced Situational Awareness
- Concept demo planned May 07



Engineering Boat (MK1) Survivability Enhancements

- Baseline Design Complete
- Prototype Demo Planned May 07
- LRIP Quantity Planned 3rdQ FY07

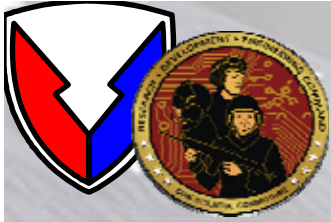
MAJOR DESIGN GOALS

- Maximize protection level & area
- Minimize weight
- Maintain situational awareness
- Use existing attachment points
- Utilize proven ballistic materials
- Minimize number of components
- Interface with standard weapon mounts
- Modularity

Initial Production
Prove-Out and
Fielding Support

Close Coordination with Customers Key to an Integrated Solution for Survivability, Lethality, and Situational Awareness

Concept Design



Rapid Prototyping Initiatives

Examples of "Tech Push" for Early User Demo's AND Support to Production/Fielding Requirements



Remote Armaments for Unmanned Platforms



Picatinny LtWt Mount on TAGS

- ARDEC in-house developed mount
- <200lb weight class with M240/M249
- 3 mounts supporting customer demos



Obj NLOS Mortar Technology

- Elevating automated turret concept
- Demo on surrogate platforms FY07-09



"I'm ready to deploy with this unit and SWORDS"

- SGT, 1-3 Cavalry, 3BDE/3ID

Special Weapon Observation-Reconnaissance Direct Action System (SWORDS)

- Safety Confirmation Jun 06
- 3 Deployed to 3rd ID for Training
- Urgent Material Release expected

Key Design Challenges:

- Weight/Cube/Power
- Weapon Re-arm/Automation
- Integration on COTS platforms
- Communications
- Roof and internal structures
- No fire zones / motion inhibits
- Vehicle dynamics
- EMI



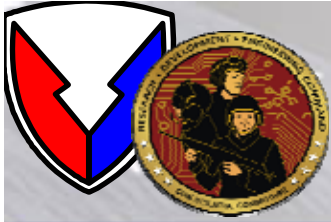
Remote Armament Sys Tech

- Weapon designs specifically for unmanned platforms
- Ease of integration/functionality
- Concept demos FY08/09

Initial Production
Prove-Out and
Fielding Support

Valuable Lessons Learned on Design and Safety Considerations to Apply to Remote Armament Programs

Concept Design



Engineering Analysis/Evaluation

Example of evaluation of system technology performance



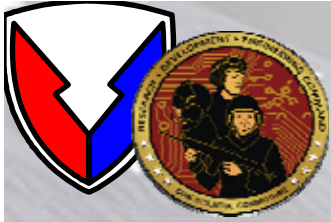
Evaluation of Acoustic Sniper Detection Systems

- **PURPOSE:** Validate accuracy of vehicle mounted gunfire detection systems, both statically and on the move against vendor stated performance specifications
 - Verify performance of system's ability to detect/locate sniper fire under various conditions
 - Verify system robustness to false alarms
- **Three-Phase Test at APG:**
 - Stationary – Open Field (Completed)
 - On the Move – Open Field (Completed)
 - Stationary – Urban Environment (May - Jun)
- **Emerging Results:**
 - System tested provide varying degrees of detect and locate capabilities
 - In general, discrepancies exist between vendor claimed performance specifications and test results
- **Specific platform testing requested by customers underway**



SYSTEMS	MANUFACTURER
PD-Cue® 4 Corner	AAI
PD-Cue® Tetrahedral	AAI
Ferret	MacDonald Detwiller & Associates
VM-GDS	01dB, Metravib
Boomerang v2.5	BBN Technologies
SNIPOS	Axcess Technologies
VAAPS/LWAS	Land Warrior Acoustic Systems
Red Owl	iRobot

Testing Critical for Requirements Generation and Establishing TTPs

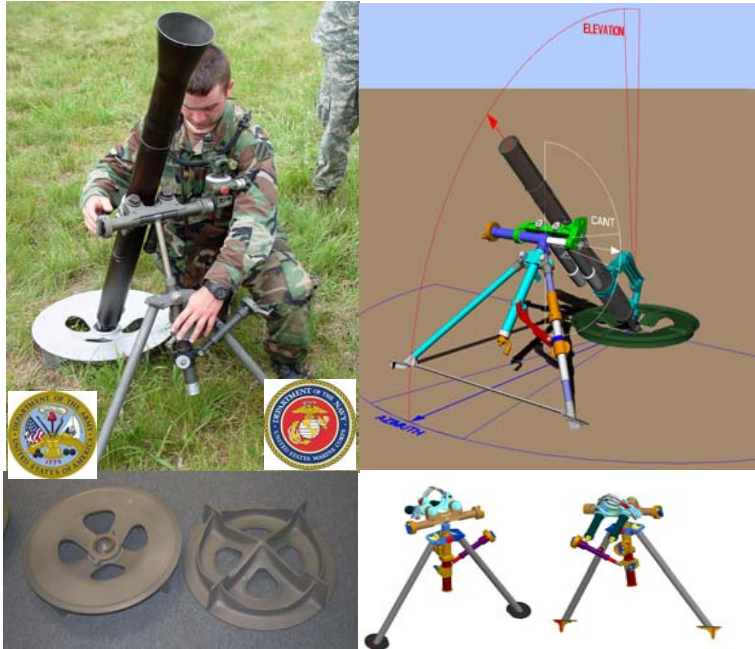


Recent Tech Base Transitions

Major Examples-Weapons

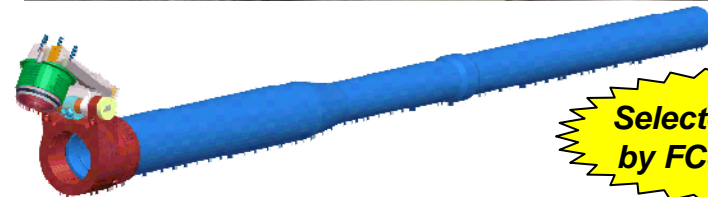


LtWt 81mm Dismounted Mortar



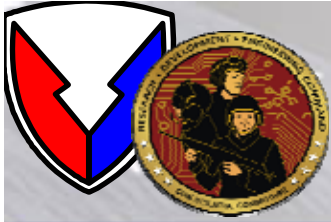
- Joint Army/Navy Funded
- ~30% weight reduction (to <70lbs)
- New Inconel Tube Mat'l & Process
- Simpler, More Ergonomic Bi-Pod
- ~50% UPC reduction
- Transitioning to Prod ECP FY07

XM325 120mm Mortar Cannon



**Selected Cannon
by FCS Program**

- 3 meter tube with screw block breech
- 8 km range with M900 series ammo
- Demonstrated 12 rpm firing rate (FCS Threshold Requirement)
- Transitioned to FCS Program at TRL 6



Recent Tech Base Transitions

Major Example-Ammunition



Line-of-Sight-Multi-Purpose (LOS-MP)

Current



Future- 1 Round



• Enhanced Lethality with One-Round against:

- Concrete Wall
- Earth and Timber Bunker
- Lt Armor
- Personnel

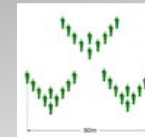
• LOS-MP TRL6 Exit Criteria met:

- Defeated Double reinforced concrete wall with Hole size 30"x50" in <3 shots
- Demonstrated greater than threshold range (700m) with potential to meet objective capabilities (40-2000m)

• Transitioned to PM-MAS



1-Shot T-55 Defeat



30 Man Platoon Defeated > 1000m



2 Shots- Defeat DRC



1 Shot Bunker Defeat



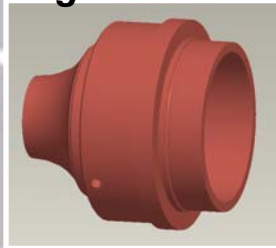
LOS-MP Design Process



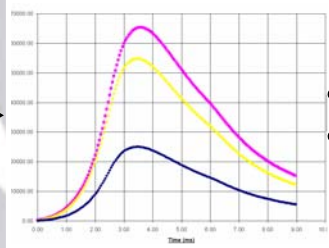
Enabled TRL 6 Demo in 2 Years

- Initial conceptualization to meet requirements
- Definition of high risk process and long lead items
- Define shortfalls of M&S: Fill gaps with test, experience

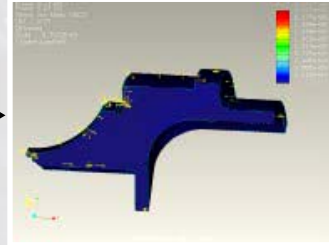
**Modeling/
Configuration Pro
Engineer/ Intralink**



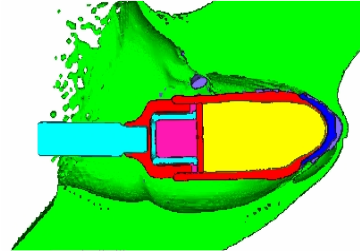
**IB Simulation
IBHVG2**



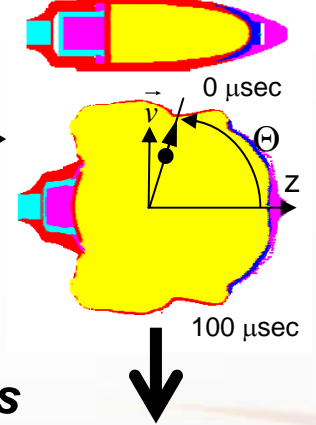
**Structural analysis
FBD/ ANSYS**



**Target penetration
CTH**

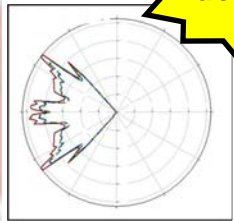


**Fragmentation
CALE/PAFRAG**

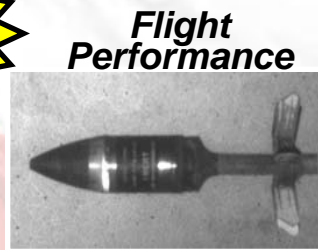


Failure in any model reiterates design process

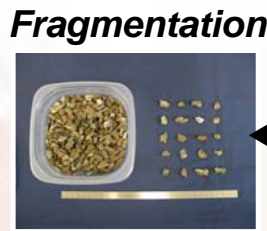
No iteration of design during testing!



**Lethality Models
CASRED/MPR3D/
AJEM/MUVES**



Flight Performance

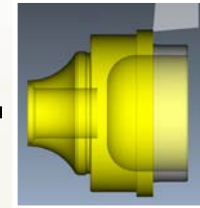


Fragmentation

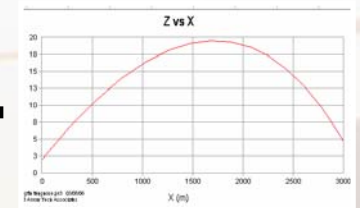


DR concrete wall

Verify Models



**3D numerical control
Pro Manufacture**

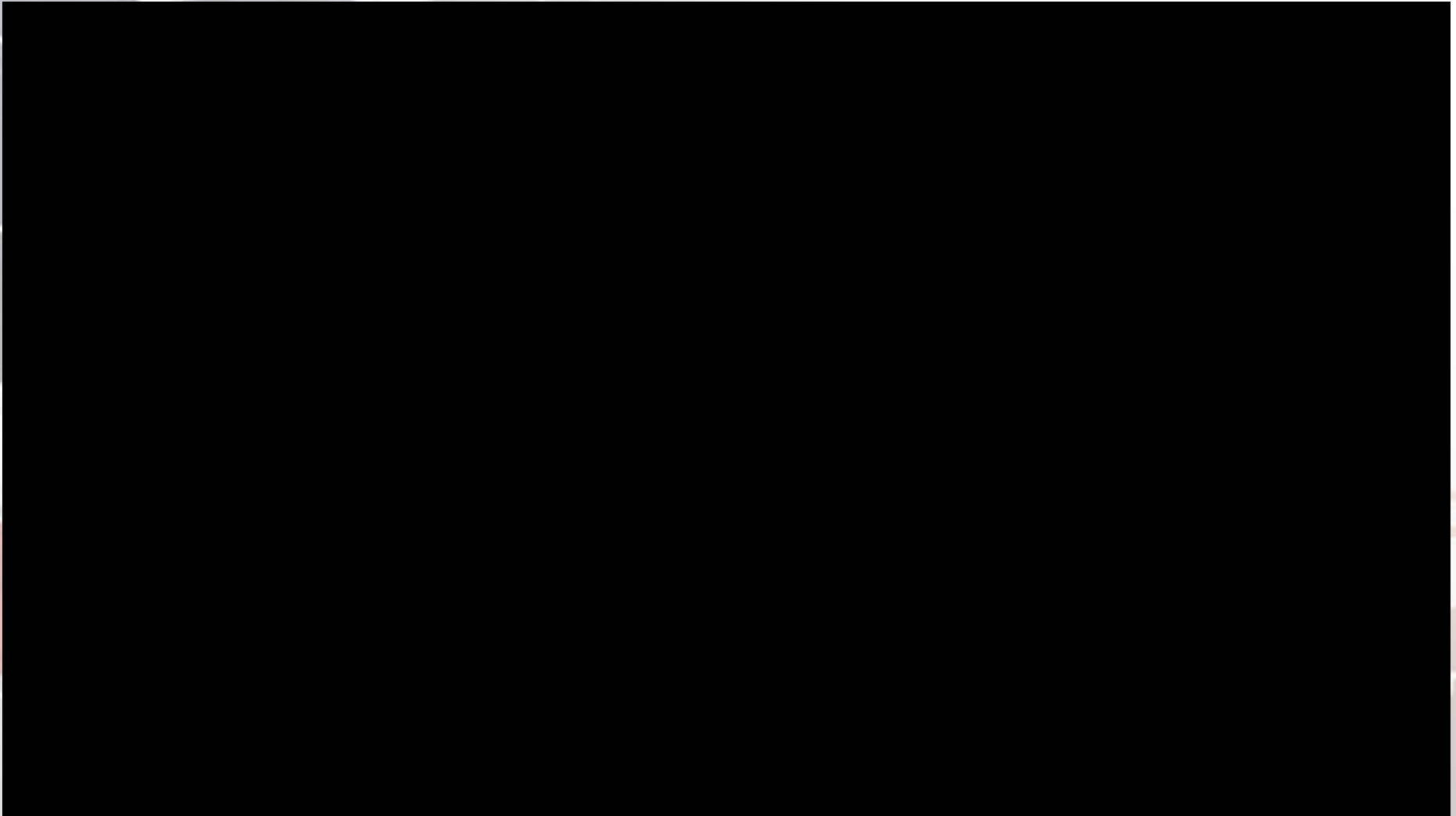


**Flight performance
PRODAS**

Modeling and Simulation Saved \$6.8M and 27 Months



LOS-MP Video



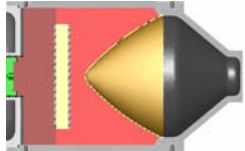


ARDEC Tech Base Investments

Some Examples w/ Joint Service Applications



Hardened Combined Effects Penetrator Warheads (FY04-08)

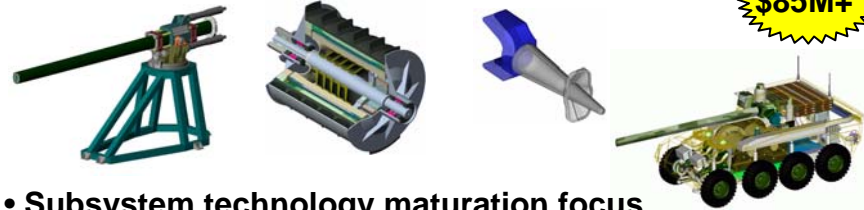


- Single warhead to defeat armor, bunkers, personnel, UAVs with capability to bash-through and detonate within urban structures and clear re-bar.
- Broad applications across guns and missiles

~\$38M



Electromagnetic Gun (FY04-08+)



\$85M+

- Subsystem technology maturation focus
- Enables next level of mission area analysis to support Army program path forward decisions
- Broad weapon mission applications across Services
- Army/Navy collaboration



LtWt Small Arms Technologies (FY05-08)



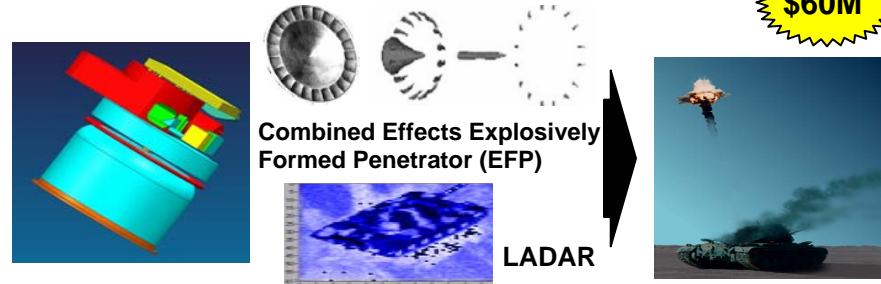
- Technologies to reduce weight, increase reliability, and decrease training burden
- Plastic cased and caseless ammo under evaluation
- 35-45% total weapon/ammo weight reduction in 5.56mm achievable (Baseline: M249)

~\$35M



Common Smart Submunition (FY04-09)

\$60M



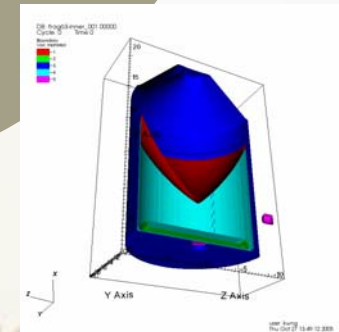
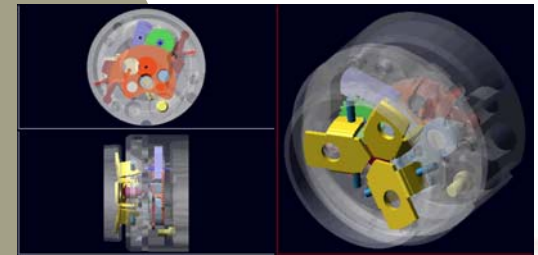
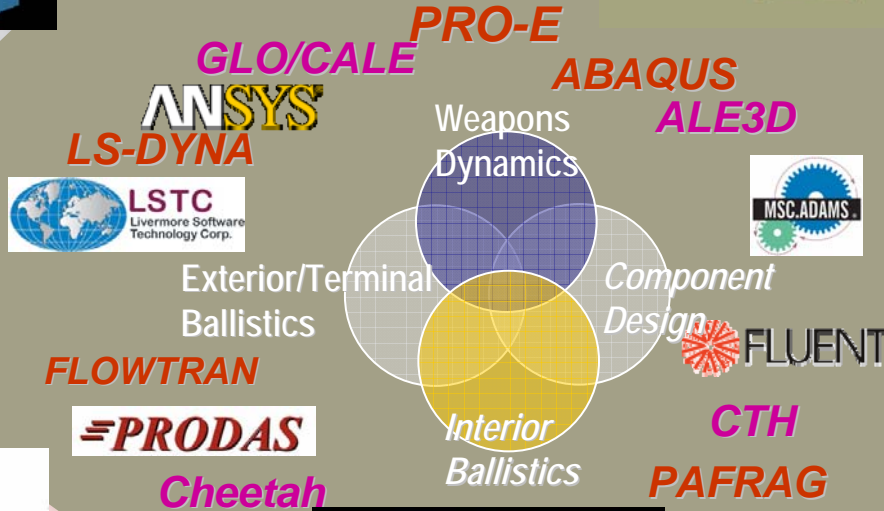
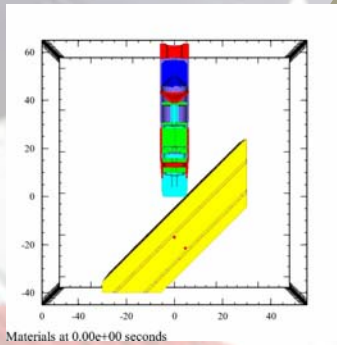
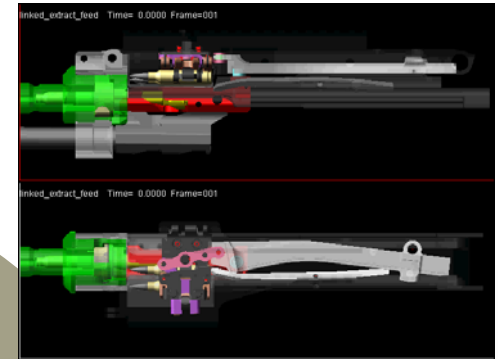
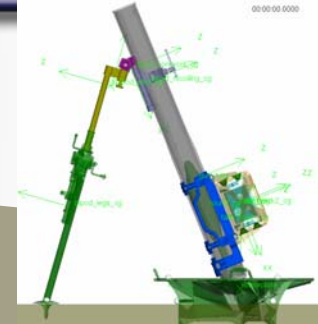
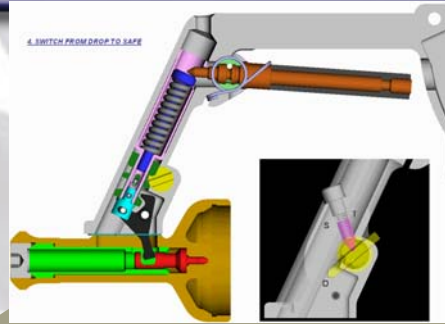
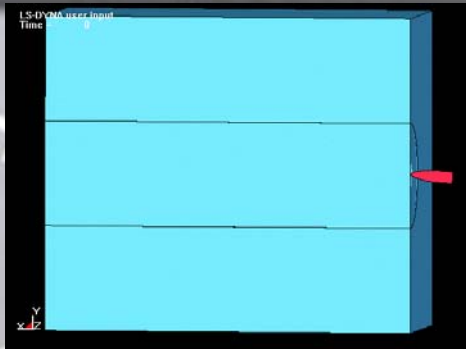
- Next generation smart submunition
- High kill probability against threat spectrum incl APS
- Application across munitions/missiles (≥120mm) & UAVs
- Supports Air Force "Area Dominance" via MOA



\$xM = Army Funding



Engineering Design and Analysis



Application of World-Class M&S Tools is Dramatically Enhancing the Way We Design and Assess Products/Processes



In Summary....ARDEC/Picatinny...



- **Established “Center of Mass” for Armament Systems and Munitions for Joint Services**
- **Proven track record of rapid transition of technology to the field**
- **Modernizing R&D facilities maintaining world-class capabilities**
- **Developing new concepts/technologies to enhance warfighter capabilities**
- **Demonstrating future warfighting capabilities today!**

ARDEC/Picatinny.....

Products, people, and processes enabling our ultimate customer, the soldier, to “take care of business” throughout the spectrum of conflict!