

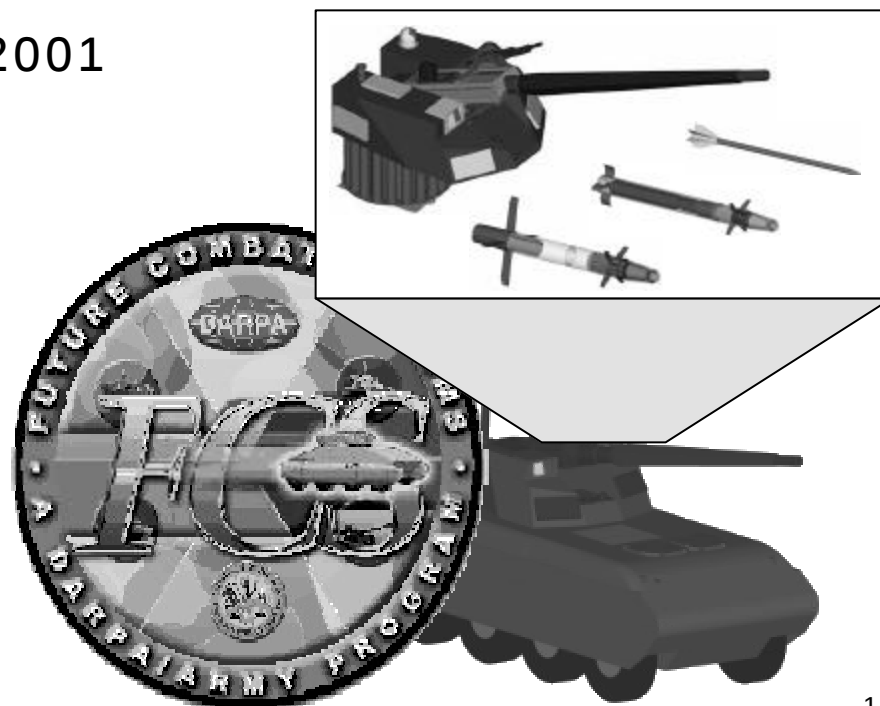


Ammunition Suite for the FCS Multi-role Armament and Ammunition System (MRAAS)

NDIA Armaments for the Army Transformation Conference

20 June 2001

Ernie Logsdon
US Army TACOM/ARDEC
FCS MRAAS Ammunition Manager
(973)724-6186
erniel@pica.army.mil



Report Documentation Page

Report Date 20JUN2001	Report Type N/A	Dates Covered (from... to) -
Title and Subtitle Ammunition Suite for the FCS Multi-role Armament and Ammunition System (MRAAS)	Contract Number	
	Grant Number	
	Program Element Number	
Author(s) Ernie Logsdon, Ernie	Project Number	
	Task Number	
	Work Unit Number	
Performing Organization Name(s) and Address(es) US Army TACOM/ARDEC	Performing Organization Report Number	
Sponsoring/Monitoring Agency Name(s) and Address(es) NDIA (National Defense Industrial Association 2111 Wilson Blvd., Ste. 400 Arlington, VA 22201-3061	Sponsor/Monitor's Acronym(s)	
	Sponsor/Monitor's Report Number(s)	
Distribution/Availability Statement Approved for public release, distribution unlimited		
Supplementary Notes Proceedings from Armaments for the Army Transformation Conference, 18-20 June 2001 sponsored by NDIA		
Abstract		
Subject Terms		
Report Classification unclassified	Classification of this page unclassified	
Classification of Abstract unclassified	Limitation of Abstract UU	
Number of Pages 23		



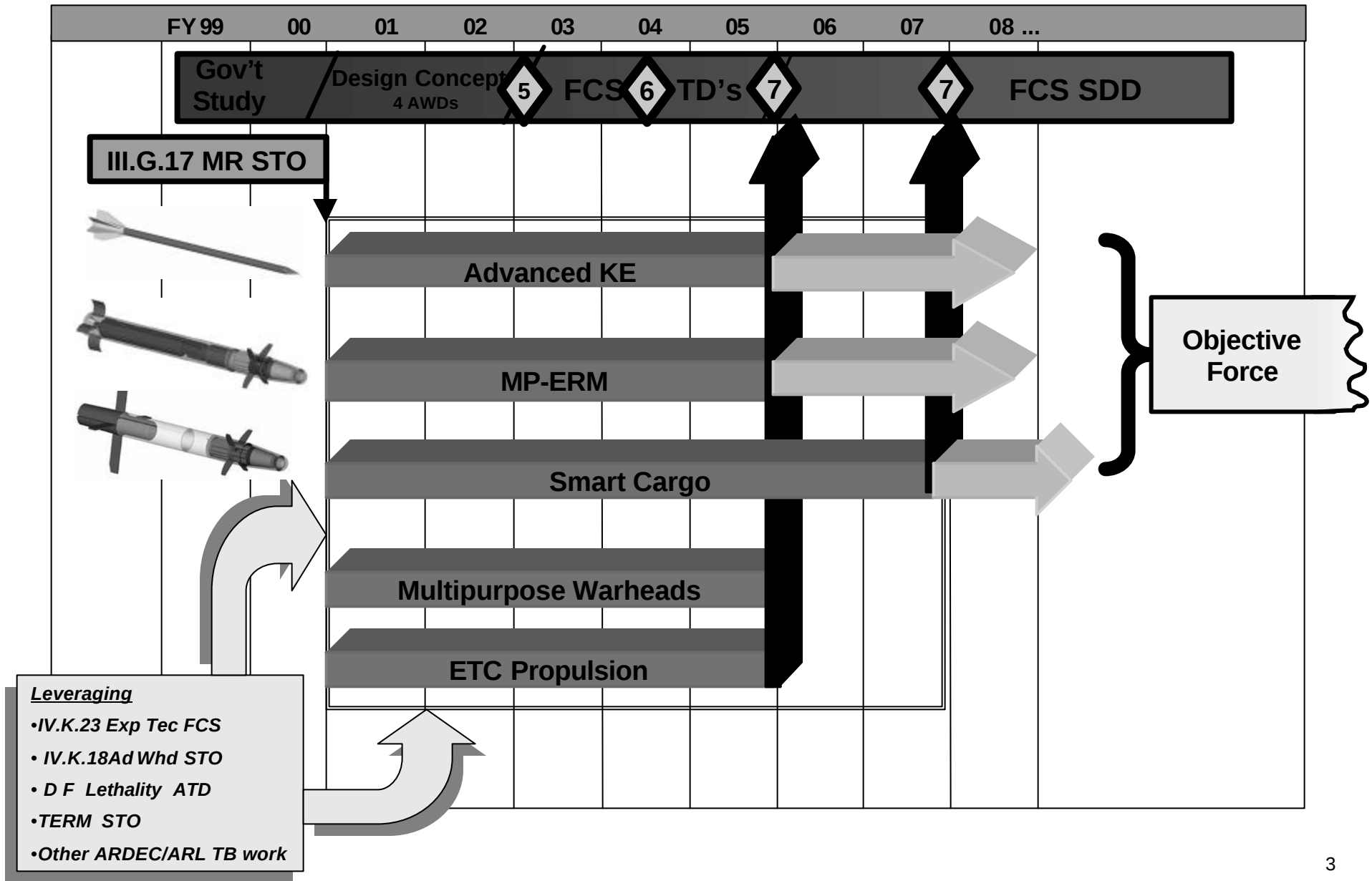
FCS Multi-role Ammunition Suite



- Attributes
 - Family of munitions capable of engaging full target spectrum from 0km to 50km.
 - Small, Light, Versatile, and Lethal
- Pacing Technologies
 - Three Round Munition Suite
 - MP-ERM with multi-purpose warhead
(precision delivery of multi-purpose warhead out to 12+km – **Red Zone**)
 - Smart Cargo
(accurate delivery of bomblets, high explosive, smart submunition, etc. out to 50km- Tactical Deep)
 - Advanced KE
(Defeats LOS heavy armor threats)
 - Electro-Thermal-Chemical (ETC) Propulsion
(precise ignition to support fire out of battery)

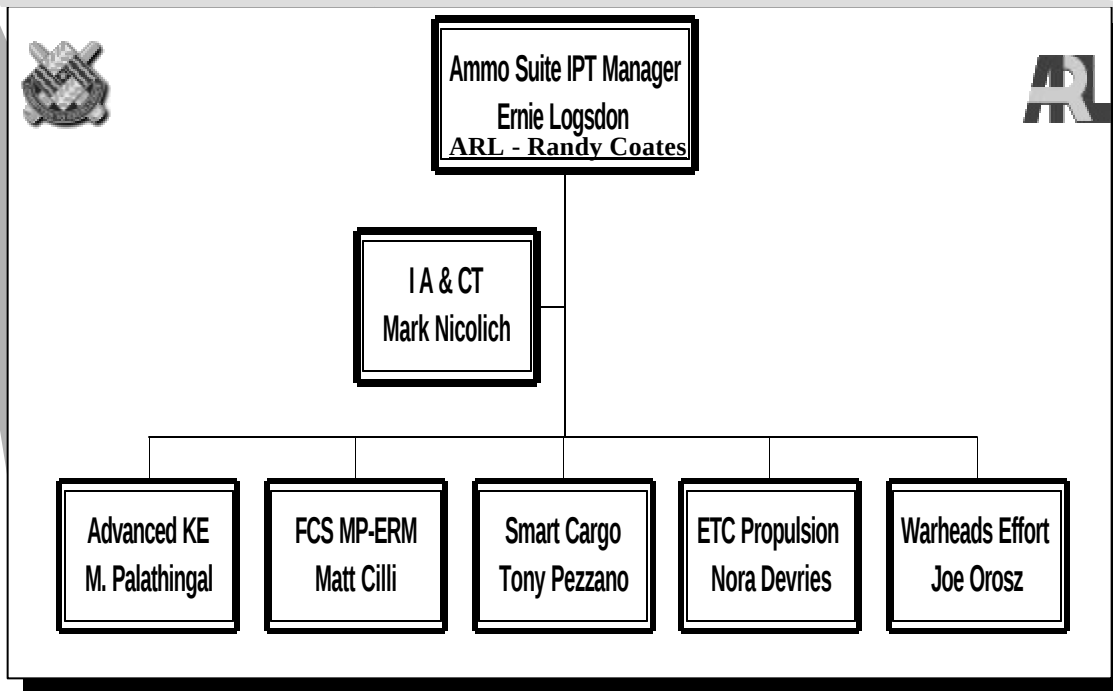
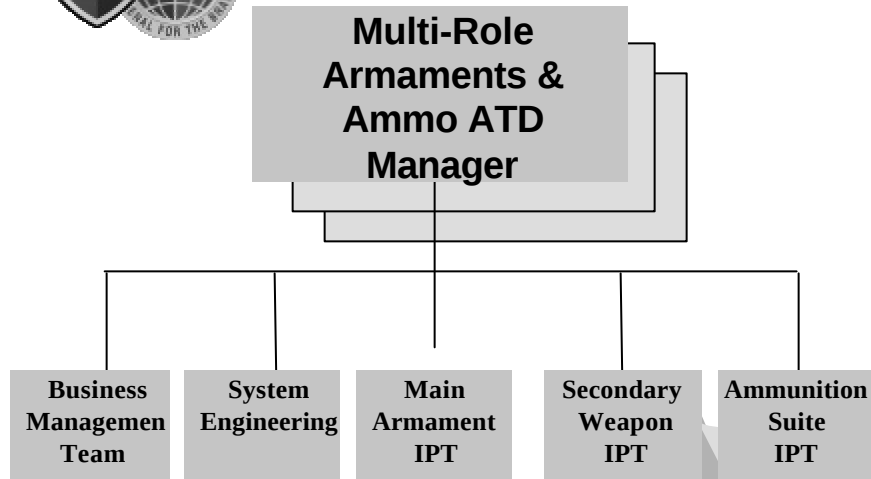


FCS Multi-Role Ammunition Roadmap





AMMUNITION SUITE FOR FCS MULTI-ROLE ARMAMENTS IPT





FCS Advanced KE

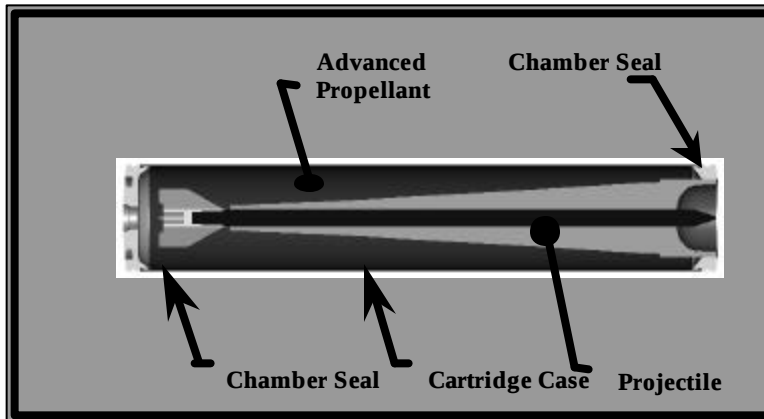
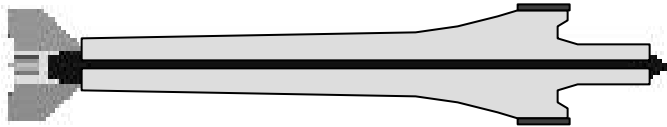


Penetrator



Composite Sabot

Pull Configuration



- **Challenge**
 - Increased lethality against heavy armor at LOS ranges .
- **Barrier**
 - Increasing threat protection
 - Smaller, lighter round
- **Pacing Technologies**
 - ✓ **Novel Penetrator**
 - ✓ **Composite Sabot**
 - ✓ **ETC Propulsion**

Advanced KE: Defeats LOS Heavy Armor threats

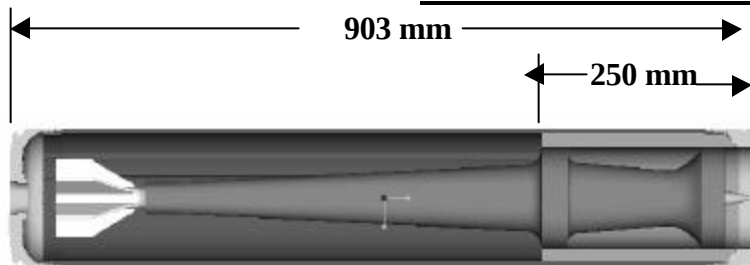


FCS Advanced KE Accomplishments

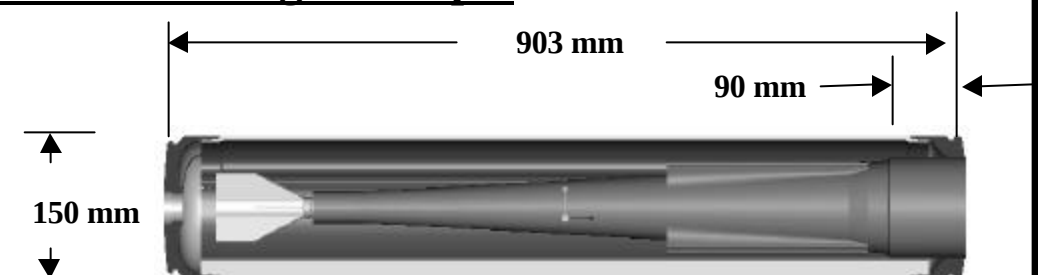


- ✓ Reviewed & evaluated Puller Sabot Technology (i.e., 75mm & 90mm Auto Cannon Case Telescope Ammunition (CTA) KE munition)
- ✓ Teamed with Industry to support IR&D 105mm composite sabot work.
- ✓ Completed engineering design and analysis of puller and conventional (pusher) composite sabot projectiles and integrated them into CTA cartridge.

FCS Advanced KE CTA Cartridge concepts



KE Pusher Sabot Configuration



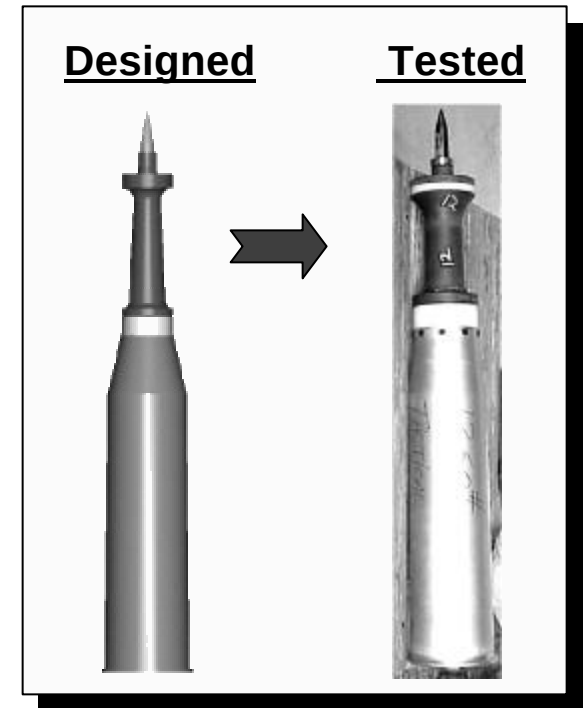
KE Puller Sabot Configuration



FCS Advanced KE Accomplishments/Plans (con't)



- ✓ **Fabricated and Successfully Tested first iteration of conventional (pusher) composite sabot projectiles (May 2001).**
 - ✓ **Fired 5 rounds from a 105mm smooth bore gun tube at ambient**
 - ✓ **All test objectives were met:**
 - **Demonstrated the application of a composite Ad KE projectile in a 105mm gun system**
 - **Survived launch while maintaining structural integrity.**
 - **Observed clean, symmetric, sabot discard and little projectile yaw.**

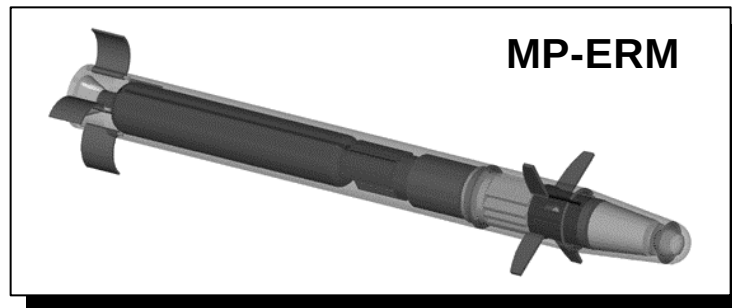


Future Plans:

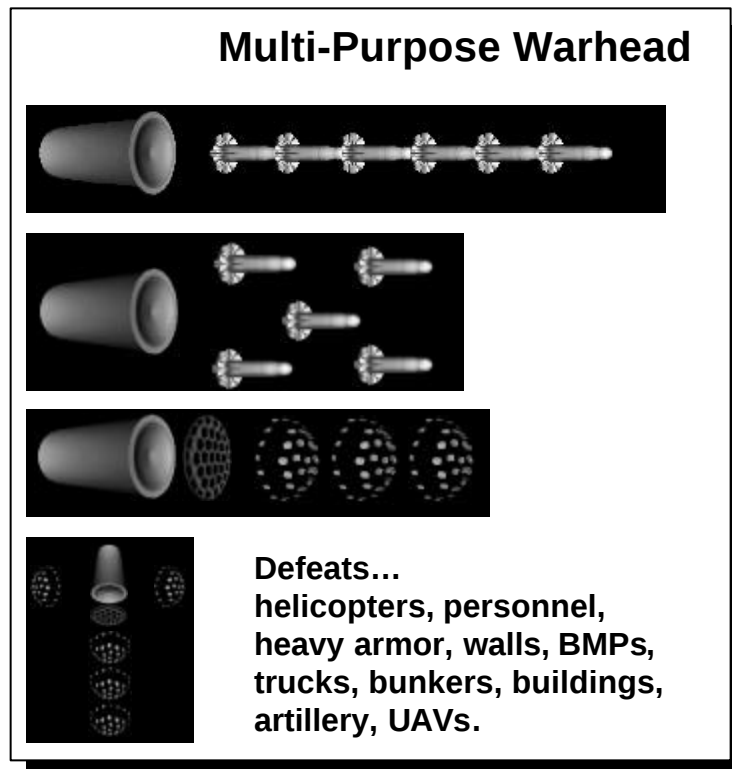
- **Integrate and test FCS Ad KE projectiles with the CTA propulsion system.**
 - **Puller and conventional (pusher) type composite sabots projectiles**



MP-ERM with Multi-Purpose Warhead



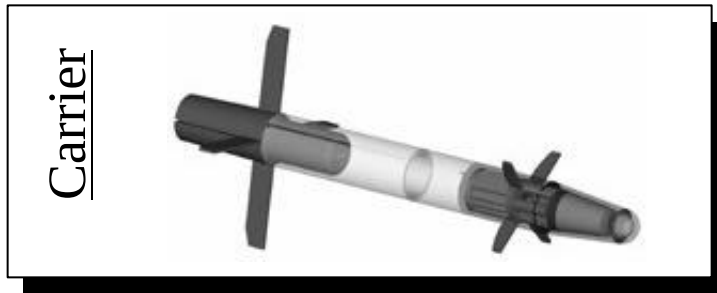
MP-ERM



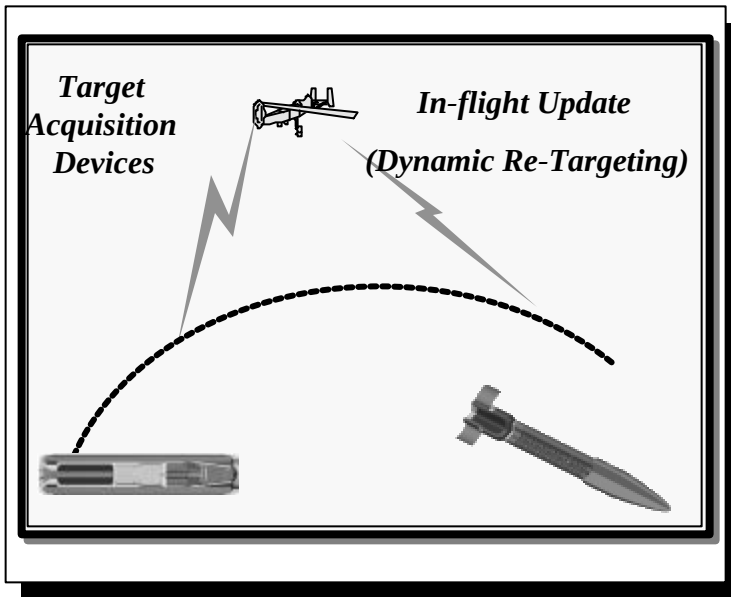
- **Challenge**
 - Warhead effects against multiple targets with one munition type (in order to reduce logistics burden) out to 12km – Red Zone.
- **Barrier**
 - Constraining volume while increasing performance
 - Current warheads are optimized for particular target classes
 - Delivery errors of ballistic flight
- **Pacing Technologies**
 - ✓ Precision munition
 - Hi-G survivable G&C
 - ✓ Multi-purpose warhead
 - More powerful explosives
 - Ignition circuits / selectable ESA



FCS Smart Cargo Carrier



- Challenge
 - Lightweight carrier round with sufficient volume to carry multiple payloads out to 50km.
- Barrier
 - Smaller round leaves less room for cargo than a 155mm cargo round
 - Latency of target location information due to long time of flight.
- Pacing Technologies
 - ✓ Lightweight Accurate Carrier Round
 - Maximize payload volume
 - smart skin (smart materials and structures for control actuation surfaces)
 - Metal matrix composites for airframe
 - Hi-G survivability of navigation sensor and airframe (IMU, GPS/INS)
 - Dynamic Retargeting
 - Robust commo links with FO to munition

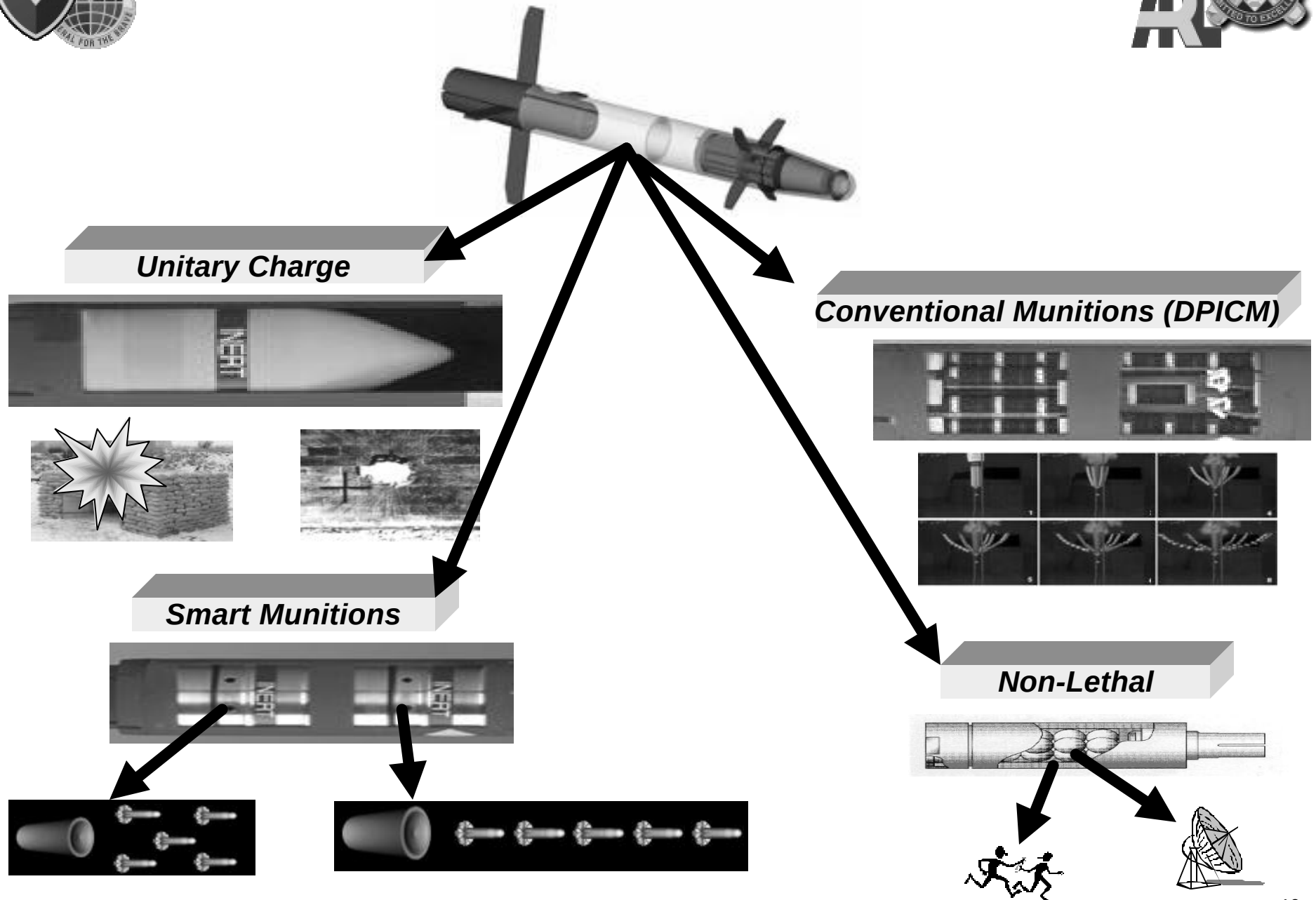


Leverages Army MEMS IMU Effort

Smart Cargo Carrier: Precision delivery of Full Spectrum lethal payloads



Smart Cargo - Submunitions Options





MP-ERM & Smart Cargo Accomplishments to date



- **Accomplishments**

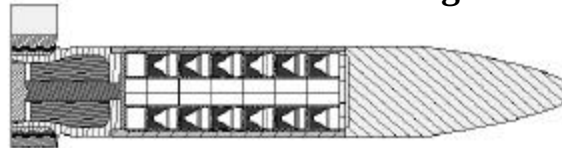
- Initial meetings with TRADOC, Ft Knox and Ft Sill held
- Initiated study to determine feasibility of implementing smart materials and structures for control actuation surfaces
- Following Captive Flight Tests of TERM STO
- Projectile design and aeroballistic study initiated
- Combined MP-ERM & Smart Cargo to form a Smart Suite



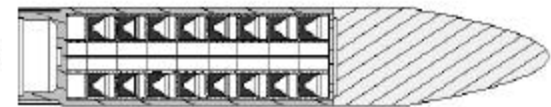
MRAAS Trades underway

- ✓ Trade off performance with size, weight, etc.
- ✓ Develop initial space claim for submunition
- ✓ Dynamic Analysis of projectile for different submunitions

Rocket Assisted - 36 M80 Grenades
With Center Burst Charge

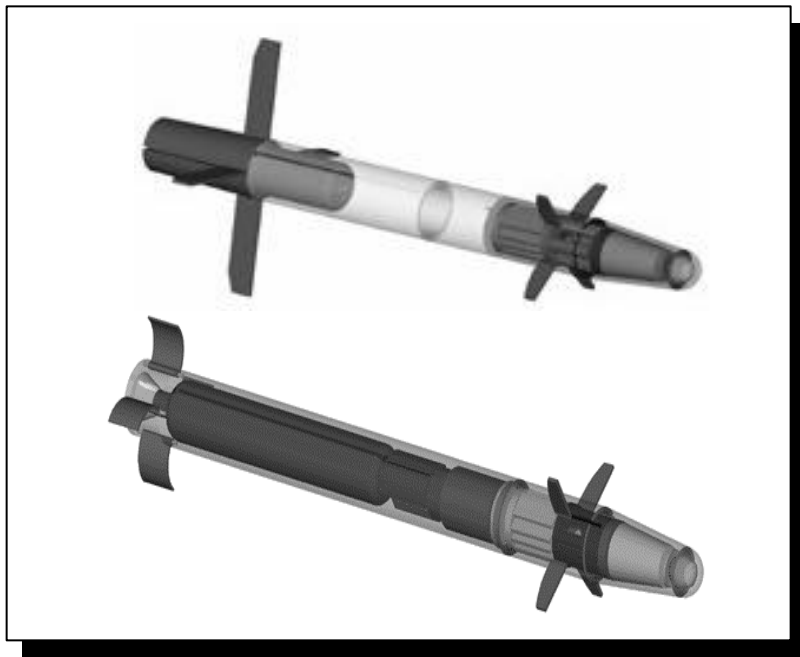


48 M80 Grenades
With Center Burst Charge





Smart Suite Approach



- **KE Round**
 - KE round has robust simplicity
 - LOS Heavy Armor Defeater
- **Build a family of rounds around KE round**
 - **Manage From Suite Perspective w/ one RFP**
 - What: Find one prime to build entire family of rounds
 - Why: Enables trades to find most efficient manner of servicing entire target spectrum – balances cost and logistics trades. Encourages commonality. Reduces risks of capability gaps. Reduces risk of redundant S&T efforts.
- **Utilize Government Baseline to aid in making decisions**
- **Obtain TRL 7 by end of FY05**
- **Industry day held (6 Dec 2000)**



4 Contracts Awarded

in Support of the Smart Suite for the FCS MRAAS ATD

SAIC
An Employee-Owned Company

TEXTRON Systems

CAES

Talley Defense Systems

Northrop Grumman

ASR International

DE Technologies

LOCKHEED MARTIN

ATK
ALLIANT TECHNOLOGIES

Draper

Raytheon

GENERAL DYNAMICS
Ordnance and Tactical Systems

AEROJET

GENERAL DYNAMICS
Armament Systems

SAT Inc.

Litton

Electro-Optical Systems

Litton

Laser Systems Division

Kaman Aerospace

- Four team contracts awarded on 30 March 2001
- Each industry team will conduct a trade study in which they generate at least three suite concepts and then identify best value suite concept.
- Final results of the trade study will be available in August 2001.

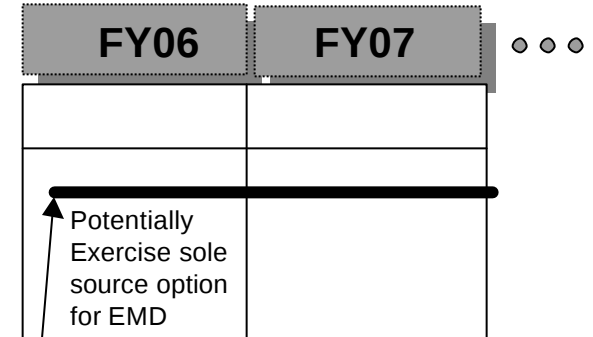


Smart Suite Acquisition Strategy Overview

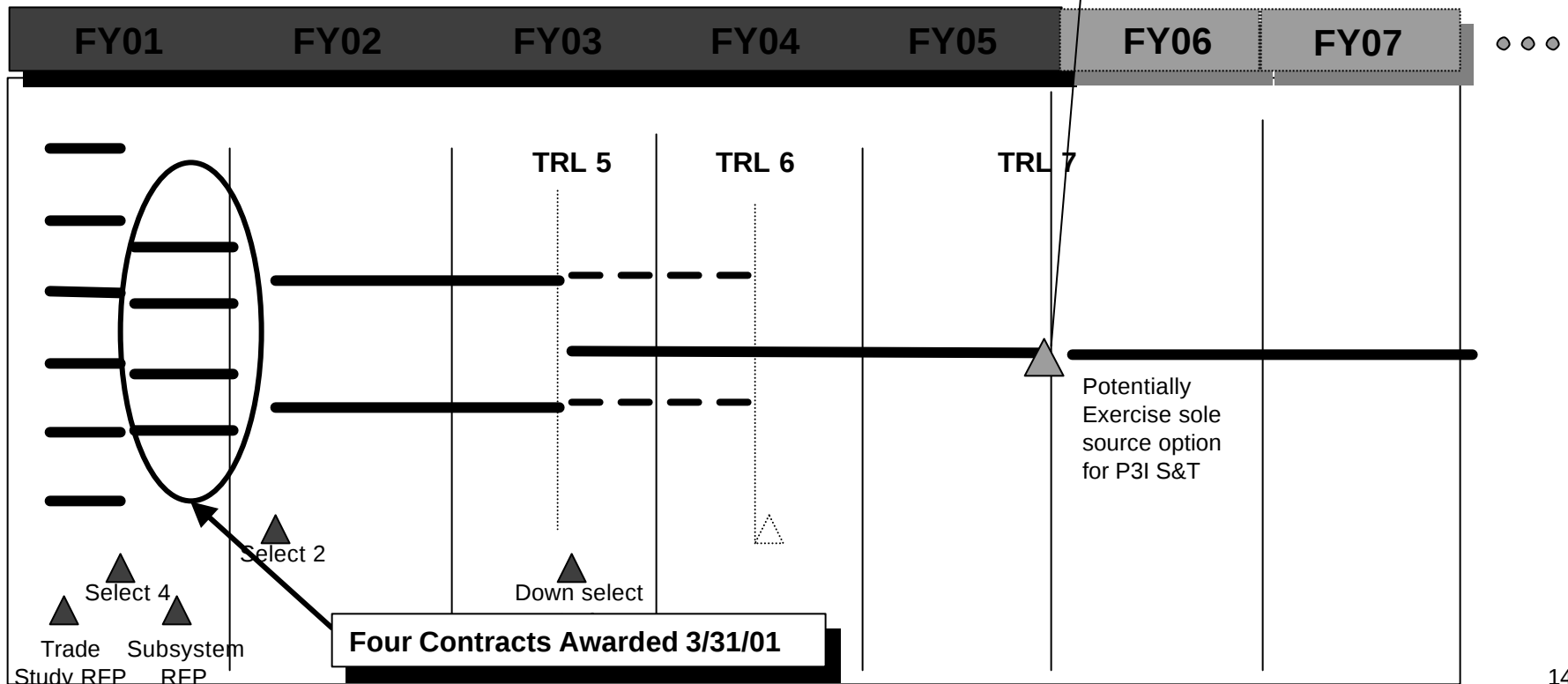


- Full and Open Competition for Trade Study - select up to four industry teams for a four month concept generation and detailed trade study
- Full & Open Competition for Subsystem Design & Testing Phase - Select two industry teams for subsystem development.
- Down-select to one industry team for system integration and demonstration (@ TRL 5 or TRL 6).

FCS SDD

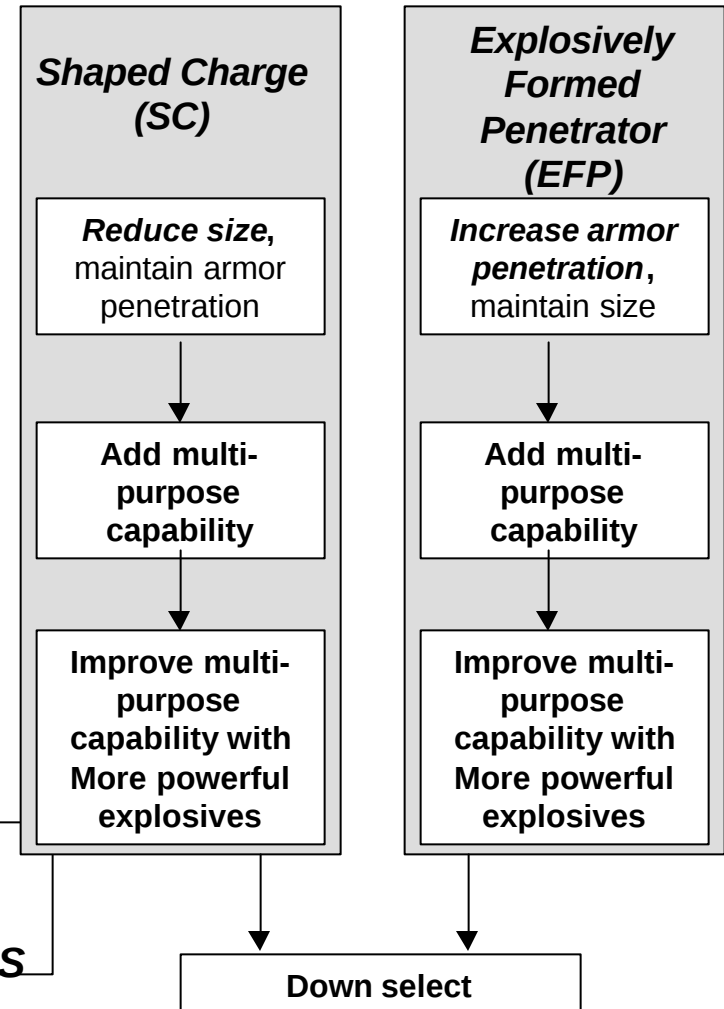
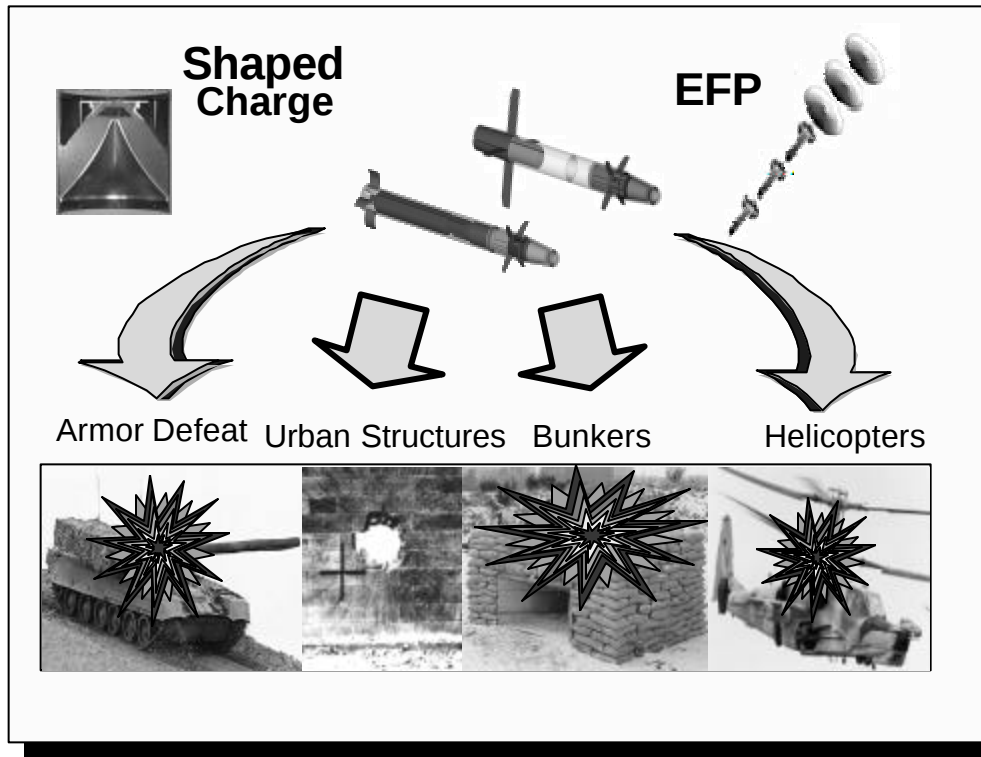


S&T





Multipurpose Warheads for FCS MRAAS



ENABLING TECHNOLOGIES:

- *Explosives Technology for FCS*
- *Electronic Safe & Arming (ESA) Technology for FCS*

Payoff: Increased munitions lethality over a broader spectrum of targets



Compact Multi-purpose SC Warhead Concept



Compact Warheads

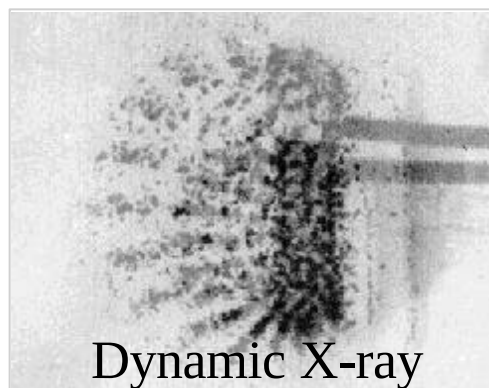


Shorter, lighter!



Multi-Purpose
capability

Fragmentation/Blast



Dynamic X-ray

Defeat Bunkers!
Defeat Helicopters!
Anti-personnel lethality!

Wide Area Penetration



Defeat Walls & BMP!

Deep Penetration



Defeat Tanks!

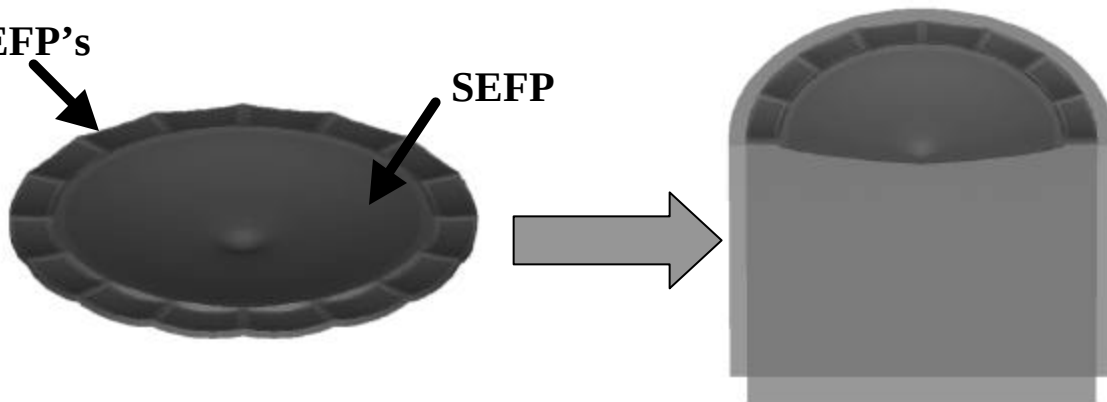


Mult-Purpose Combined Effects EFP Warhead



16 MEFP's

SEFP





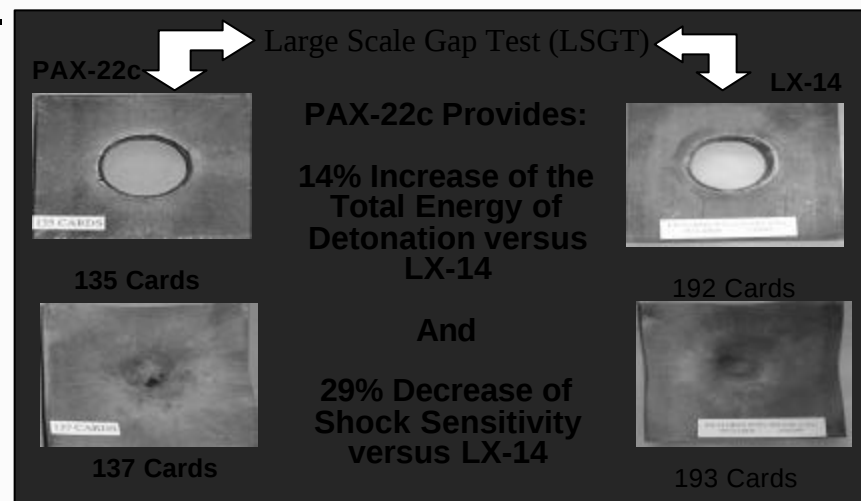
Enabling Technologies for FCS Multipurpose Warheads



Advanced Explosives Technology

More Energetic = Increase in anti-armor warhead penetration by smaller diameter munitions - *More Firepower for the Soldier*

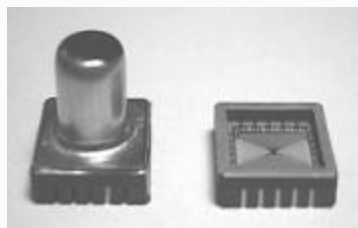
Less Sensitive = Minimize the probability of inadvertent initiation when subjected to unplanned stimuli - *More Safety for the Soldier*



Electronic Safe & Arming (ESA) Technology

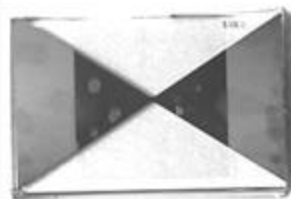
Exploding Foil Initiator (EFI) Effort

Low Energy EFI (LEEFI)



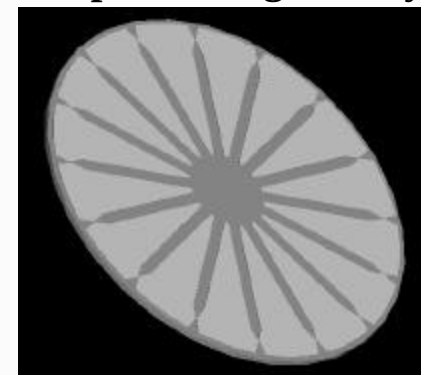
Ceramic Thick Film Technology

Very Low Energy EFI (VLEEFI)



Silicon/Quartz IC Technology

Shaped Charge Array



16 Points



Electro-Thermal-Chemical (ETC) Propulsion



- **Challenge**

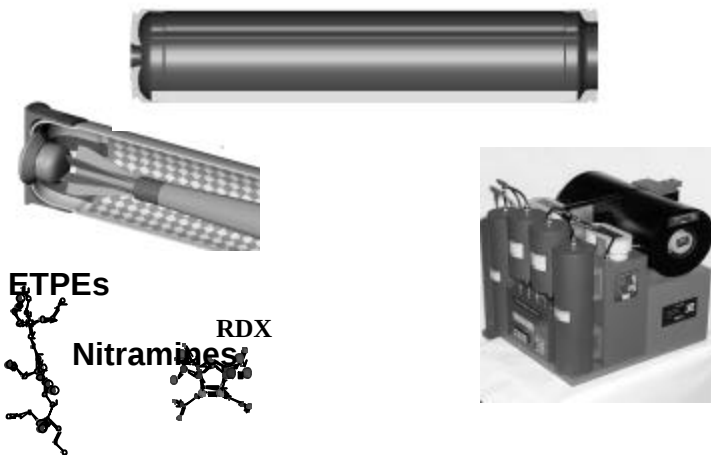
- Precision ignition (efficient FOOB)
- High energy propellant insensitive to temperature (KE & extended range)
- Low sensitivity (survivability)
- Low flame temps (long gun life)

- **Barrier**

- Conventional propellants
 - Hi energy => hi flame temps
 - Hi energy => hi sensitivity

- **Major Efforts:**

- ***Cartridge Case and Seals***
- ***Advanced Propellants***
- ***Charge Design & ETC injector***
- ***Power Supply***



ETPES

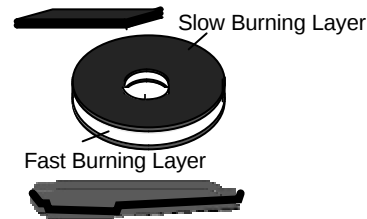
RDX

Nitramines

CL20



CONSOLIDATED

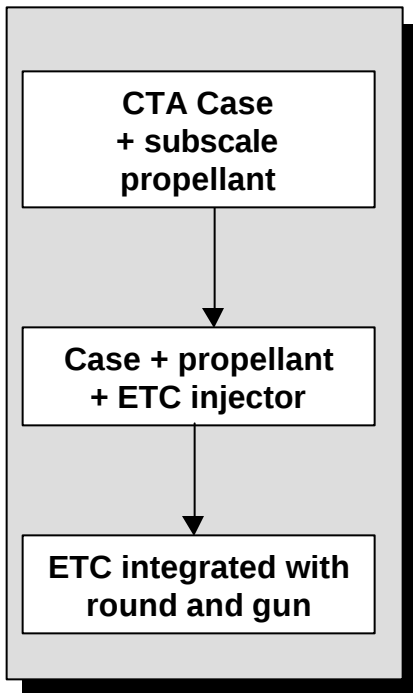


FASTCORE

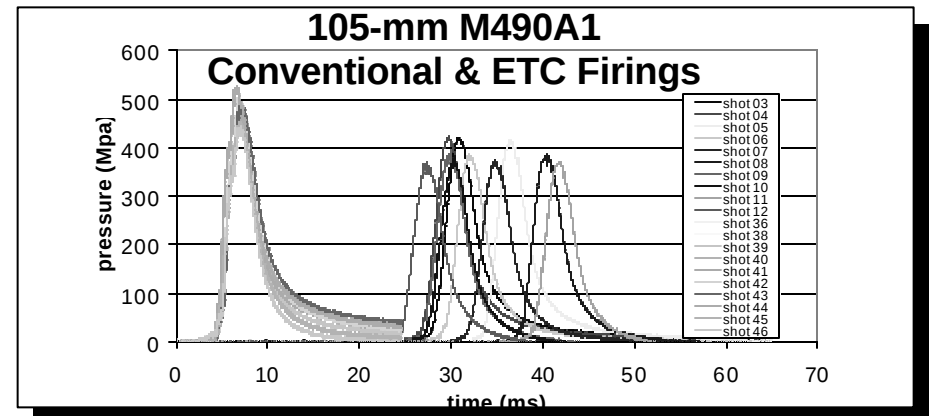


ETC Propulsion

Accomplishments/Plans



- To Date
 - 120mm ETC ignition with JA2 propellant / cartridges demonstrating precision ignition and temperature compensation.
 - 105mm ETC ignition demonstrating precision ignition and temperature compensation completed
 - Successfully demonstrated ETC/FOOB in Feb 01
 - Successfully demonstrated Cased Telescoped Ammunition (CTA) cartridge
- Near Term
 - Small scale development of Advanced Propellants (GEN 2), decide if ready for full scale
 - Design, fab, test CTA case, seal designs, several ETC injectors

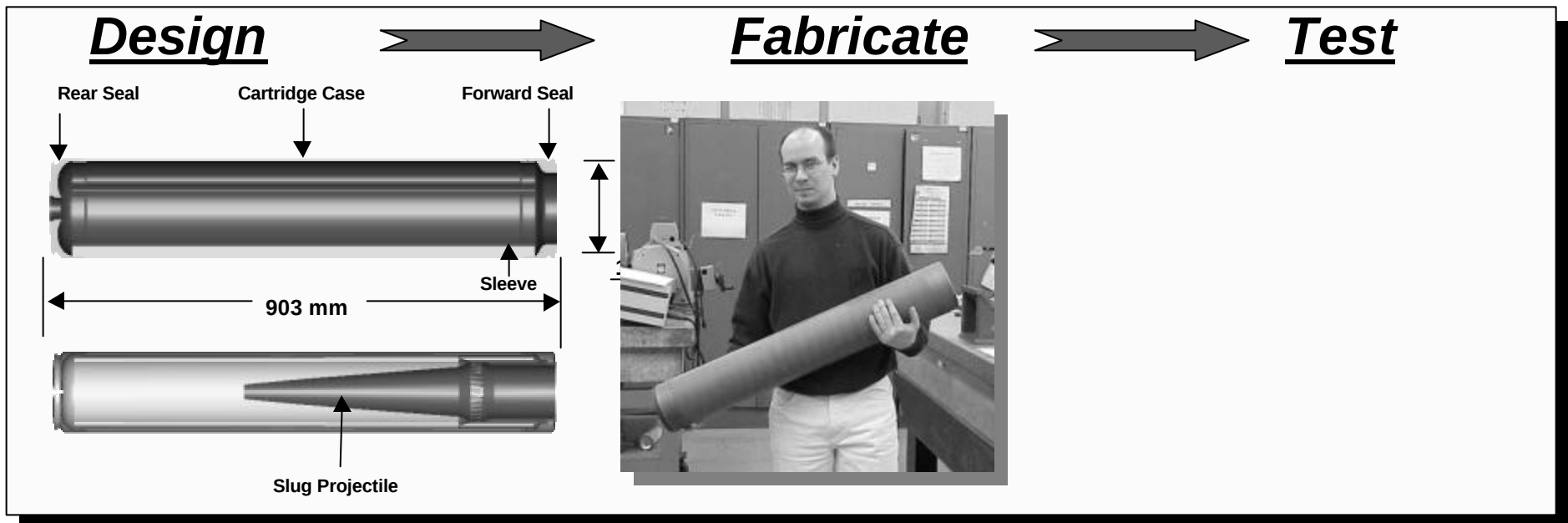




ETC Propulsion Accomplishments (con't)



- **Successfully Demonstrated CTA cartridges in May 2001**
 - Fired 7 CTA with slugs from the MRAAS 105mm test fixture @ APG, Ambient (21C) and cold (-32C).
 - The CTA ammunition contains a composite cartridge case and a slug projectile, which is completely encapsulated in the cartridge case.
 - Demonstrated the ability of a CTA cartridge to be fired and extracted out of the 105mm MRAAS gun test fixture.
- Next iteration schedule for July/Aug







Summary

Ammunition Suite for FCS MRAAS



- ✓ Pacing technologies have been identified
 - ✓ Demonstrated via live fire test and analysis.
- ✓ Advanced KE, first iteration composite sabot
Successfully tested
- ✓ Smart Suite (MP-ERM & Smart Cargo) Trade Study underway
- ✓ Completed Initial SC and EFP Warhead designs – Testing is underway
- ✓ Successfully demonstrated first CTA cartridge
- ✓ Fire-Out-of-Battery/ETC Successfully Demonstrated
- ✓ Working with DARPA & DARPA Primes



One Lethality Approach...
A Lightweight Armament System to Dominate Red Zone & Beyond