TACOM

Lethality, Survivability, Mobility and Sustainment for America's Army

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

NDIA Armaments for the Army Transformation Conference

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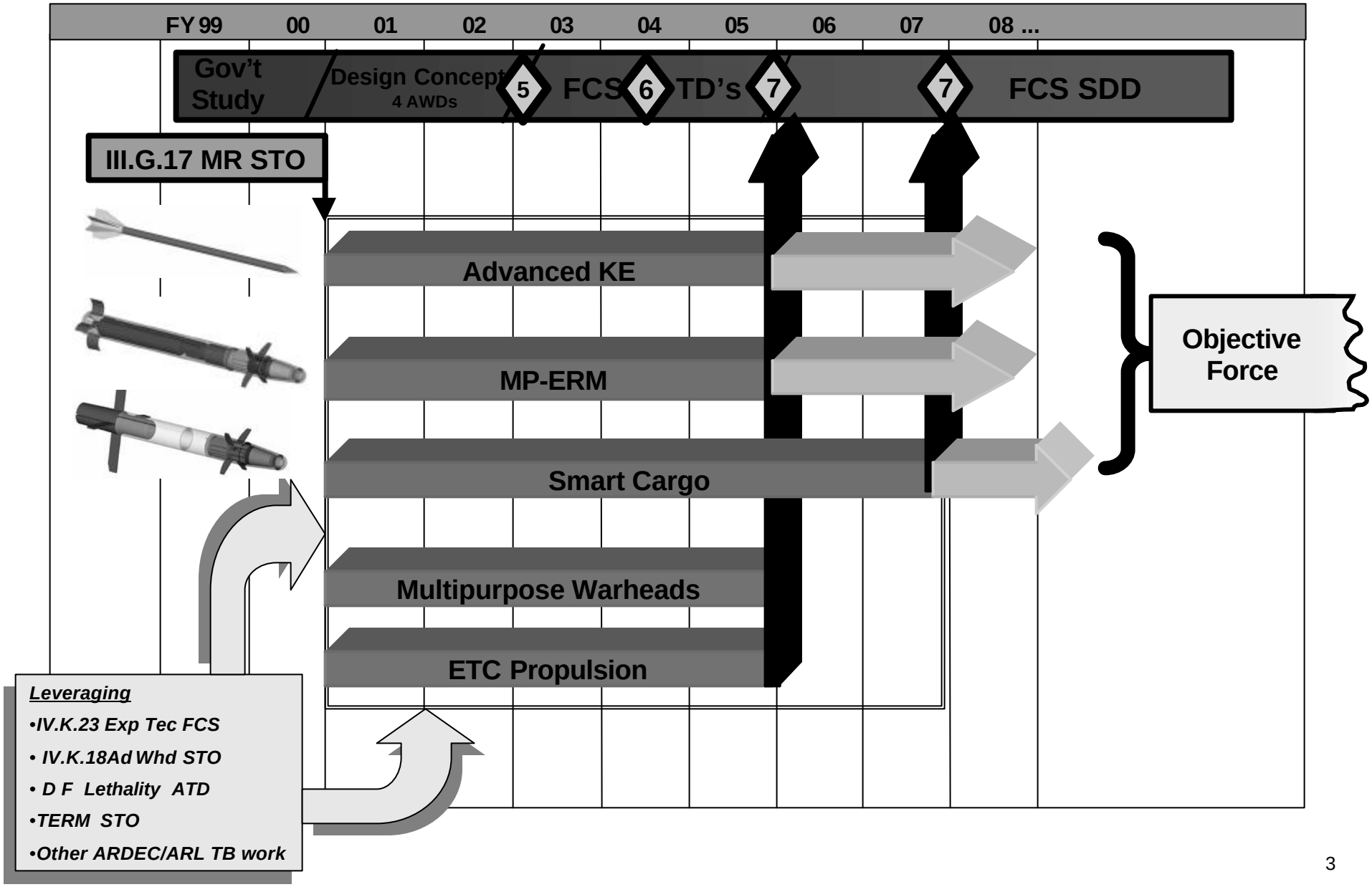
FCS Multi-role Ammunition Suite

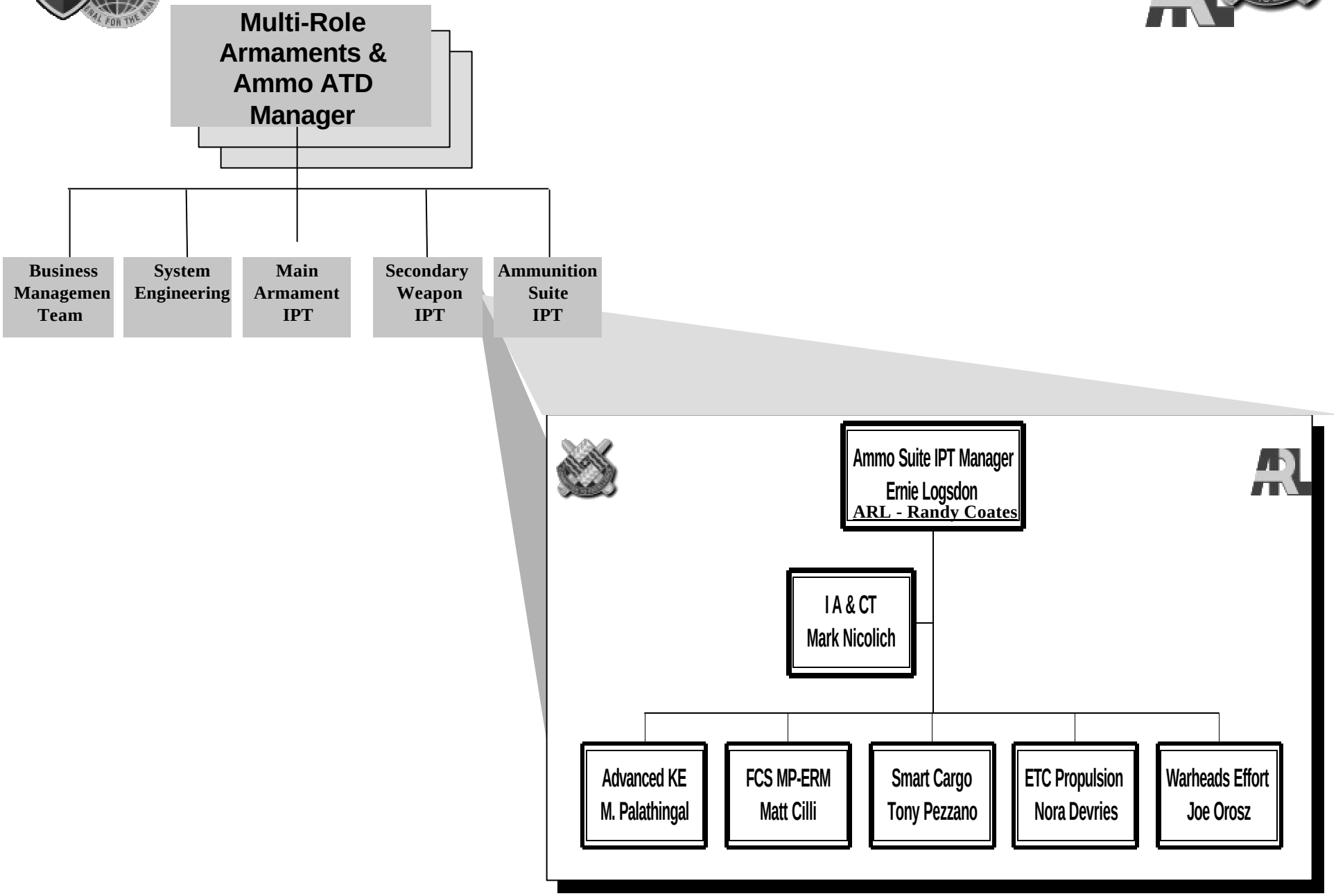
- Attributes
  - Family of munitions capable of engaging full target spectrum from 0km to 50km.
  - Small, Light, Versatile, and Lethal

- Pacing Technologies
  - Three Round Munition Suite
    - MP-ERM with multi-purpose warhead (precision delivery of multi-purpose warhead out to12+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)

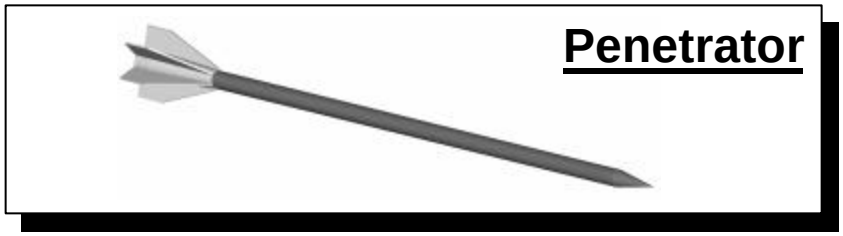
FCS Multi-Role Ammunition Roadmap

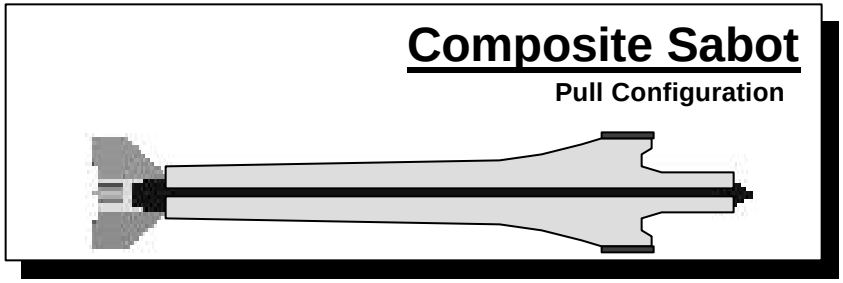


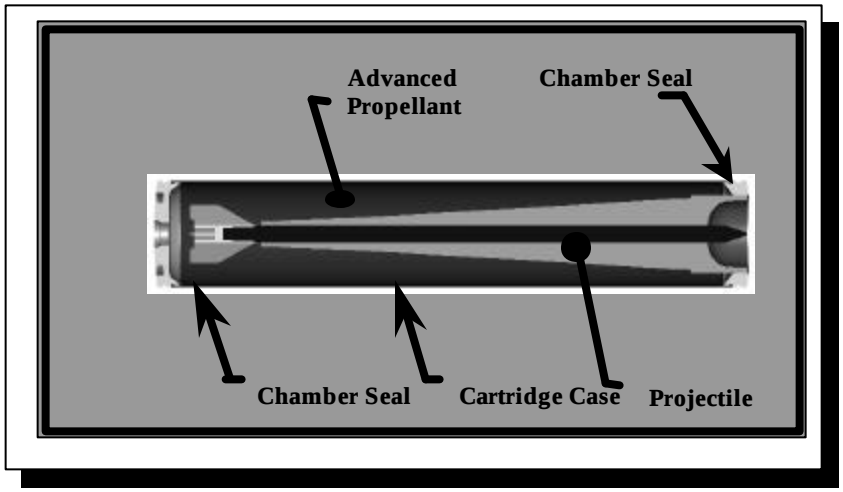
AMMUNITION SUITE FOR FCS
MULTI-ROLE ARMAMENTS IPT



FCS Advanced KE







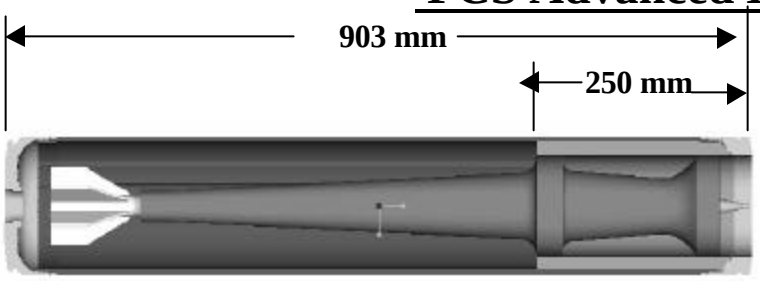
- Challenge
  - Increased lethality against heavy armor at LOS ranges .
- Barrier
  - Increasing threat protection
  - Smaller, lighter round
- Pacing Technologies
  - ✓ **Novel Penetrator**
  - ✓ **Composite Sabot**
  - ✓ **ETC Propulsion**

Advanced KE: Defeats LOS Heavy Armor threats

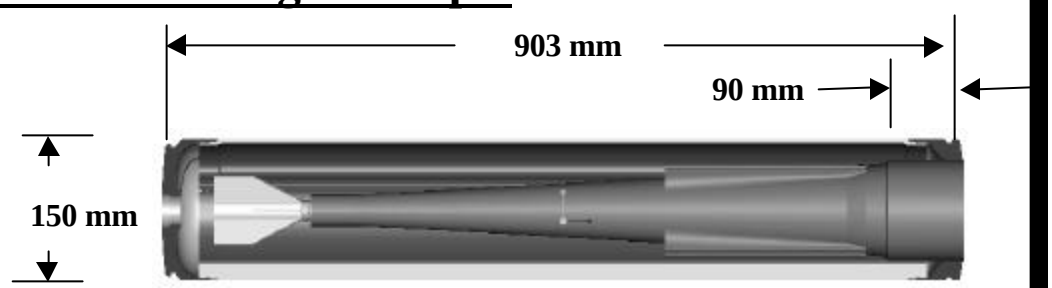
FCS Advanced KE Accomplishments

- ✓ **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



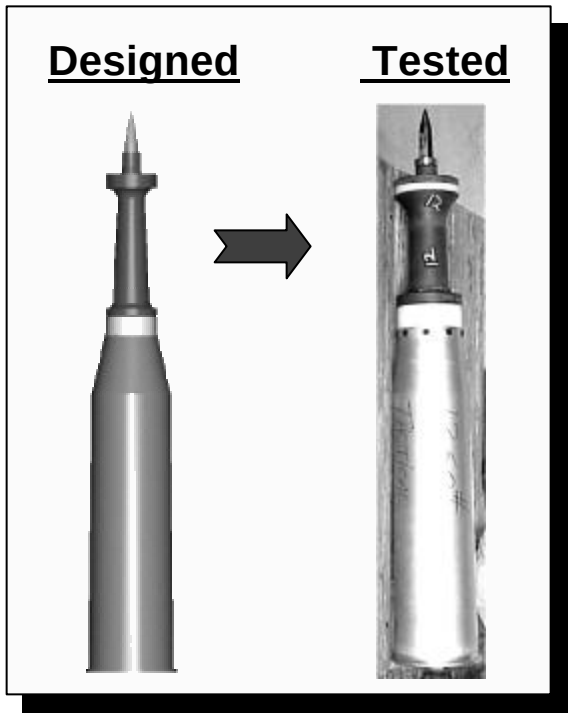
KE Pusher Sabot Configuration



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.**



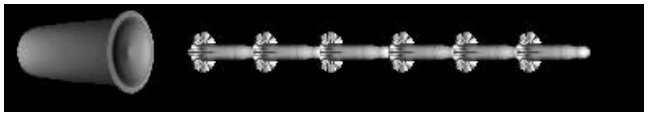
<u>Future Plans</u>:

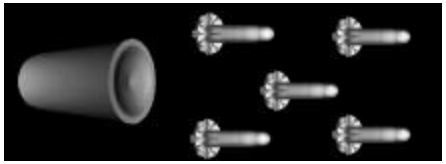
- **Integrate and test FCS Ad KE projectiles with the CTA propulsion system.**
  - **Puller and conventional (pusher) type composite sabots projectiles**

MP-ERM
with Multi-Purpose Warhead

MP-ERM

Multi-Purpose Warhead

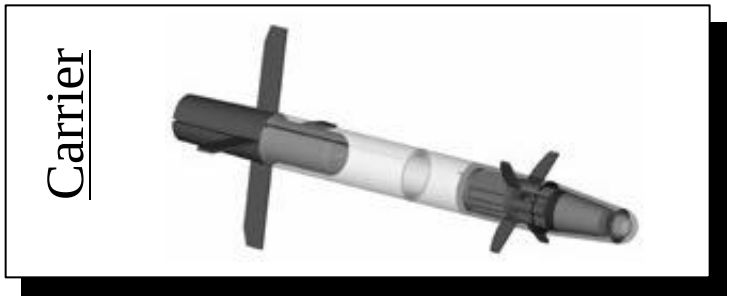


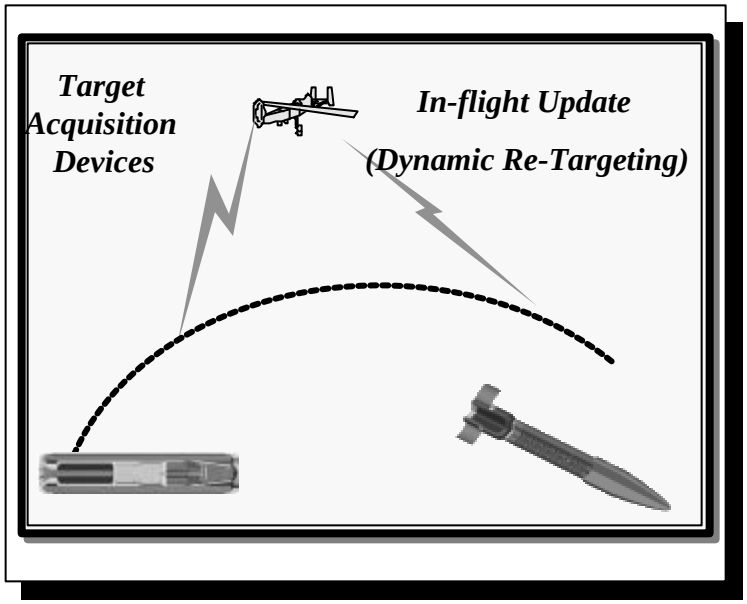


Defeats…
helicopters, personnel, heavy armor, walls, BMPs, trucks, bunkers, buildings, artillery, UAVs.

- 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



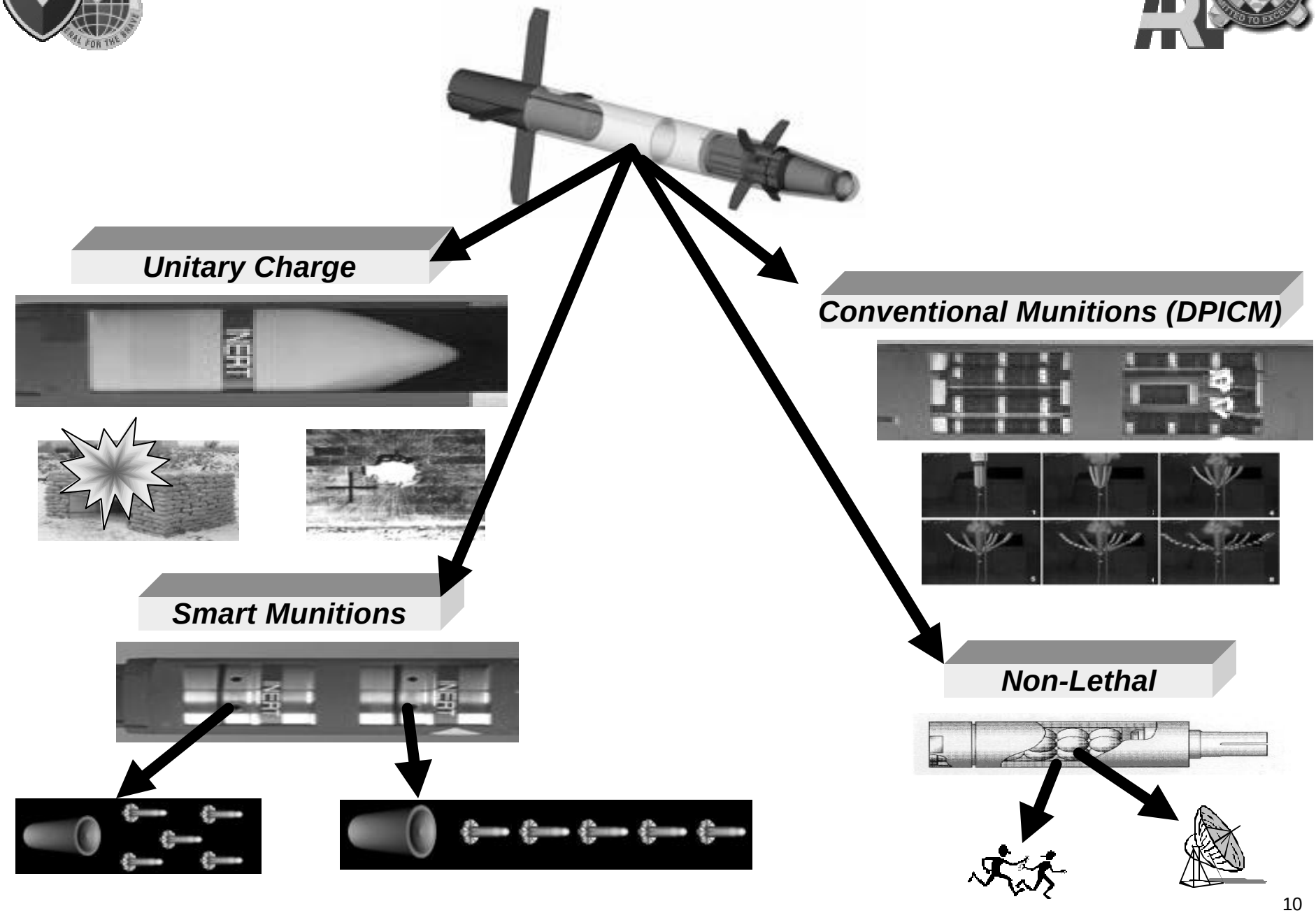


- Challenge
  - Lightweight carrier round with sufficient volume to carry multiple payloads out to 50km.
- Barrier
  - Smaller round leaves less room for cargo than a 155mm cargo round
  - Latency of target location information due to long time of flight.
- Pacing Technologies
  - ✓ Lightweight Accurate 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

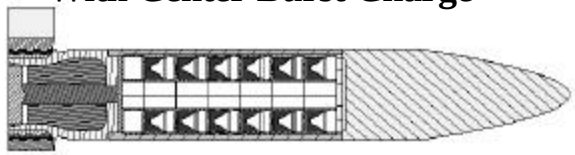
- **Accomplishments**
  - **Initial meetings with TRADOC, Ft Knox and Ft Sill held**
  - **Initiated study to determine feasibility of implementing smart materials and structures for control actuation surfaces**
  - **Following Captive Flight Tests of TERM STO**
  - **Projectile design and aeroballistic study initiated**

  - **Combined MP-ERM & Smart Cargo to form a Smart Suite**

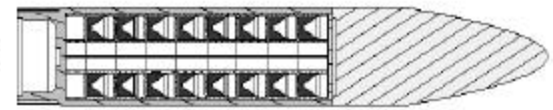
MRAAS Trades underway

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

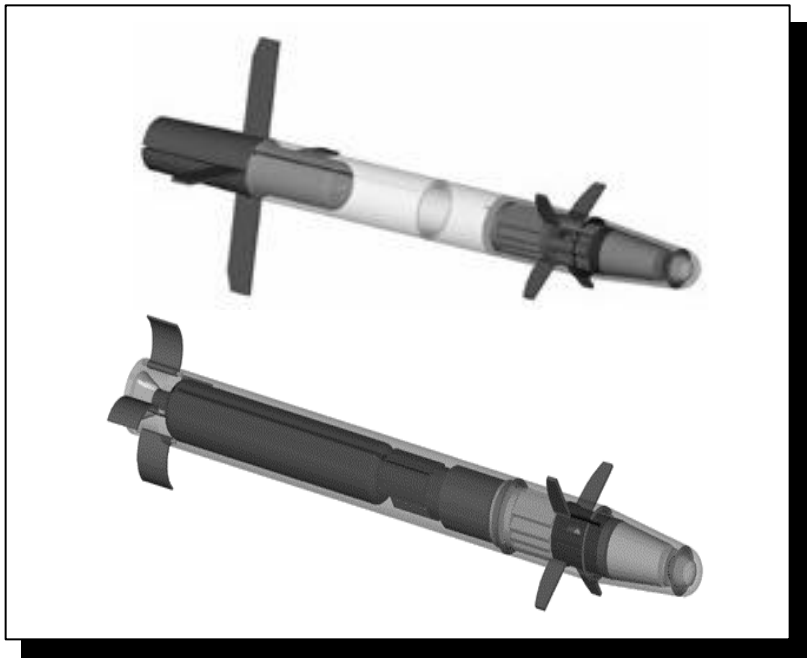
Rocket Assisted - 36 M80 Grenades With Center Burst Charge



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**
    - **<u>What</u>: Find one prime to build entire family of rounds**
    - **<u>Why</u>: 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 TECHSYSTEMS

- Draper

Raytheon
GENERAL DYNAMICS Ordnance and Tactical Systems

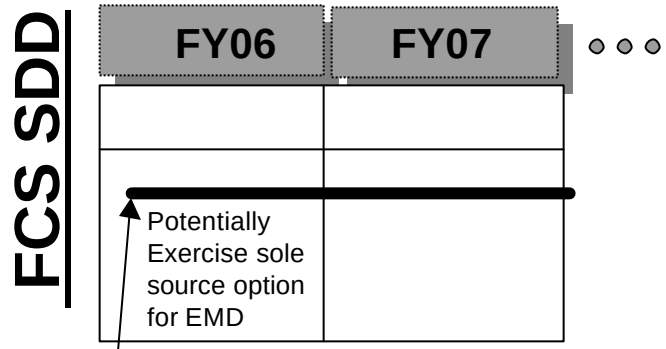
AEROJET
GENERAL DYNAMICS Armament Systems

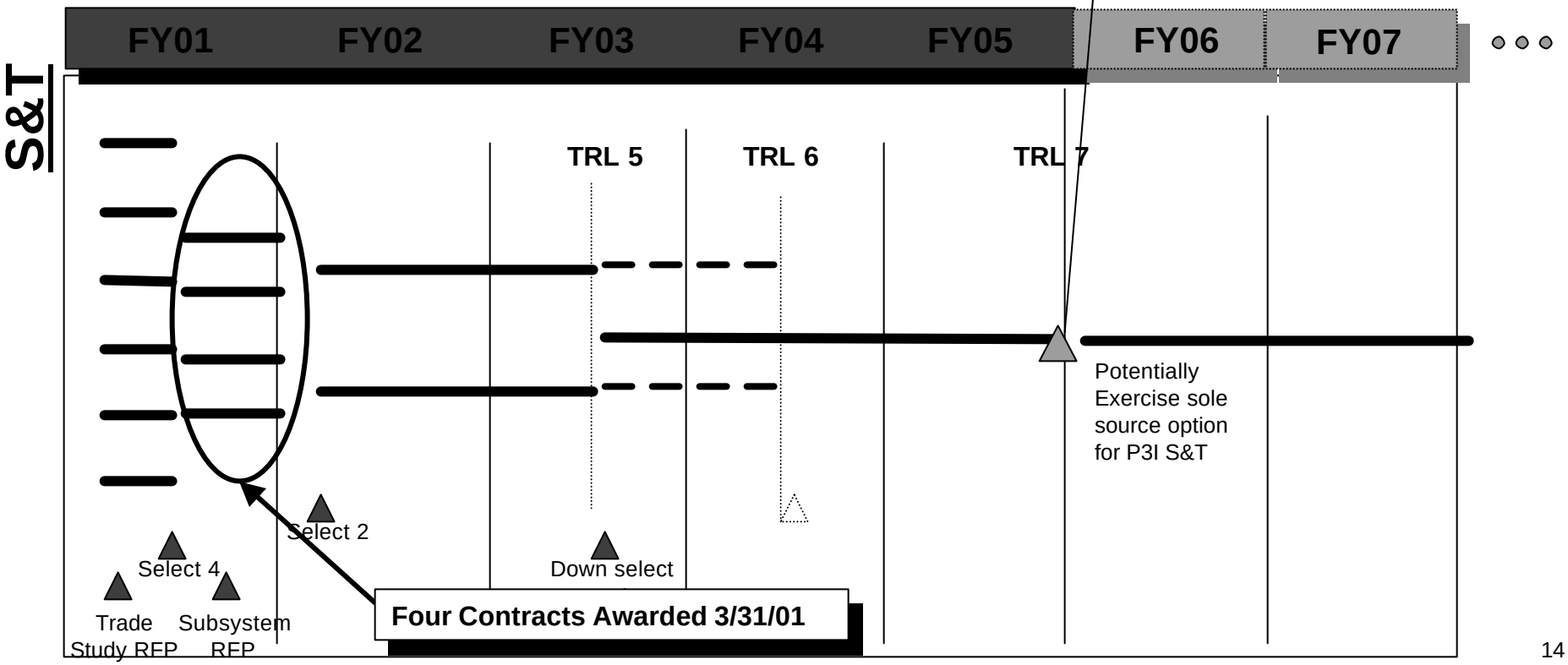
- SAT Inc.
- Litton Electro-Optical Systems
- Litton Laser Systems Division
- Kaman Aerospace

- 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.

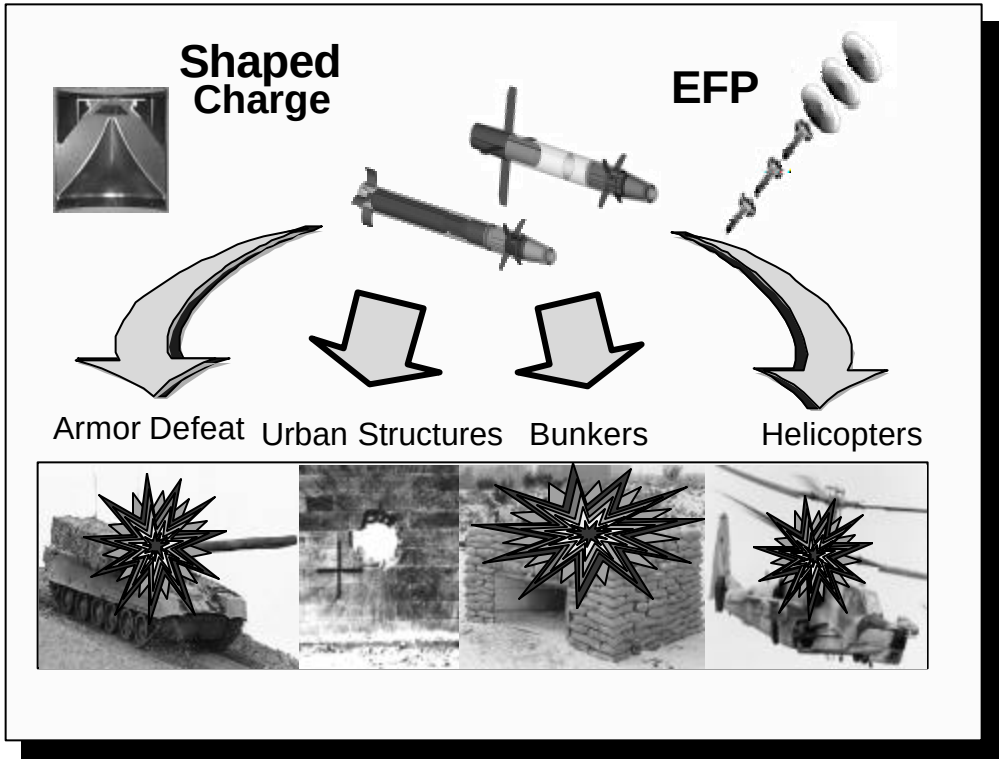
Smart Suite
Acquisition Strategy Overview

- 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).





Multipurpose Warheads for FCS MRAAS



Shaped Charge (SC)

***Reduce size*, maintain armor penetration**

↓

Add multi-purpose capability

↓

Improve multi-purpose capability with More powerful explosives

Explosively Formed Penetrator (EFP)

***Increase armor penetration*, maintain size**

↓

Add multi-purpose capability

↓

Improve multi-purpose capability with More powerful explosives

↓

Down select

ENABLING TECHNOLOGIES:

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

Payoff: ***Increased munitions lethality over a broader spectrum of targets***

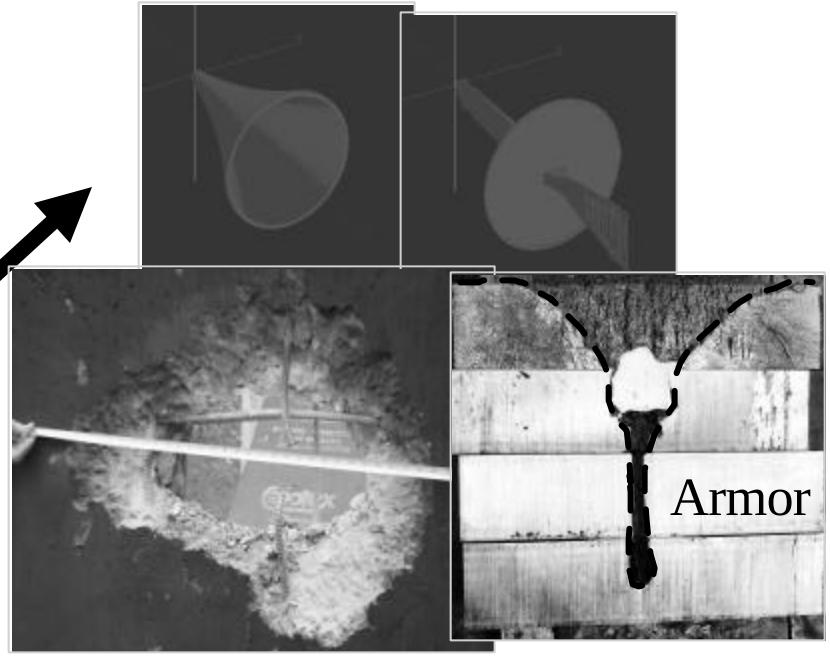
Compact Multi-purpose SC Warhead Concept

Compact Warheads

Shorter, lighter!

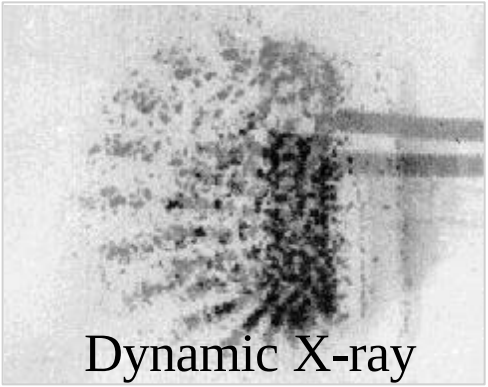
Multi-Purpose capability

Wide Area Penetration



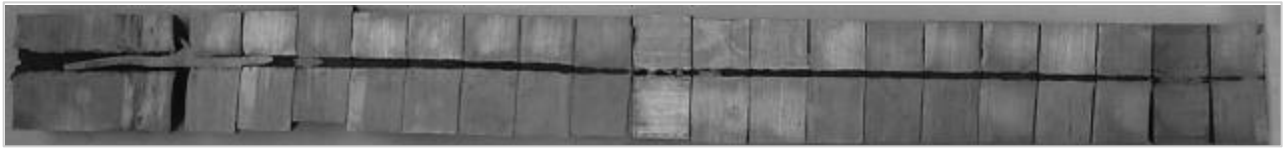
Defeat Walls & BMP!

Fragmentation/Blast



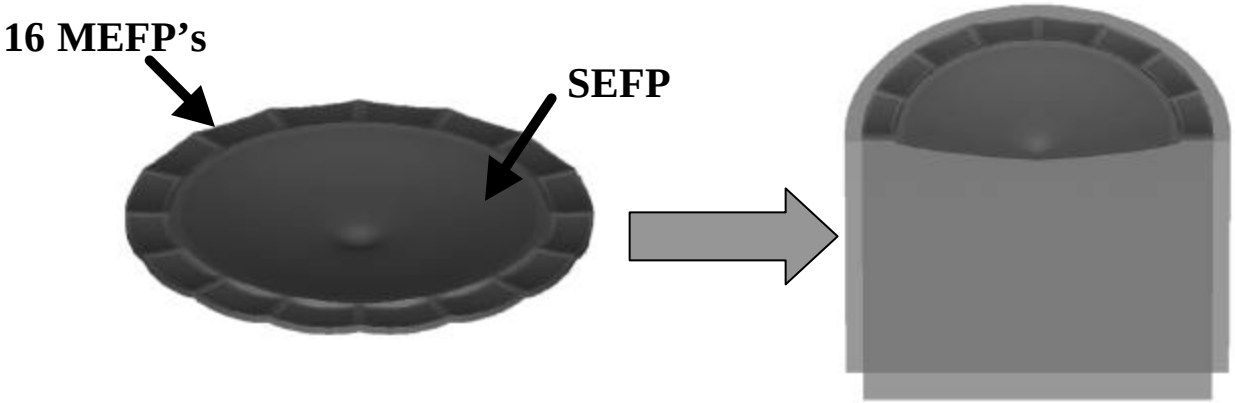
Defeat Bunkers!
Defeat Helicopters!
Anti-personnel lethality!

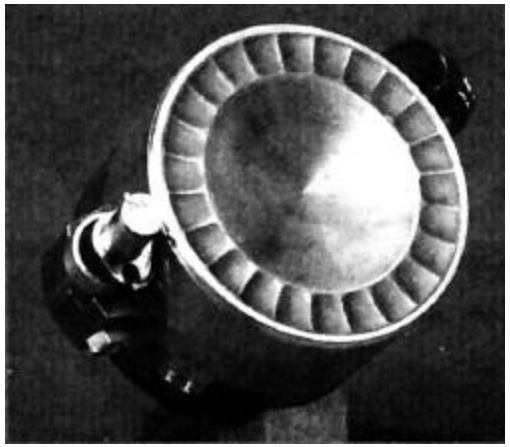
Deep Penetration

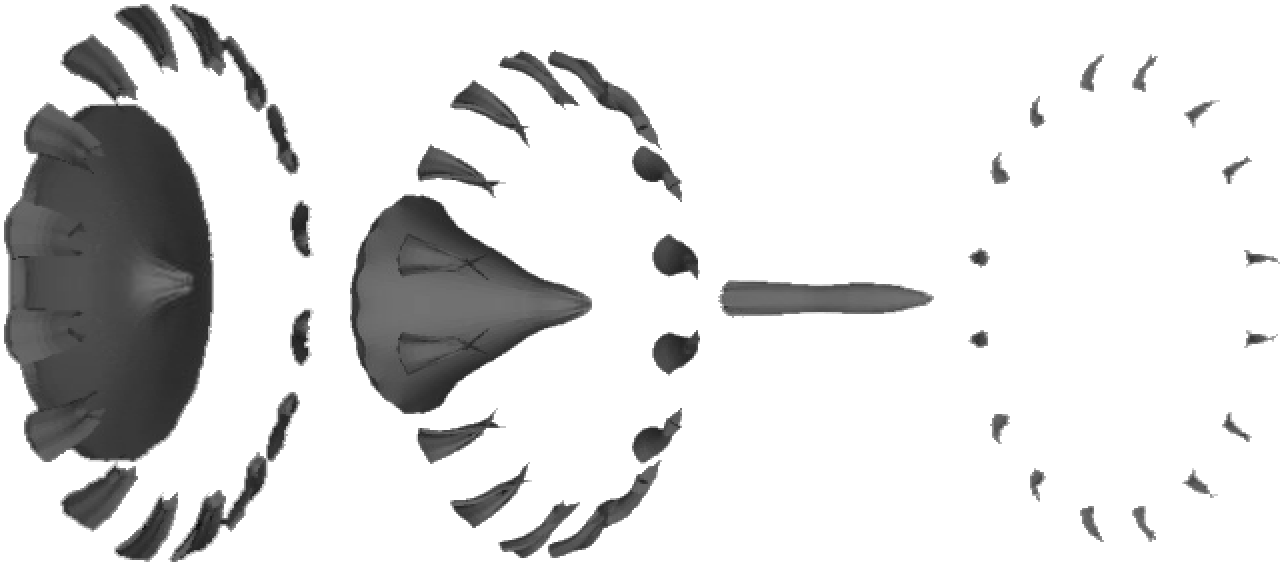


Defeat Tanks!

Mulit-Purpose Combined Effects EFP Warhead





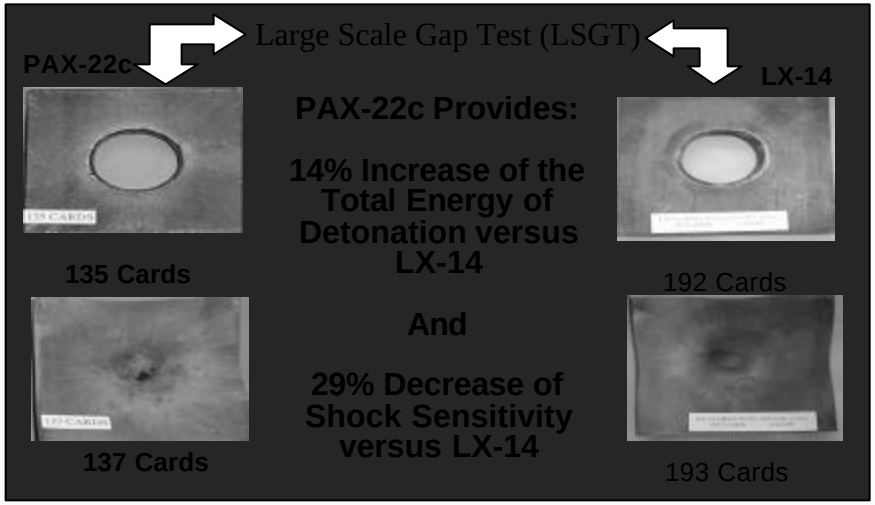


Enabling Technologies for FCS Multipurpose Warheads

Advanced Explosives Technology

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

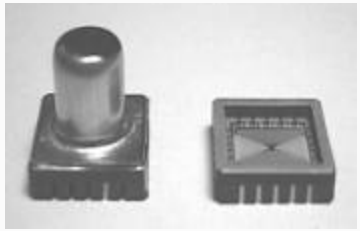
Less Sensitive **= Minimize the probability of inadvertent initiation when subjected to unplanned stimuli -** ***More Safety for the Soldier***



Electronic Safe & Arming (ESA) Technology

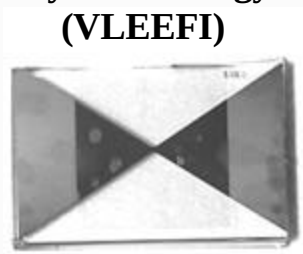
Exploding Foil Initiator (EFI) Effort

Low Energy EFI (LEEFI)



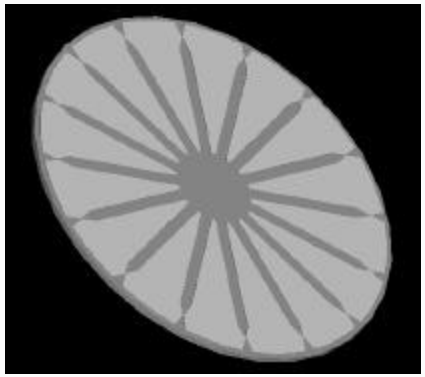
Ceramic Thick Film Technology

Very Low Energy EFI (VLEEFI)



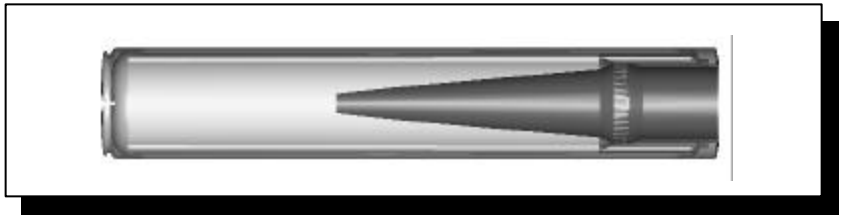
Silicon/Quartz IC Technology

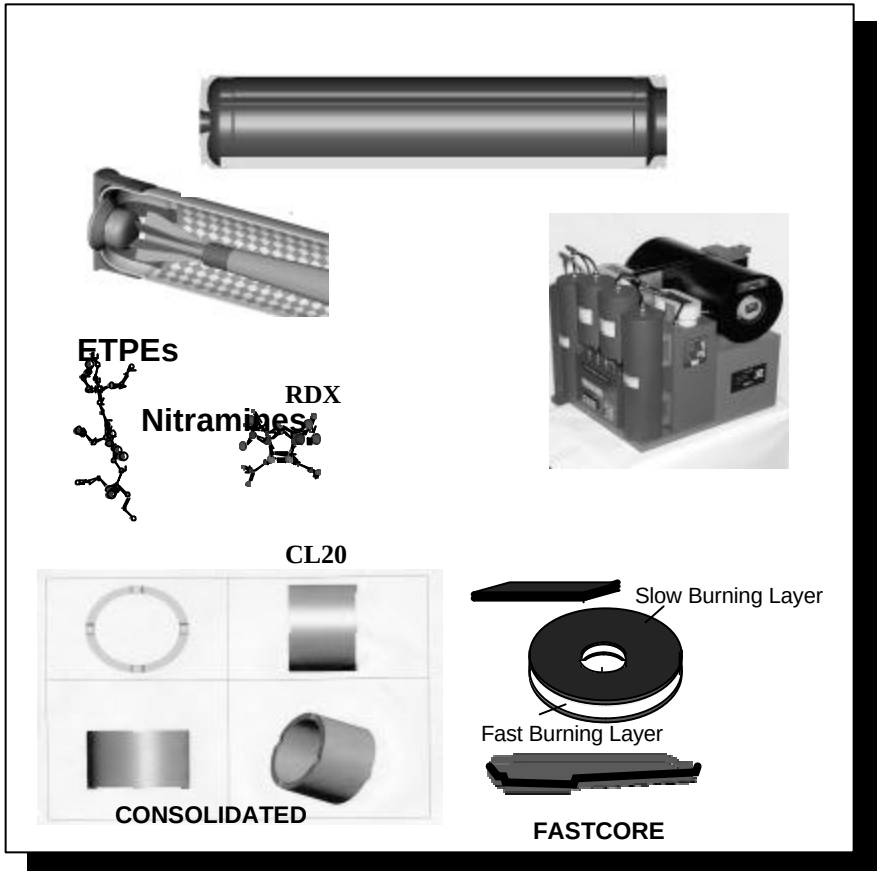
Shaped Charge Array



16 Points

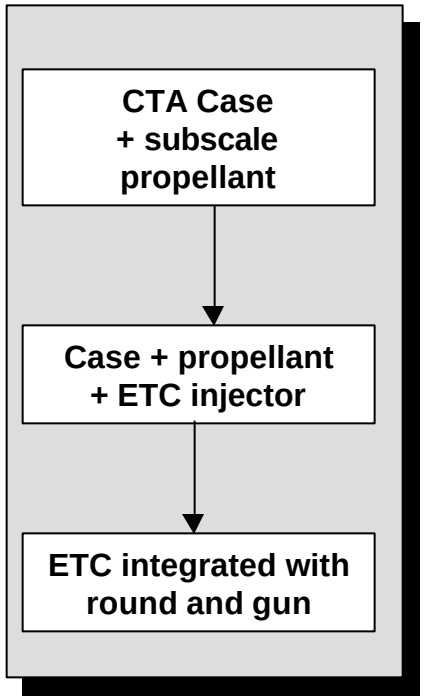
Electro-Thermal-Chemical (ETC) Propulsion



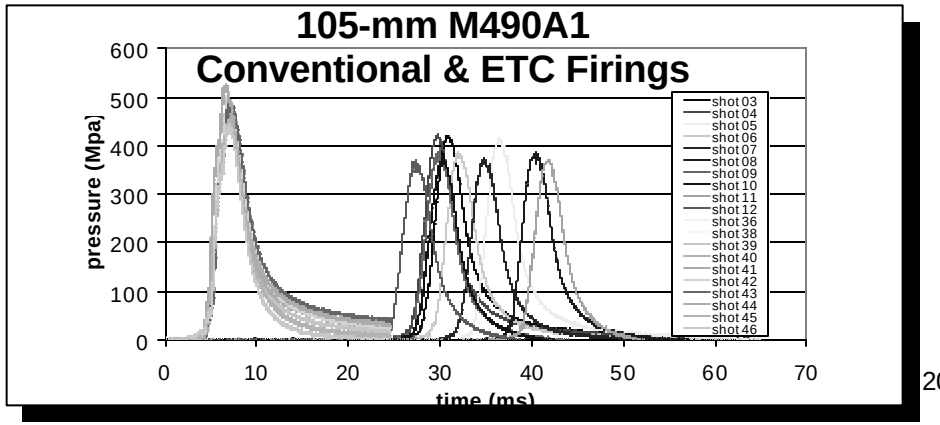


- Challenge
  - Precision ignition (efficient FOOB)
  - High energy propellant insensitive to temperature (KE & extended range)
  - Low sensitivity (survivability)
  - Low flame temps (long gun life)
- Barrier
  - Conventional propellants
    - Hi energy => hi flame temps
    - Hi energy => hi sensitivity
- Major Efforts:
  - ***Cartridge Case and Seals***
  - ***Advanced Propellants***
  - ***Charge Design & ETC injector***
  - ***Power Supply***

ETC Propulsion
Accomplishments/Plans



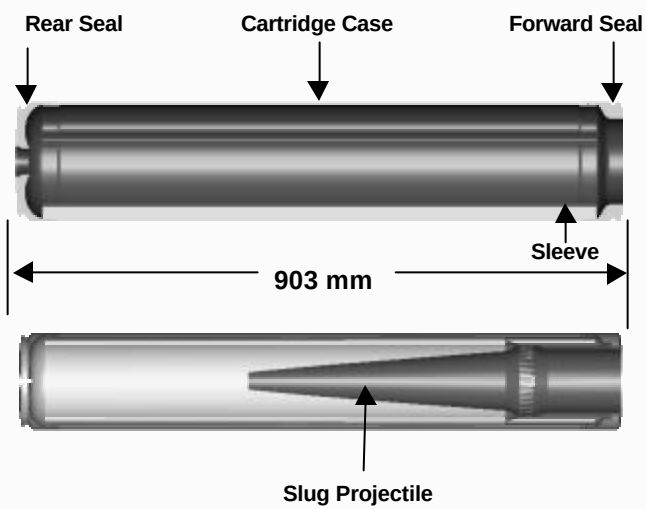
- To Date
  - 120mm ETC ignition with JA2 propellant / cartridges demonstrating precision ignition and temperature compensation.
  - 105mm ETC ignition demonstrating precision ignition and temperature compensation completed
  - Successfully demonstrated ETC/FOOB in Feb 01
  - Successfully demonstrated 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



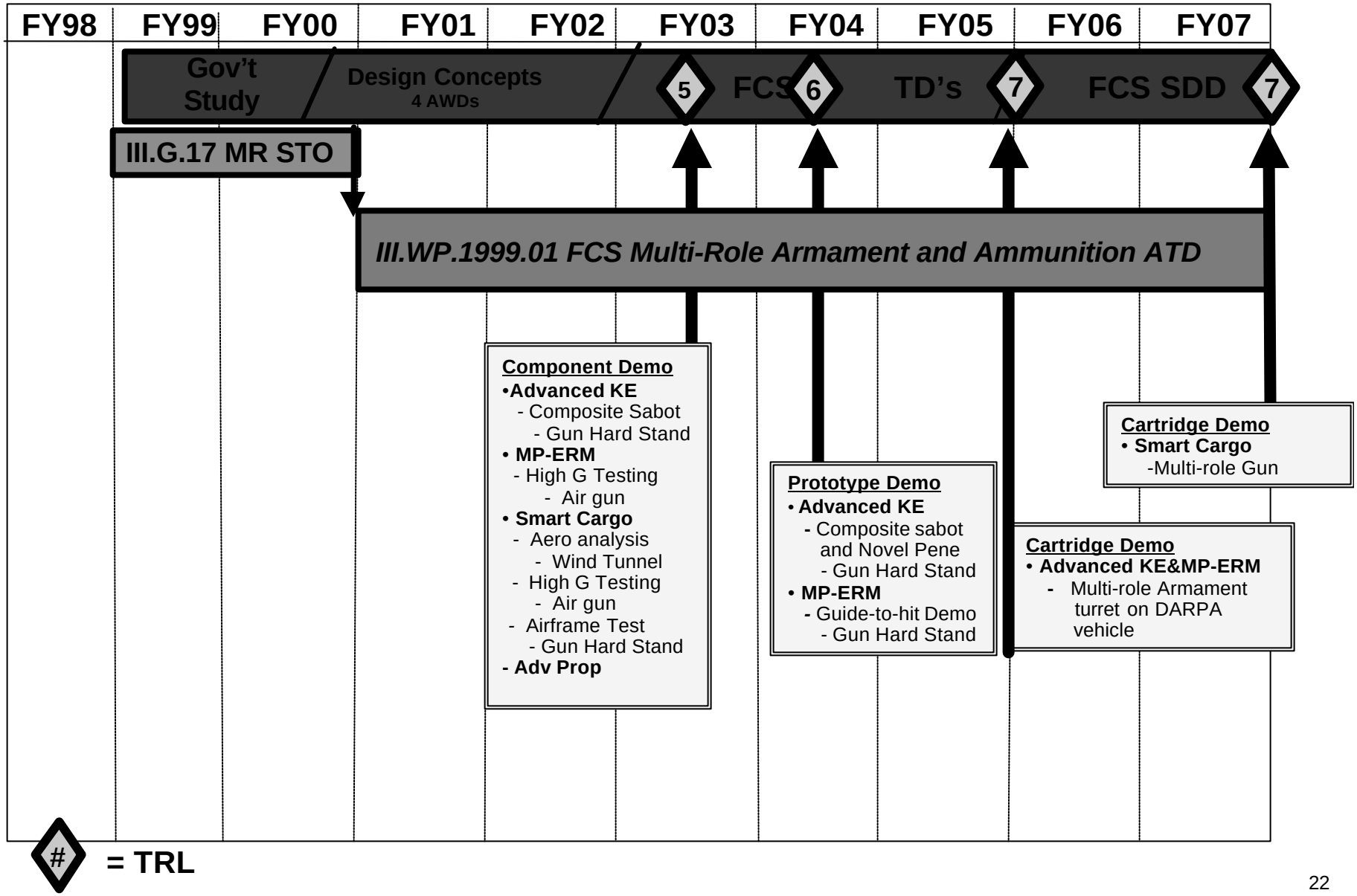
ETC Propulsion
Accomplishments (con't)

- **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**

Design → ***Fabricate*** → ***Test***



FCS MRAAS Ammunition Critical Tests



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