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

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

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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 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

Objective

FY 99 00 01 02 03 04 05 06 07 08 ...

Gov't Study
Design Concepts
4 AWDs 5 FCS 6 TD's 7 FCS SDD

III.G.17 MR STO

Advanced KE
MP-ERM
Smart Cargo
Multipurpose Warheads
ETC Propulsion

Leveraging
• IV.K.23 Exp Tec FCS
• IV.K.18Ad Whd STO
• D F Lethality ATD
• TERM STO
• Other ARDEC/ARL TB work

Objective
Force
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.

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FCS Advanced KE CTA Cartridge concepts

KE Pusher Sabot Configuration  KE Puller Sabot Configuration
✓ 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
**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

- Unitary Charge
- Conventional Munitions (DPICM)
- Smart Munitions
- Non-Lethal
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

• 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

- 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.

CAES
Talley Defense Systems
Northrop Grumman
ASR International
DE Technologies

Draper

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

SAIC
An Employee-Owned Company

LOCKHEED MARTIN

Raytheon

GENERAL DYNAMICS
Ordnance and Tactical Systems

AEROJET

GENERAL DYNAMICS
Armament Systems
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).

Trade Study RFP
Subsystem RFP

Select 2
Select 4

Four Contracts Awarded 3/31/01

Potentially Exercise sole source option for P3I S&T

Potentially Exercise sole source option for EMD
**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!

Fragmentation/Blast

- Dynamic X-ray
- Defeat Bunkers!
- Defeat Helicopters!
- Anti-personnel lethality!

Multi-Purpose capability

- ARM

Deep Penetration

- Defeat Walls & BMP!
- Defeat Tanks!
Multi-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*
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 (21°C) and cold (-32°C).
  • 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
FCS MRAAS Ammunition Critical Tests

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Gov’t Study

Design Concepts
- 4 AWDs

III.G.17 MR STO

III.WP.1999.01 FCS Multi-Role Armament and Ammunition ATD

Component Demo
- Advanced KE
  - Composite Sabot
  - Gun Hard Stand
- MP-ERM
  - High G Testing
  - Air gun
- Smart Cargo
  - Aero analysis
  - Wind Tunnel
  - High G Testing
  - Air gun
  - Airframe Test
  - Gun Hard Stand
  - Adv Prop

Prototype Demo
- Advanced KE
  - Composite sabot
  - Novel Pene
  - Gun Hard Stand
- MP-ERM
  - Guide-to-hit Demo
  - Gun Hard Stand

Cartridge Demo
- Smart Cargo
  - Multi-role Gun

Cartridge Demo
- Advanced KE & MP-ERM
  - Multi-role Armament turret on DARPA vehicle

# = TRL
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