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Malcolm Baldrige
National
Quality
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2007 Award
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TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

*ARDEC
Cluster Munition Replacement Technologies (CMRT)
S&T Concepts*

Current Landscape



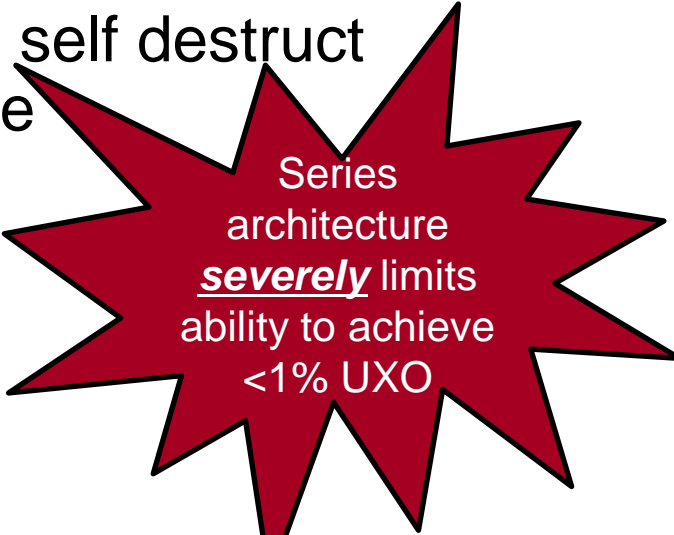
- Cluster Munitions have come under ever increasing scrutiny for unexploded ordnance (UXO)
- US submunition payloads are classified as Cluster Munitions & required to meet a <math><1\%</math> UXO rate by 2018
- “Legacy” cannon fire Cluster Munitions in inventory not compliant
- Retrofit Self-Destruct Fuzing Technology has not been able to reach <math><1\%</math> UXO in current systems
- Monitor Domestic & Foreign Policy
- Significant opportunity to provide solutions through maturation of viable technologies



System Reliability



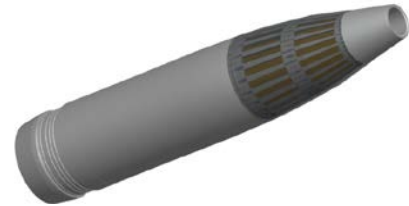
- Primary mode fuze reliability is a function of
 - Arming
 - Expected target stimulus to the fuze
 - Initiation of explosives
 - Propagation of explosives
- Self-destruct/self-neutralizing independence requires
 - Reliability based on actions **independent** of primary mode actions
 - Doesn't depend on target sensing
- Past M42/46 DPICM SDF efforts have self destruct capabilities in series with primary mode



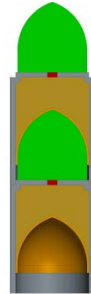
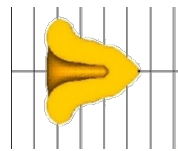
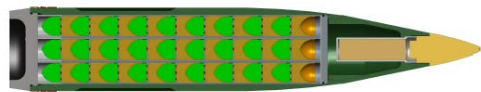
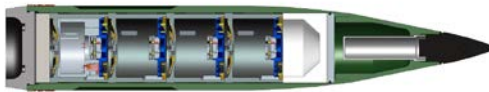
Series
architecture
severely limits
ability to achieve
<1% UXO

Policy & Requirement Evolution

- 1993: M915 Required Operational Capability (ROC)
 - No more than 1 in 500 hazardous duds
- DoD Policy
 - 2001: Memo released lays out desire to achieve less than 1% UXO
 - 2008: Memo release provides guidance on future cluster munitions
 - 1% or less UXO
 - Cluster Munitions that do not meet UXO requirement cannot be used after 2018
 - No waivers
- 2010: Convention on Cluster Munitions (CCM), aka “Oslo Treaty”
 - Developed by countries in conjunction with non-government organizations (NGOs)
 - To date 112 countries have signed
 - Items exempt if certain criteria met
 - The US as well as other major producers of CM have ***not*** signed Oslo
- 2011: UN Convention on Certain Conventional Weapons (CCW)
 - Attempt to bridge gap between CCM-signatories and non-signatories
 - Consensus was not reached
 - No future discussions planned for CCW on CM



(U)



(U) Schedule

(U) Milestone	FY16	FY17	FY18	FY19
Conduct Systems Trades	█			
Downselect		█		
Mature Concepts	②	③	④	█
Demonstrate Concepts @ TRL 5			④	⑤
Conduct End-to-End & Arena Test				⑥

This is the current project plan (schedule and resources) with the funding as per 2016 Appropriation

(U) Purpose:

- Develop an NLOS Cluster Munition (CM) Alternative(s) which is compliant with signed DoD CM Policy that demonstrates enhanced lethality against personnel, light vehicle and medium armor targets

(U) Products:

- TRL6 materiel solution
- 155mm cannon ballistic demonstration of integrated prototype
- Arena test demonstrating enhanced lethality blast fragmenting submunition & effective lethal area
- Potential to apply technology across calibers and systems

(U) Payoff:

- Warfighter operational benefits
 - Potential materiel solution for personnel, light vehicles and medium armor targets
 - Enables continued use of critical lethality capability

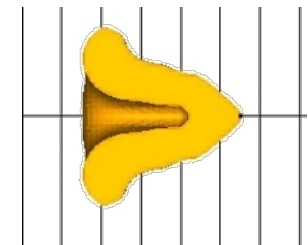
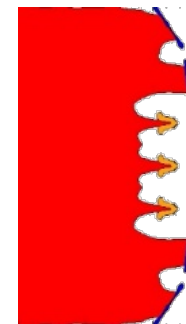
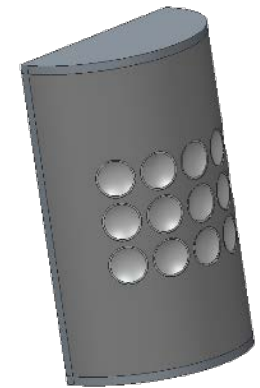
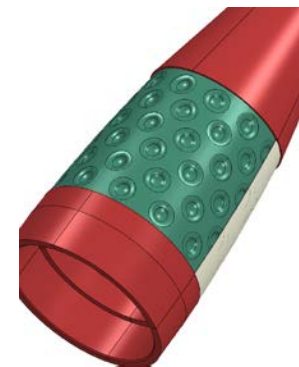
(U) Other Factors:

- Leverage TRADOC ARCIC “Area Effects Assessment and USMC “Initial Capabilities Document For (U) Cannon-Delivered Area Effects Munitions” for emerging requirements



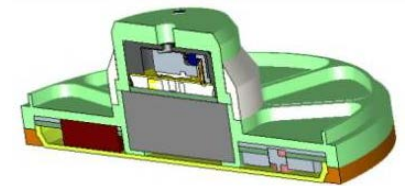
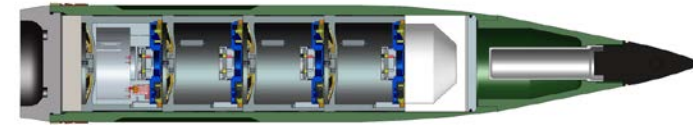
MACE (Unitary):

- Unitary munition geared towards well located, point, medium armor targets
- Fully zoneable to 22.5km
 - Capability could be incorporated into extended range efforts
- Requirement to be compatible with existing nose fuzes
 - Leverage near precision
- Lethal mechanisms
 - Multiple Explosively Formed Penetrators (MEFP)
 - Sized to address medium armor targets and deliver behind armor effects
 - Naturally fragmenting and/or pre-formed fragments (PFF)
 - Address personnel targets
- **EXEMPT** from all CM policies (OSD and Oslo)



PRAXIS (Submunition):

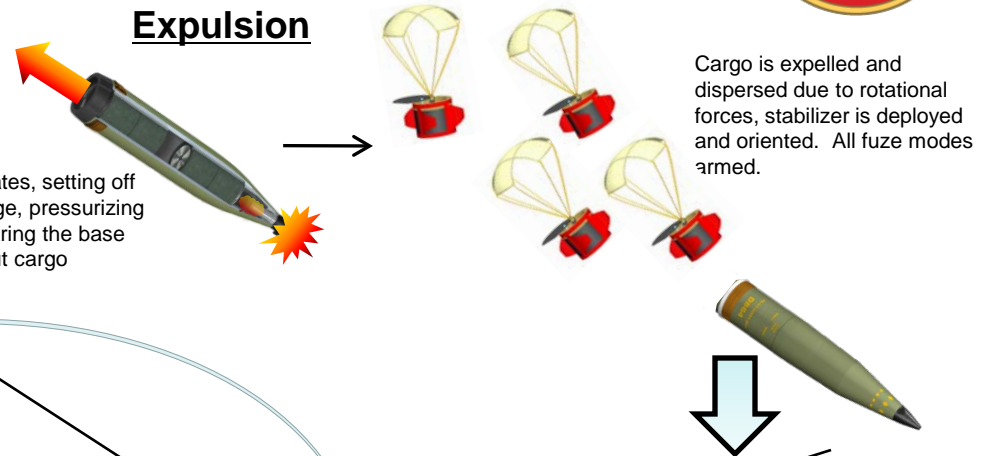
- Submunition geared to poorly located, large area targets
- Four (4) full-bore submunitions
- Fits in M483A1 projectile payload volume
 - Leverage existing projectile metal parts
 - Mitigate projectile development risk
- Fully zoneable to MACS5 (22.5km)
- High-reliability tri-mode fuze w/parallel architecture
 - Proximity, impact and time modes
- Lethal Mechanisms:
 - Detonated radially
 - Anti-personnel & light materiel targets: Fragmenting steel case and tungsten PFF
 - Ability to incorporate wide variety of lethal mechanisms into submunition form factor
- Concept meets intent of OSD CM Policy



Projectile Fuzing



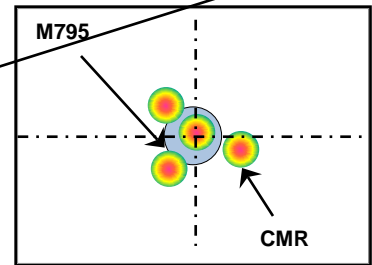
Expulsion



Firing

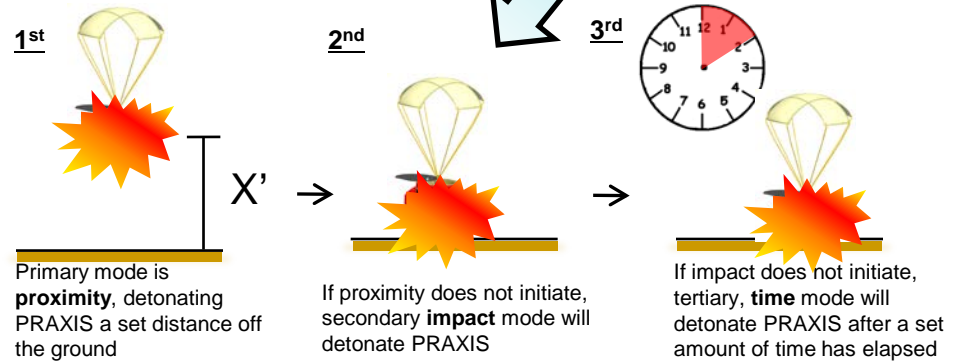
Fire projectile at intended target
Fully zoneable up to MACS5

22.5 KM Max Range



Fuze Functioning

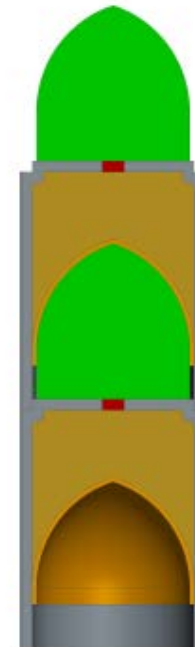
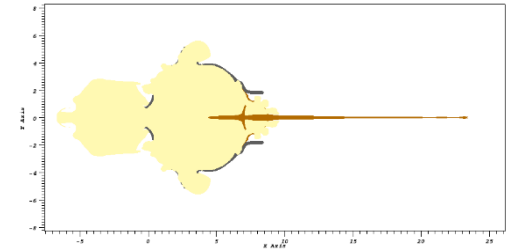
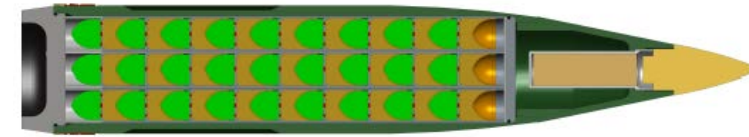
All three fuze functioning modes operate in parallel, removing common point failures.



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DPICM-XL (Submunition):

- Submunition geared towards poorly located, large area targets
- Approximately Sixty (60) submunitions
- Fits in M483A1 projectile payload volume
 - Leverage existing projectile metal parts
 - Mitigate projectile development risk
- Fully zoneable to MACS5 (22.5km)
- High-reliability fuze w/parallel architecture
 - Multiple function modes
 - Self contained
 - Increase in available volume over M223
- Incorporate lessons learned from past SDF efforts
- Lethal mechanisms:
 - Anti-personnel and light materiel: Fragmenting steel case
 - Detonated radially
 - Medium armor targets (BMP & BTR): Shaped charge jet
 - Fired downward on impact
- Concept meets intent of OSD CM Policy





- Fuze Reliability
 - M223 & SDF fuzes relied on multiple events in series to work (ribbon deploy, back out arming screw, etc.)
 - Incorporate parallel architecture into fuzing design (multiple S&As, etc.)
- Expulsion
 - Air Fratricide: the event where DPICM bomblets expel, arm, collide and detonate, creating UXO for the system
 - Fewer submunitions and debris
 - Alter the arming environment
 - Physical protection of fuze
- Impact environment
 - Relied on arming screw which requires a hard, flat impact surface
 - Omni-directional impact switch
- Fuze space claim
 - Components required to fit on bomblet makes them costly, difficult to produce
 - DPICM-XL has larger fuze space claim than DPICM

Projectile Fuzing



Expulsion

Nose fuze initiates, setting off expulsion charge, pressurizing the ogive, shearing the base and pushing out cargo

Cargo is expelled and dispersed due to rotational forces, stabilizer is deployed and oriented. All fuze modes armed.

Firing

Fire projectile at intended target
Fully zoneable up to MACS5

22.5 KM Max Range

1st

2nd

Fuze Functioning

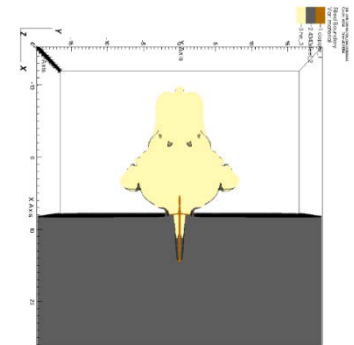
Both fuze functioning modes operate in parallel, removing common point failures.



Primary **impact** mode will detonate submunition



If impact does not initiate, secondary, **time** mode will detonate submunition after a set amount of time has elapsed



- ARDEC S&T looking at concepts to address Area Effects capability gap for 155mm Cannon Artillery at direction of OSD
 - Three parallel efforts starting in FY17
 - Large area, poorly located, personnel to medium armor targets identified as capability gap
- ARDEC has been active since FY10 looking at materiel solutions to replace artillery DPICM
- ARDEC is working towards materiel solutions that are OSD policy compliant, **NOT** necessarily Oslo compliant



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Back-up



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Oslo Accord (30 MAY 2008)

- The Oslo Process bans all munitions with multiple explosive submunition payloads each weighing less than 44 lbs (20 kg)
- Exempts CM that adhere to the following criteria:
 - Each submunition must weigh more than 8.8 lbs. (4kg)
 - CM must contain less than 10 submunitions
 - Each submunition must detect and engage a single target
 - Must have an electronic self destruct and self deactivate capability.
- CM stocks must be destroyed within 8 years (can request up to 4 year extension)
- Prohibits use of existing stockpile of artillery US DPICM (referenced above)
- Permits German SMArt 155mm Round

DOD Policy (19 JUN 2008)

- CM defined as “munitions composed of a non-reusable canister or delivery body containing multiple, conventional explosive submunitions.”
- After 2018, only employ CM containing submunitions that, after arming, do not result in >1% UXO across range of “intended operational environments”
 - No waivers
 - SD/SDA can reduce hazards, but are factored in the 1% UXO
- Until 2018, use of CM requires approval by Combatant Commander



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