



RDECOM



High Reliability Fuzing Architecture for Cluster Munitions



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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- Current Landscape
- Political Policy
- Artillery Submunitions
- Cluster Munition Study
- High Reliability Fuzing
- Approach
- Probabilistic Technology
- Summary

- DPICM Munitions have come under increasing scrutiny for UXO left on the battlefield
- US cannon and rocket weapons carrying submunition payloads are classified as Cluster Munitions & required to meet a <1% UXO rate by 2018
- “Legacy” cannon fire Cluster Munitions in the inventory are all not compliant with existing policy
- Retrofit Self-Destruct Fuzing Technology has not been able to reach the goal of <1% UXO in current systems
- Impacts:
 - warfighter has lost the military utility of DPICM warheads
 - Less effective substitute munitions have been used in theatre



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 expulsion, 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

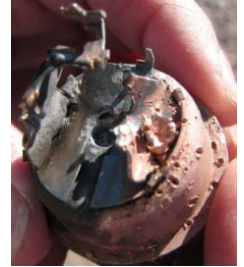
Oslo Process (30 MAY 2008)

- 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)

The United States did not sign up to the Oslo Process

Background:

- Submunitions are fired from 105 mm and 155 mm artillery
- The Dual purpose Improved Conventional Munition (DPICM) submunitions used in these artillery applications have reliability issues
 - Several programs have tried to add backup self-destruct or self-neutralize features
 - Self-neutralize will not meet the requirements of the DoD policy
- DPICM target sets include armor and light targets/personnel
- The solution must provide compliance with existing DoD 1% Unexploded Ordnance (UXO) policy in all operational environments – given proper cargo expulsion.



DPICM Submunitions:

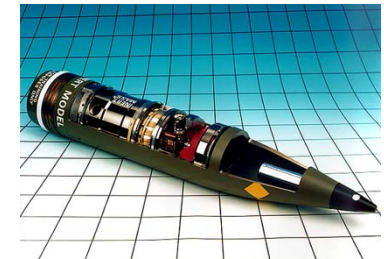
- M42/M46 DPICM use M223 fuze
 - Arming ribbon is critical element in reliability
 - Ribbon provides drag to unscrew arming mechanism and to orient submunition in flight
 - Single impact mechanism for detonation



US Full bore Submunition Efforts:

– Sense and Destroy Armor (SADARM) XM898

- Medium to hard targets
- No longer in production



SADARM

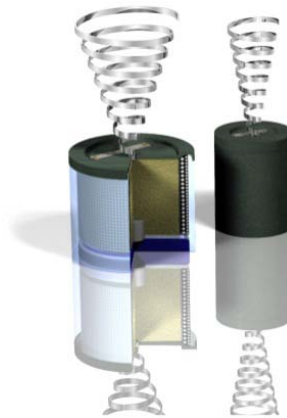
– Common Smart Submunition

- ARDEC S&T Program to demonstrate a low-cost anti-armor submunition
- Currently in development

– Proximity Initiated Submunition (PRAXIS) concept

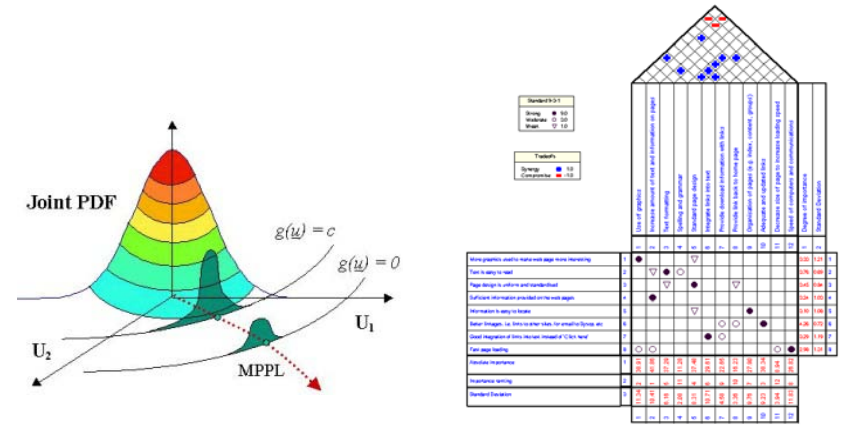
- Tri-mode fuze that includes a proximity fuze, a time fuze and a point Detonating (PD) fuze in each submunition

- Army conducted a study on the target sets & the potential solutions
- One of the conclusions was to pursue a PRAXIS-type of solution
- PRAXIS concept was the most effective and efficient against the desired target sets



PRAXIS

- Many fuze components affecting reliability
 - Target sensing
 - Arming signature sensing
 - Power supply
 - Safe and arm
 - Explosive train
 - Backup modes to function



- Reliability of systems vary dependant on firing / target conditions, manufacturing lots, etc.
- Expulsion / dispense environment is harsh
- Having redundancy within the fuzing architecture to increase functional reliability may require additional safeties in the system.
- Eliminate single point and common mode failures

Purpose:

- Demonstrate an ultra reliable, lethal Cluster Munition (CM) Alternative which is compliant with signed DoD CM Policy and achieve <1 % UXO.

Products:

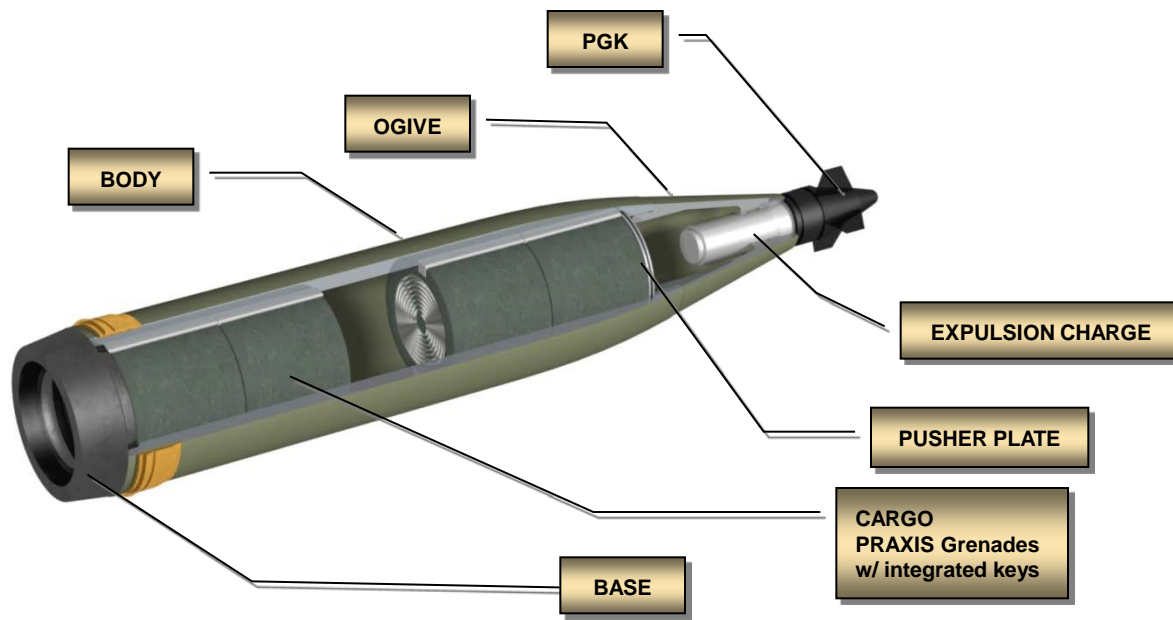
- 155mm cannon ballistic demonstration of integrated “full bore” submunition prototype
- Arena test and analysis demonstrating enhanced lethality blast fragmenting submunition & effective lethal area
- Application scalability analysis across multiple calibers and delivery systems

Payoff:

- Warfighter operational benefits
 - Enables continued use of critical lethality capability
- Benefits (ATO-D)
 - DoD CM Policy compliance (<1% UXO)
 - Lower costs via reuse of demilled 155mm metal parts

PRAXIS features

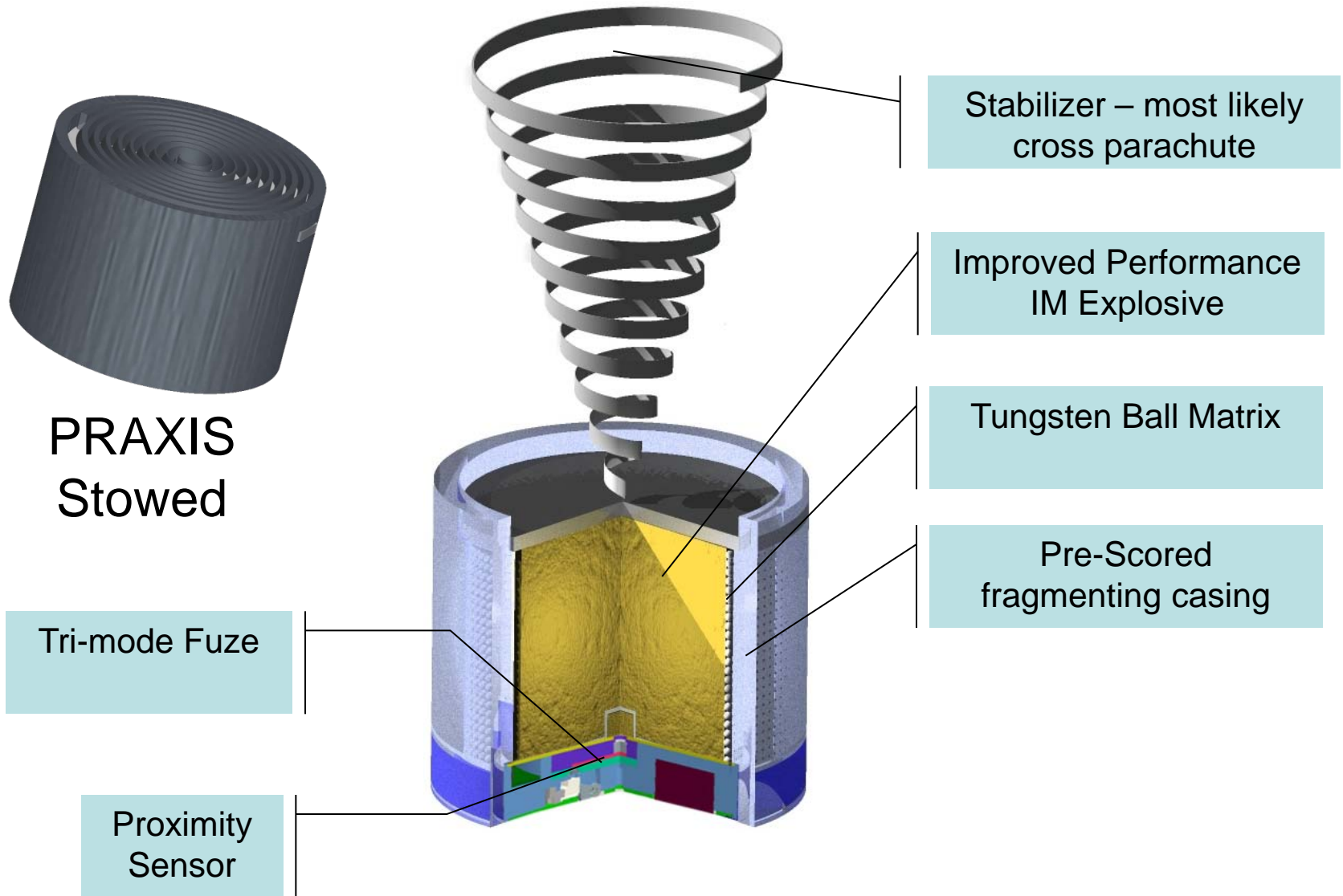
- Full bore submunition
- Extreme Reliability Tri-Mode Fuze
 - Proximity
 - Impact
 - Time
- ATO Goal- < 0.25% UXO
- Can be fired at MACS5
- Reuse existing M483A1 metal parts
- Adaptable
 - 155mm Artillery
 - 105mm Artillery
 - GMLRS Rocket Systems



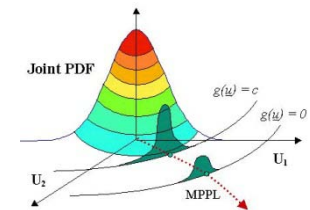
- The PRAXIS submunition is designed for:
 - Low Cost
 - Few moving parts
 - Conventional materials
 - Leverage proximity submunition fuze work done for Navy ERGM
 - High Reliability
 - Tri-Mode Fuze to provide extreme reliability
 - Proximity
 - Impact
 - Time
 - Enhanced Lethal Effects
 - Improved performance energetics
 - Bi-Modal Effects Warhead
 - Optimized Anti-Materiel Fragments from Submunition Casing
 - Optimally sized Tungsten Ball Matrix for Anti-Personnel Effects
 - Detonation at optimum height for Cannon Cluster Munition target sets



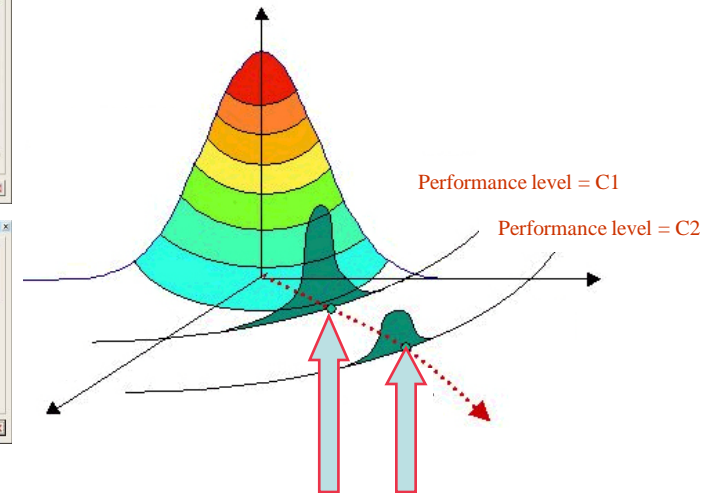
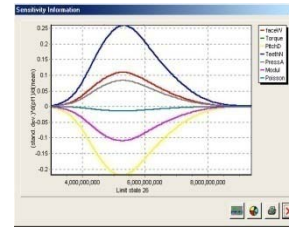
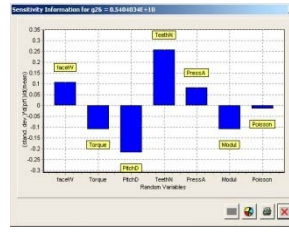
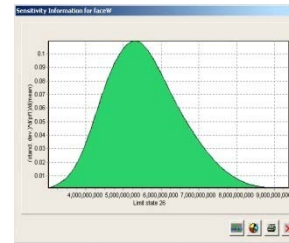
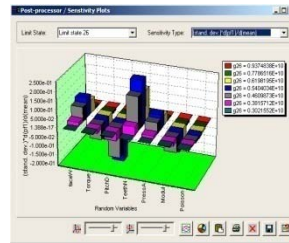
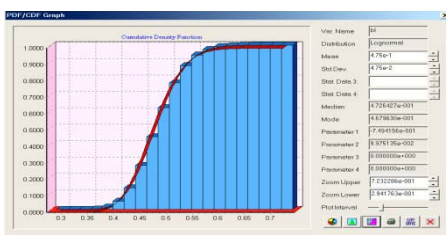
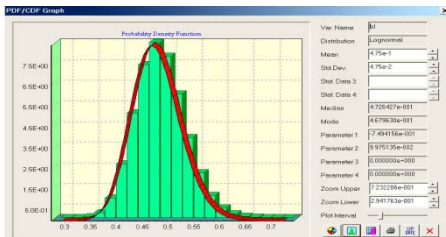
Approach (contd)



- Fuzing architecture with parallel features in terms of arming, target sensing, and power functions IS NECESSARY.
- Highly reliable arming scheme achieved with the following characteristics:
 - Redundant, independent methodologies
 - Elimination of common mode failures
- Require the expulsion system concept as part of the fuzing architecture
- Perform component trade study
- Perform component reliability analysis
- Perform modeling & simulation
- Identify high reliability fuze architectures
- Organize initial Quality Function Deployment (QFD) matrix



- Probabilistic Technology provides 3 metrics to quantitatively evaluate process performance early in the decision process when no data is available



1. Probability Information

- Reliability, risks, failure prob.
- Critical failure modes ID
- Performance range
- Most-likely performance value
- Safety-factor calibration
- Many more

2. Process Sensitivity Measures

- Key process variables & uncertainties
- Guidelines to develop test plans
- Guidelines for inspection & repair planning
- Guidelines to develop improvement plans
- Guidelines to develop control plans
- Guidelines to develop monitoring plans
- Many more

3. Most-Probable-Points (MPP)

- Safety control systems
- Certification tests
- Reliability demonstration tests
- Critical combination of parameters
- Most likely failure points
- Many more

- Investing in technology research to provide improved capability once afforded by Cannon Cluster Munition
- Domestic & foreign policy could impact future design requirements
- ARDEC is proactive in ICM technologies:
 - ✓ Providing core expertise to develop replacement technologies for CM
 - ✓ Process member in the effort
 - ✓ Addressing customer needs with stakeholders
- Developer must provide new munitions that:
 - ✓ Address the technical gap
 - ✓ Compliant with existing/emerging policy
 - ✓ Producing, Reliable & Cost competitive

