



ARDEC Fuze S&T Overview

60th NDIA Fuze Conference

Presented by:
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Chief, Munitions Fuzing Branch, Fuze Division
10 May 2017

**UNPARALLELED
COMMITMENT
& SOLUTIONS**

Act like someone's life depends on what we do.



**U.S. ARMY ARMAMENT
RESEARCH, DEVELOPMENT
& ENGINEERING CENTER**

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AGENDA



- Army Senior Leadership
- ARDEC Organization
- ARDEC Science and Technology Process
- Fuze Division Overview
 - Competencies
 - Products
 - Facilities
- Fuze S&T Efforts
- Fuze S&T Needs
- List of ARDEC's 2017 Fuze Conference Briefings



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ARMY SENIOR LEADERSHIP



Assigned/Direct Support
Coordination

Headquarters, Department of the Army



Army Materiel Command, AMC
Gen. Gustave F. Perna

Assistant Secretary of the Army
Acquisition, Logistics and Technology
Ms. Steffanie Easter



Joint Munitions & Lethality LCMC
BG Richard B. Dix



PEO Ammunition
Mr. James Shields



Ammunition Enterprise

Research, Development and Engineering Command, RDECOM
MG Cedric T. Wins



Armament Research, Development and Engineering Center, ARDEC
Mr. John Hedderich



TACOM LCMC
MG Clark W. Lemasters Jr.



Program Executive Office Combat Support and Combat Service Support
Program Executive Office Ground Combat Systems
Program Executive Office Soldier



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ARDEC Organization

Chain of Command



Army Materiel Command
AMC Commanding General
★ ★ ★ ★

Research, Development & Engineering Command
RDECOM Commanding General
★ ★


AMRDEC
Aviation & Missile
Research, Development
& Engineering Center


CERDEC
Communications- Electronics
Research, Development &
Engineering Center


ARL
Army Research Laboratory



ARDEC
Armament Research
Development &
Engineering Center


NSRDEC
Natick Soldier Research, Development &
Engineering Center



ECBC
Edgewood Chemical
Biological Center


TARDEC
Tank Automotive Research,
Development & Engineering
Center



TEAM PICATINNY



Other Tenants




PEO Soldier
PM Soldier
Weapons



PEO Ground Combat Systems
PM Ground Combat Vehicle



Defense Contracting Agency
Springfield



Civilian Human Resources Agency



ARDEC



CG/PEO Ammunition



Joint Munition & Lethality



Garrison Commander



Office of the Executive Director for Conventional Ammunition



Naval Surface Warfare Center



Marine Corps G Company 2-25



Army Contracting Center - NJ



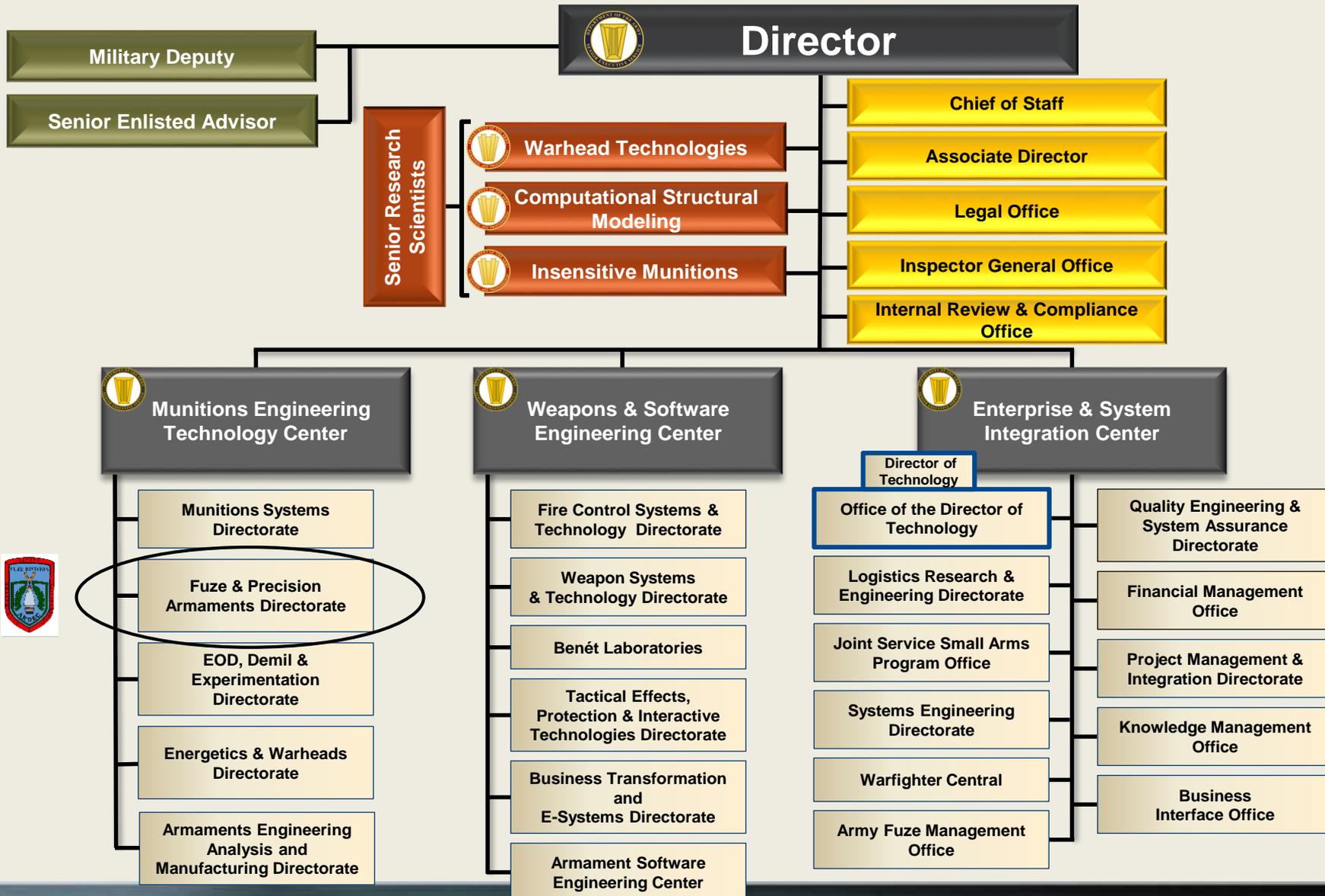
Army Recruiting Northern NJ HQ (Company)



7245th Installation Medical Support Unit

- Gov't Population >5000
- Total Population >6000
- 6,500 Acres
- 1000 Structures
- 64 Laboratories

The Joint Center of Excellence for Armaments and Munitions





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ARDEC's ROLE



RESEARCH



DEVELOPMENT



PRODUCTION



FIELD SUPPORT



DEMILITARIZATION

Advanced Weapons:

Line of sight/beyond line of sight fire; non line of sight fire; scalable effects; non-lethal; directed energy; autonomous weapons

Ammunition:

Small, medium, large caliber; propellants; explosives; pyrotechnics; warheads; insensitive munitions; logistics; packaging; fuzes; environmental technologies and explosive ordnance disposal

Fire Control:

Battlefield digitization; embedded system software; aero ballistics and telemetry

“Center of Mass” for Armament Systems and Munitions for Joint Services



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Unclassified

ARDEC S&T Needs & Investment Equation



Needs/Source Documents

DoD/DA



- Army Big 6 +1 Initiatives
- Army Enduring Challenges
- OSD Elegant 11
- COCOM IPLs
- G2 Threat Data
- JUONS, JEONS, etc.

PEOs



- PEO AMMO Priorities
- PEO Soldier Priorities
- PEO GCS Priorities
- PEO CS&CSS Priorities
- PEO Aviation Priorities

TRADOC

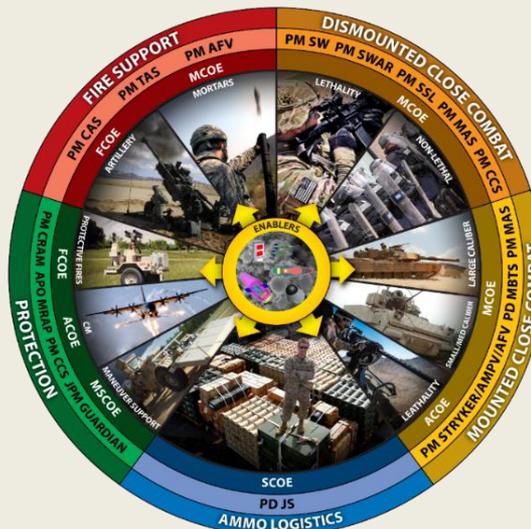


- Army Operating Concept
- Army Warfighting Challenges
- Army Functional Concepts
- JCIDs Draft CDDs
- JCIDs ICDs

- Capability Needs Analysis (CNAs)
- Guidance Memos - Endorsements, etc.

- ✓ Identification, coordination, organization of individual "Source Documents" needs/gaps/priorities into one list
- ✓ Collected from multiple lethality stakeholders

ARDEC S&T Portfolio



- ✓ Sets priorities for future investments (POM)
- ✓ Enables adjustments to on-going efforts
- ✓ Details/communicates opportunities to Service labs, industry, academia, international

Lethality S&T Opportunities



- ✓ Utilized by ARDEC Scientists and Engineers to marry innovation to needs
- ✓ Available to industry partners ...to facilitate cooperative long term planning to include IR&D investment ...realized in the DOTC Annual Technology Plan

Aligned with Initiatives of Better Buying Power



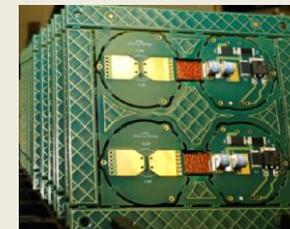
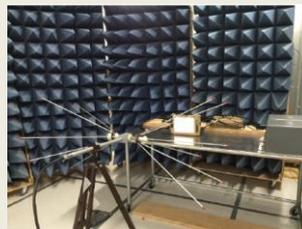
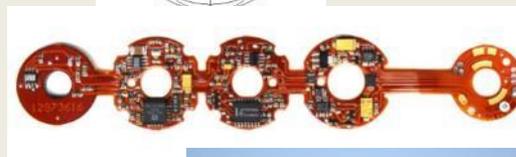
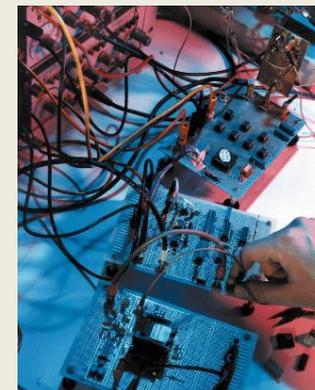
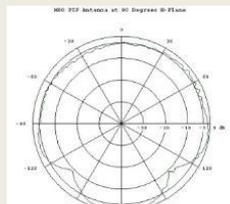
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Fuze Division Overview



- **Fuze Division has significant experience with the design, development, qualification, and production of S&A devices, target detection devices, fuze setters & power sources.**
- **Over 100 employees with expertise in:**

- Low Cost Electronic Fuzing
- Advanced Signal Processing Algorithms
- MMIC Radar Transceivers
- RF Components Design & Testing
- Analog and Digital Circuit Design
- Fuze Testers (RF and IF Simulators)
- ECM Evaluation
- Ultra miniature fuzes
- Antenna design
- MEMS Devices
- Design for High G Launch Loads
- CAD/CAM Design and Layout
- Rapid Prototype Fabrication
- Power sources
- Fuze setters





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Fuze Division Products



Artillery Fuzes



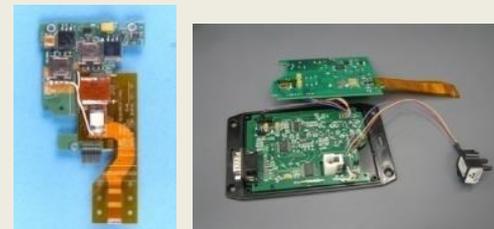
Mortar Fuzes



Medium Caliber Fuzes



Fuze Setters



Safe and Arm Devices



Hand Grenades



Rockets & Missiles



Power Sources



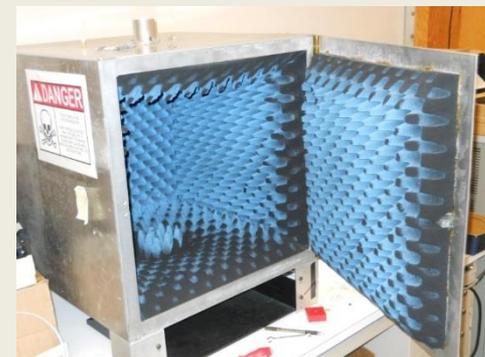
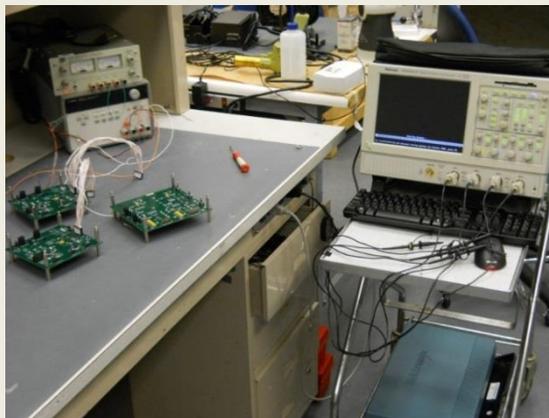
Tank Ammo



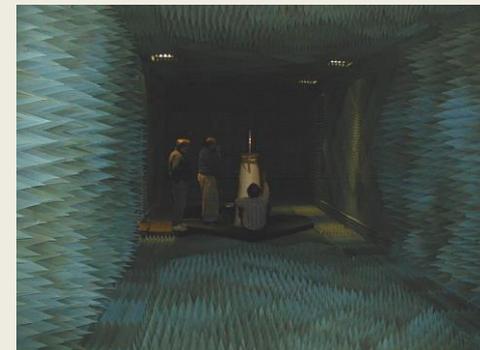
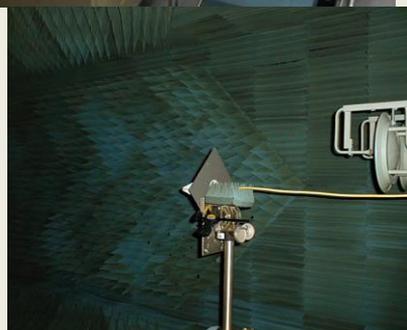


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FUZE DIVISION'S FACILITIES



Fuze Laboratories





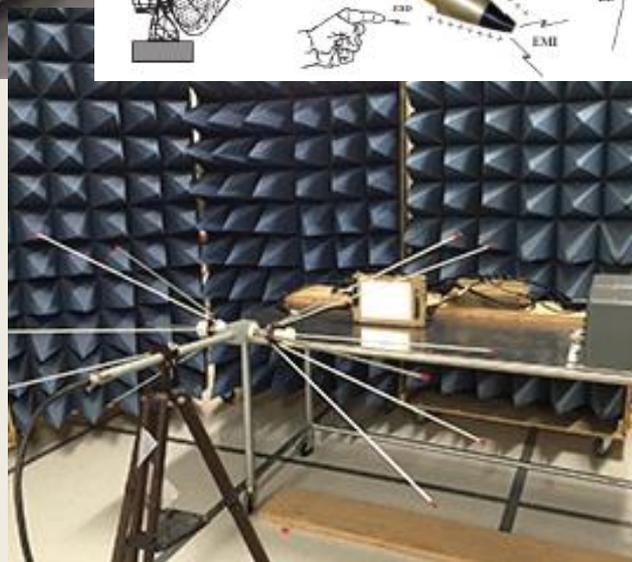
Fuze Development Center



Electromagnetic Environmental Effects Lab



MISSION: Evaluation of Army Weapons for DoD Mandated Safety & Reliability Requirements





Electromagnetic Sensor Test Facility

- EM and Optical Sensor evaluation
- Radar Cross Section analysis
- Vertical and Horizontal Air Cannons
- Drop Apparatus
- Calibrated spheres and targets available





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For Partnering and awareness of all ARDEC Facilities:

Technology Transfer Office

Phone: (973)724-6043/7953

Website: <https://www.pica.army.mi./TechTran/>

Email: usarmy.pica.rdecom-ardec.mbx.domestic-tech-transfer@mail.mil



Fuzing Challenges



Emerging Threats

- A once predictable operating environment has become increasingly complex, unstable, & dynamic
- Adversaries gain access to advanced military capabilities through exploitation of commercially available technologies
- Spread of advanced cyberspace and counter-space capabilities



Financial / Investments



- The past decade of warfare has impacted Army S&T, shifting the S&T portfolio into a near-term focus
- Future needs can drive cost-prohibitive solutions
- Budget uncertainties
- Most projects leverage other funding to deliver required capabilities

Next Gen Fuzing Solutions

- DOD Fuze IPT
- NAC/DOTC
- JFTP

Building on BBP 3.0 tenets:

Incentivizing Innovation in Industry and Government; Promote effective competition.

Supporting the Industrial Base

- Government unique requirements drives the need for unique or custom components
- IR&D in fuzing focus areas
- Need for Government – Industry partnerships for best use of core competencies
- Engaging academia & new industry partners
- Exploitation of commercially available technologies



Requirements Definition

- Emerging technologies can help inform Stakeholder requirements
- Emerging requirements can create a need that is not fully defined or fully understood
- Competing requirements with limited resources
- Requirements creep throughout program lifecycle
- Joint or common requirements / problem sets across services





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ONGOING FUZE PROJECTS



Emerging & Maturing Technologies

6.2 OSD Joint Fuze Technology Program

- ❖ Hard Target Detection algorithms using Multi G-Switches
- ❖ Micro Scale Materials and Energetic Effects Characterization
- ❖ MEMS Snap action stab detonator
- ❖ Medium Caliber Muzzle Velocity Correction
- ❖ Innovative fuze power solutions

6.3 OSD Joint Fuze Technology Program

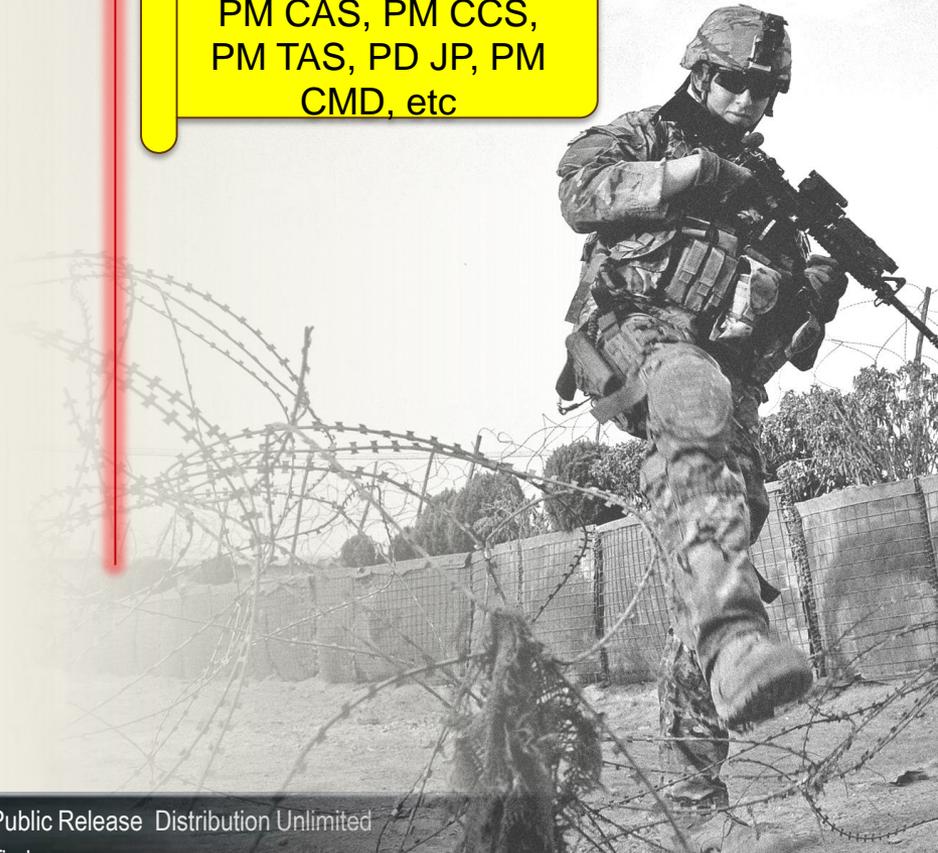
- ❖ PGK IMX-101 Compatibility
- ❖ Determination methods for High G potting solutions
- ❖ Cluster Munition – DPICM XL
- ❖ Ultra rugged MEMS arm latch
- ❖ High Reliability Micro-scale firetrain
- ❖ Prox Sensor for High Reliability DPICM Replacement
- ❖ Power Sources for Cluster Munition replacement
- ❖ Target Scene Generator
- ❖ Noise waveforms for next gen Fuze radar

Key RDECOM/ARDEC S&T Projects & Demonstrations

- ❖ Fuze and Power Technologies for Munitions
 - ❖ Airburst Precision for Medium Caliber Fuzing
 - ❖ Next Generation Large Cal Setters
 - ❖ Next Generation Sensors and Safety
 - ❖ Advanced Munitions Power
- ❖ Fuzing for Cluster Munition Replacement

On-going 6.7 RDTE Fuze
Technology Integration

EMD/Production
support for PM MAS,
PM CAS, PM CCS,
PM TAS, PD JP, PM
CMD, etc

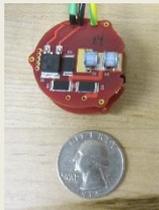




Fuze Enhanced Airburst Response



Advanced Munitions Power



Next Generation Sensors and Safety



Next Generation Large Caliber Setting



Purpose:

- Develop and advance Fuze and Power Technologies to achieve leap ahead capabilities such as high accuracy air burst, advanced setting methodologies, innovative sensing (launch and target detection), as well as next generation safety and power systems .
- Demonstrate applications of these technologies in multiple munitions across commodities in order to handoff mature concepts to Program of Record EMD efforts.

Results/Products:

- Research advanced launch and high accuracy target sensing/classification components & methodologies, advanced fuze communication schemes, integration of power sources and energy harvesters. Develop advanced safe and arm devices to support advanced warhead and munition requirements.
- Demonstrate advanced technologies for high accuracy air bursting, target classification and high rate fuze setting in a relevant environment.
- Surrogate sub-system integration of technologies and components, for a TRL 6 demonstration.
- Develop and validate Fuze-centric analysis techniques across multiple technology efforts. Validated modeling will decrease development cycle of future fuze systems .

Schedule

MILESTONES	FY15	FY16	FY17	FY18	FY19
Fuze Enhanced Airburst Response			4	5	6
Next Generation Large Caliber Setting		4	5	6	
Next Generation Sensors and Safety (Low Cost ESAD)		4	5	6	
Advanced Munitions Power			3	4	5

Milestone Indicators: TRL : Milestone Timeline:

Payoff(s):

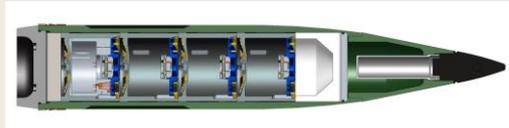
- Enables increased and scalable lethality in broader applications across multiple munitions.
- Maximizes lethality while minimizing collateral damage and reducing logistical burden.
- Spiral technology solutions into numerous Program of Records and other S&T efforts.

Affordable Fuzing and Power Systems for enhanced effects and operational overmatch



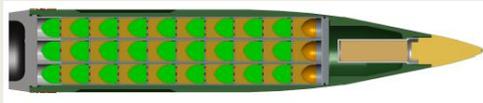
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Cluster Munition Replacement Technologies (CMRT)



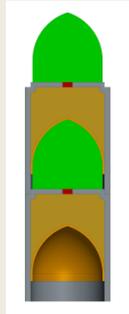
PRAXIS

- 4 Full bore submunitions
- Tri-mode Fuzing with Prox



DPICM - XL

- Approximately Sixty (60) submunitions
- High-reliability fuze w/parallel architecture



(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 material solution for personnel, light vehicles and medium armor targets
 - Enables continued use of critical lethality capability

(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

(U) Other Factors:

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



High Reliability Fuzing ($<1\%$ UXO)

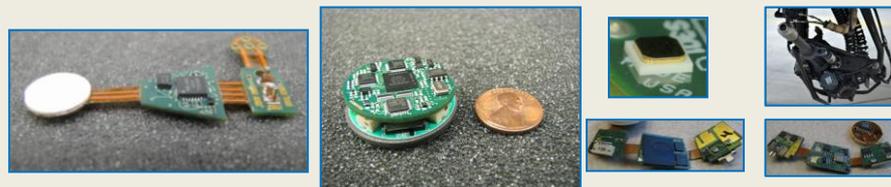


- Compliance with DoD Cluster Munition Policy
- Fuze component technologies & functional architecture(s) for a system function reliability of $>99\%$
- Non-networked, self-contained, & independent submunition fuzing solutions

Airburst Fuzing Technologies

- Higher-accuracy medium caliber air-bursting solutions
- Advanced communication & programming methodologies
- Autonomous airburst for 30mm munition

Next Generation Target Detection & Sensing



- Advanced Next Generation low cost sensor technologies to provide enhanced battlefield performance & small form fit precision burst point control
- Accurate stand-off detections for emerging threats and more complex indirect, direct, and air target sets
- Target media classification MEMS-based G-switch capable of coarsely detecting target media types & voids upon impact
- FMCW target classification proximity sensor



Networked Munitions



- MIL-STD-1911 compliant fuzing concepts
- Fireset hardware and firmware for main munition

Advanced Fuze Setting



- Smaller and lighter large caliber fuze setter for use in auto-loading cannon systems and guided mortar applications
- High rate medium caliber fuze programming & communication for enhanced airburst response
- Advanced setting for increased data and power transfer for next generation of guided mortar applications
- Advanced wireless setting techniques

Miniaturized Fuzing



- High volume, cost-effective manufacturing processes for MEMS scale components
- Mature the manufacturing readiness level with the elimination of touch labor and rework, establishing second sources of supply, optimizing tolerances and reducing process variation

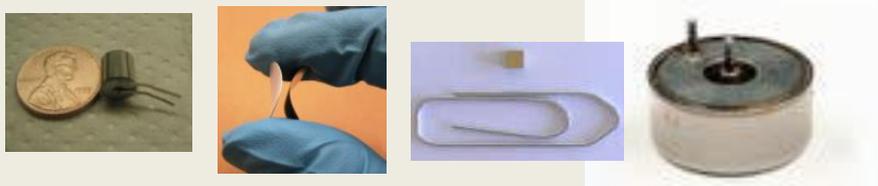
Fuze Data Hold



- Higher energy storage
- Cold temperature performance
- Unlimited number of sets & resets



Munitions Power Sources



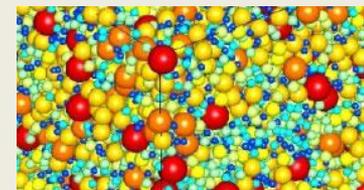
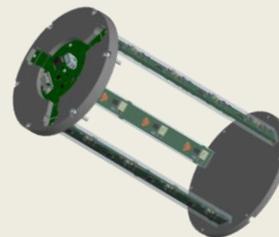
Thermal & Liquid Reserves

- New power source technologies with a very high energy density and power density
- Smaller, more reliable and affordable
- Fast rise times

Active Batteries

- Leverage commercial advancements
- Evaluate/Improve dormant shelf life
- Efficient circuit turn on, wake up

Advanced Initiation Schemes - Insensitive Munition & Advanced WarHeads



- Small, low cost, high voltage components for advanced initiation techniques for sustainment of detonation velocity in highly insensitive energetic materials
- Multi-point solutions for initiation of IM fills
- Novel integration techniques to reduce cost and size of existing component technologies
- Next generation of high voltage detonators that will reduce total energy requirements



Use of Multi-core Processor Technology in Fuzing Systems

Mr. Jeffrey Fornoff

Joint Fuze Technology's Next Generation Proximity Sensors

Mr. Evan Young

Conventional Fuze Improvements

Mr. Keith Amadio

DPICM-XL High Reliability Fuzing

Mr. Craig Doremus



DBX-1 Green Primary Explosive related efforts
Mrs. Neha Mehta

FMU-160A/B Proximity Fuze
Mr. Keith Amadio for Mr. Charles Scott Lyon

Development of Environmentally benign pyrotechnic delays
Dr. Jay Poret

Modeling and Simulation of a High Fidelity Electronics
Assembly responding to a drop test
Mr. Miroslav Tesla



Computational Evaluation of MEMS Latching Technologies

Mr. Thomas Ziegler

Developing Additive Manufacturing Process Parameters
for Fuze applications

Ms. Leila Zunino

Down Range Drag Correction for Medium Caliber Munitions

Mr. Andrew Surowiec, US Army ARDEC



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60th Fuze Conference Theme:

Celebrating 60 Years of Fuzing Excellence

Suggestion for 61st -

NDIA - Making Fuzing Great Again!!

Thank You!!

