



U.S. Army
Armament Research, Development & Engineering Center
Picatinny, NJ



120mm LOS-MP

LINE OF SIGHT MULTI-PURPOSE

Army Science Conference

Presented by
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Brief Outline



- ***Program Overview***
 - Exit Criteria
- ***XM1069 Design***
 - Process
 - Cartridge
 - Warhead
 - Fuze (XM1157)
 - Data Link
- ***XM1069 Testing***
 - Warhead
 - Structural
 - Concrete Wall
 - Anti-Personnel
- ***Conclusion***

} *Modeling & Simulation*

} *Test & Evaluation*



120mm LOS-MP
LINE OF SIGHT MULTI-PURPOSE



LINE OF SIGHT MULTI-PURPOSE (LOS-MP)

Present: 4 Rounds



Target Set

ANTI-PERSONNEL



CONCRETE WALLS



BUNKERS



LIGHT ARMOR



Future: 1 Round

XM1069



The LOS-MP
combines capabilities
of M1028, M830A1,
M908 and M830
into ONE Round

Improved Lethality with Reduced Logistic Burden



Program Overview



- **Subset of 120mm MCS and Abrams Ammunition System Technologies (MAAST) ATO**
- **LOS-MP TRL6 Exit Criteria**
 - ☐ Double reinforced concrete wall
 - Hole size 30"x50" in 3 shots or less
 - ☐ Anti-Personnel:
 - 200-700 meters Threshold
 - 40-2000 meters Objective

***All technical data
Government generated
and owned***



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LOS-MP Design Process



**Decrease design
time and tests**

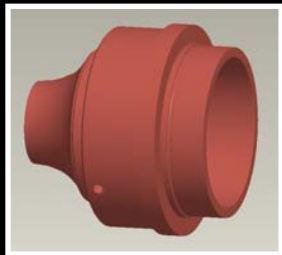
Initial conceptualization to meet requirements

Definition of high risk process and long lead items

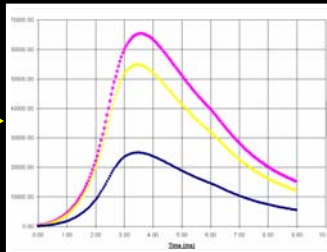
Define shortfalls of M&S: Fill gaps with test, experience

**M&S Savings:
\$6.8 mil/27 months**

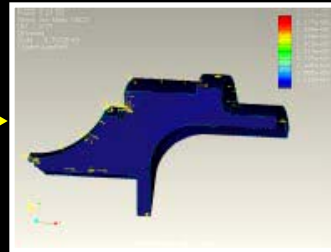
**Modeling/ Configuration
Pro Engineer/ Intralink**



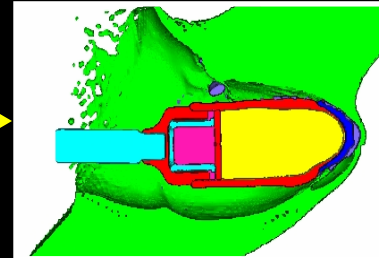
**IB Simulation
IBHVG2**



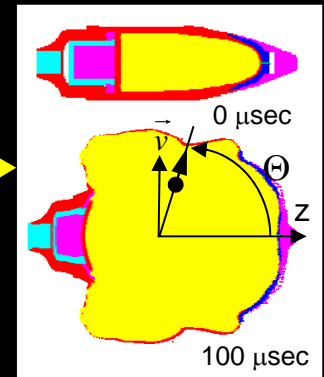
**Structural analysis
FBD/ ANSYS**



**Target penetration
CTH**



**Fragmentation
CALE/PAFRAG**



Failure in any model reiterates design process

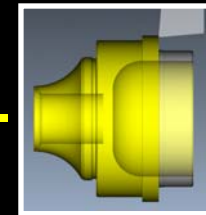
Flight Performance



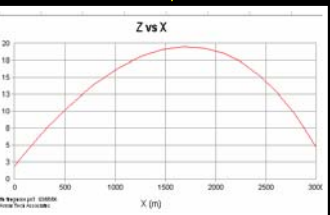
Fragmentation



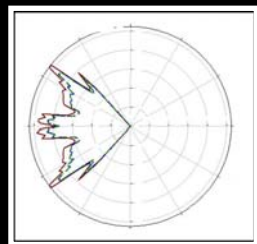
Verify models



**3D numerical control
Pro Manufacture**



**Flight performance
PRODAS**



**Lethality Models
CASRED/MPR3D/
AJEM/MUVES**



DR concrete wall

No iteration of design during testing !



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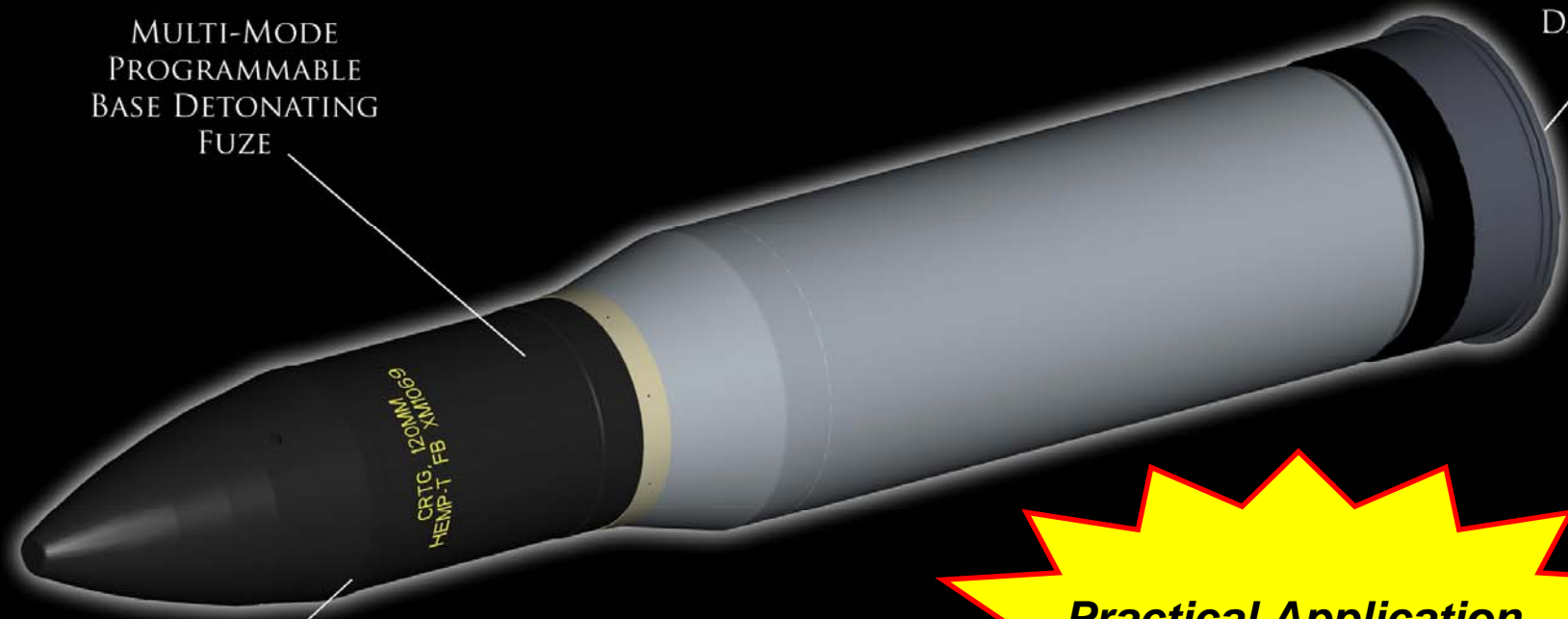


XM1069 CARTRIDGE



MULTI-MODE
PROGRAMMABLE
BASE DETONATING
FUZE

DATALINK



TARGET-PENETRATING
BLAST-FRAGMENTING
WARHEAD

**Practical Application
of
New Technology**



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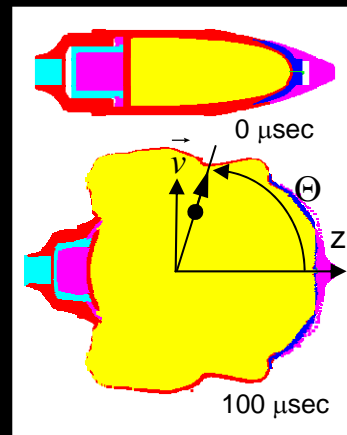


XM1069 Warhead Design

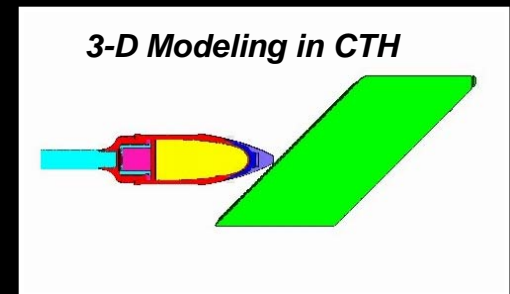


- **Blast fragmenting target penetrating**
 - Iteration of CTH/ CALE-PA FRAG modeling
 - Structural integrity for:
 - Concrete Wall
 - Earth and Timber Bunker
 - Delivers intact warhead and fuze to target sweet spot
 - Fragmentation:
 - ~20000 total fragments

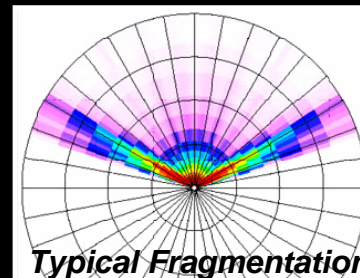
4 Patents Pending



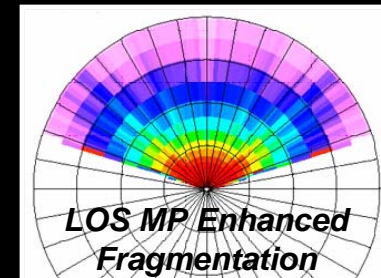
CALE/ PAFRAG predictions



X-ray after DRC



Typical Fragmentation



LOS MP Enhanced Fragmentation

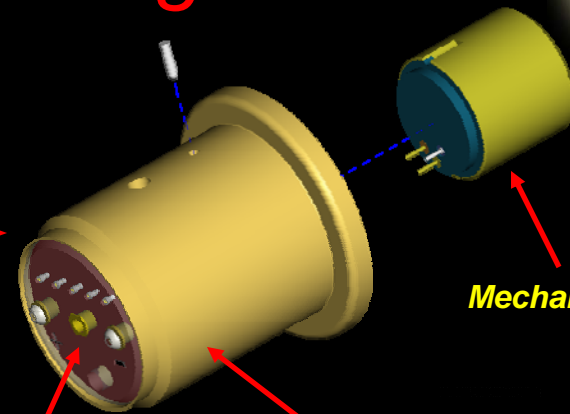
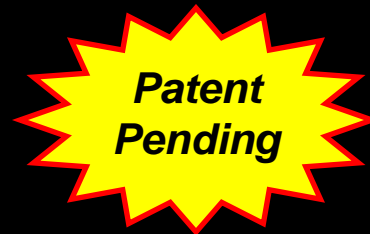
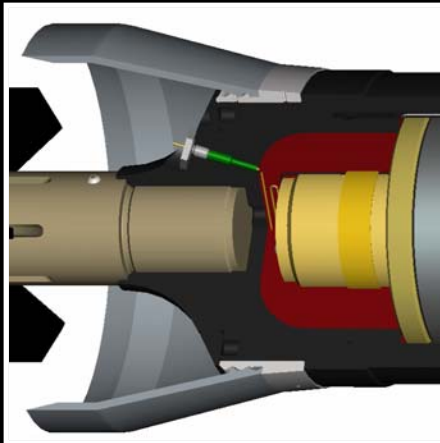
Survivable & Lethal



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XM1069 Fuze Design



Mechanical S&A

PD switch connections and
center data link connection

Electronics Control module

- **Multimode Programmable Base Detonating (XM1157)**

- 5 modes: 4-Point Detonate, Timed airburst
- Dual safe: Setback, commit to launch
 - 3 leaf mechanism
 - Electronically controlled piston actuator
- Power, function mode and time sent via data link
- S&A
 - No rotating contacts
 - 90 degree rotor
- Electronics
 - Dual Micro-controller
 - Enhanced Capabilities



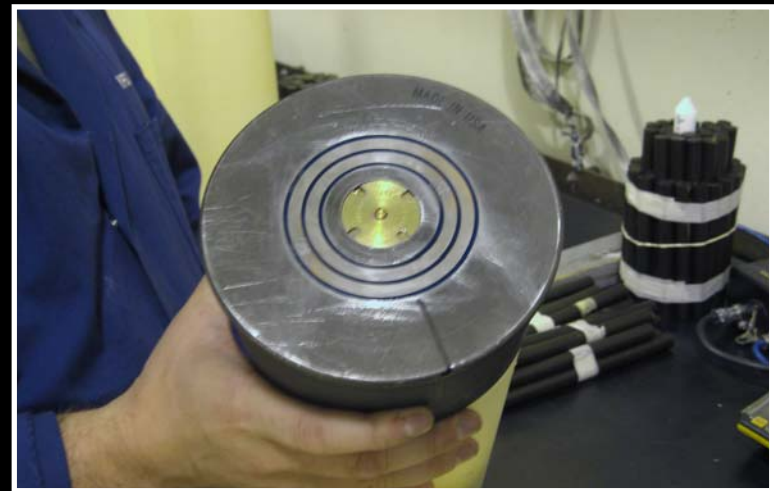
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XM1069 Data-Link



- Provides ability to:
 - Power fuze
 - Set function mode & time
 - Verify data and munition status
- Primer ignition isolated from data transmission



***Utilizes production
primer and case base***



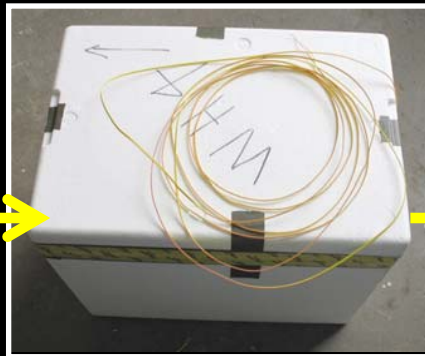
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Warhead Testing: Frag Recovery



- **Fragment Recovery**
 - Fragment recovery determines efficiency of warhead to produce desired fragment size and number
 - Fragmentation recovery results validate and refine PAFRAG/CALE modeling data



93% fragment mass recovery was achieved



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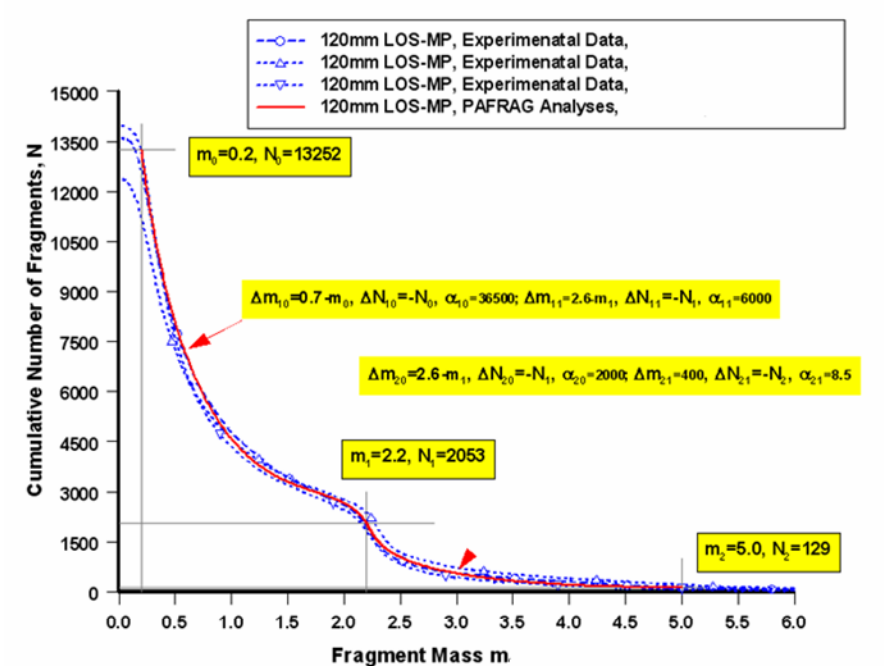
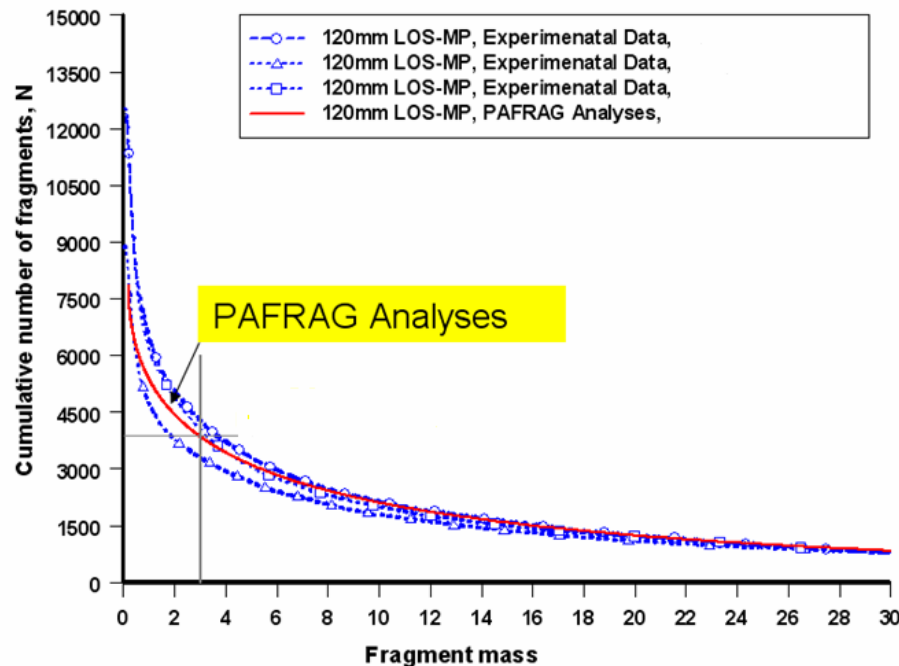
Fragment Recovery Data

Experimental vs CALE/ PAFRAG Analysis



Body Fragment # vs Mass

Nose Fragment # vs Mass



**Simulation predicted
experimentation**

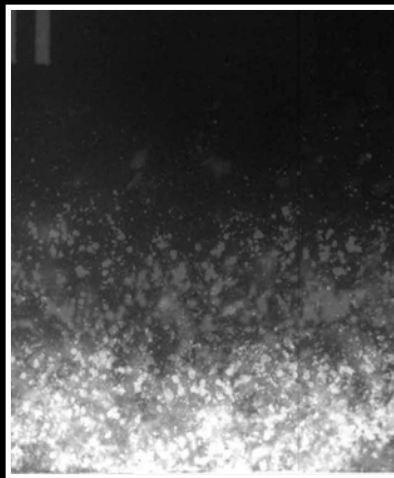


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Warhead Testing: Frag Velocity

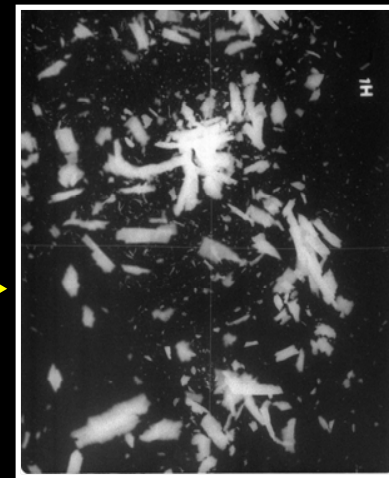
- **Fragment Velocity**
 - Determines static detonation fragment velocity
 - Fragmentation velocity results validate and refine PAFRAG/CALE modeling data



Nose Fragment Velocity
Test: 0.740 mm/ μ s
Predicted: 0.750 mm/ μ s



Fragment Velocity
Test Setup



Body Fragment Velocity
Test: 1.360 mm/ μ s
Predicted: 1.200 mm/ μ s



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Projectile Structural Testing

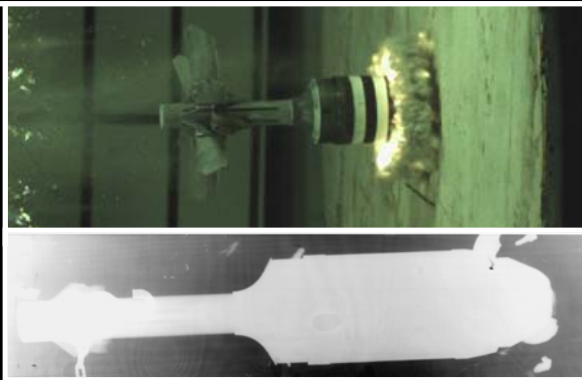


- XM1069 Structural Testing
 - Validate Propulsion models
 - Validate FEA models
 - Validate CTH model
 - Evaluate target deceleration (for fuze programming)
 - Concrete/ Double Reinforced Concrete: Equal difficulty
 - E&T Bunker hardest on airframe

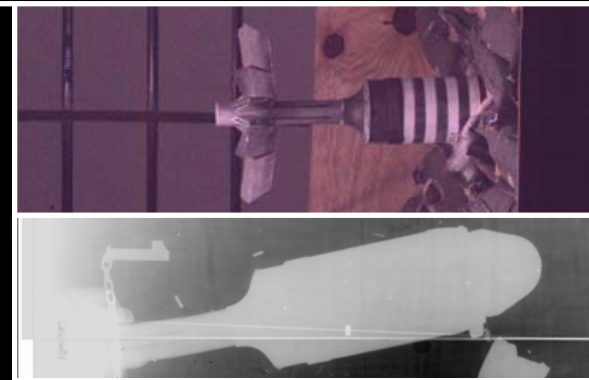


Muzzle Exit Integrity

DR Concrete Wall
Energy Decrease: 32KJ
Velocity Decrease: 60 m/s



E&T Bunker
Energy Decrease: 210KJ
Velocity Decrease: 162 m/s

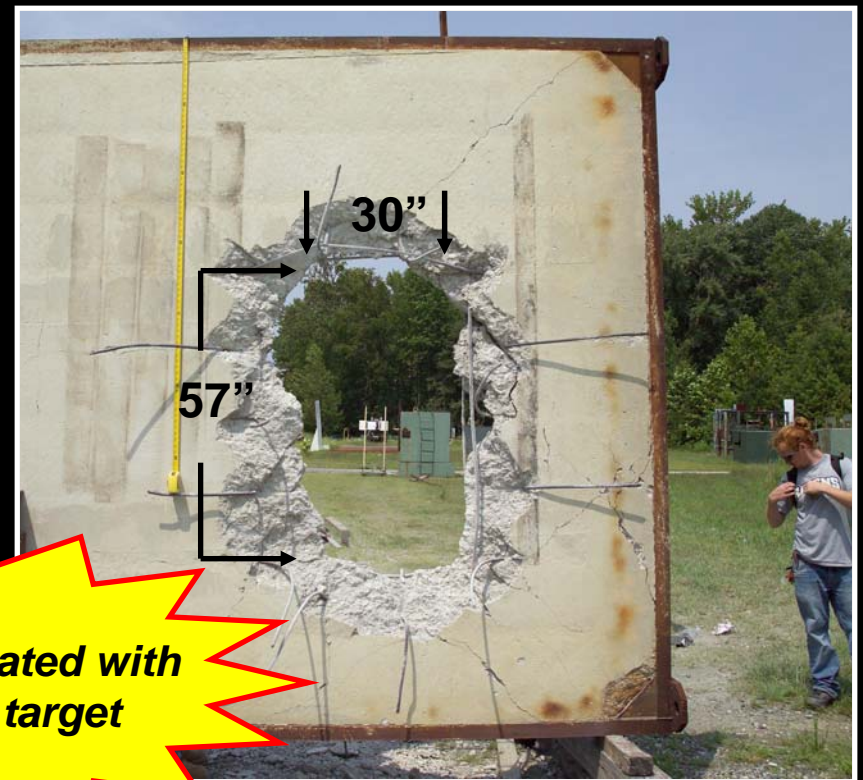


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TRL6: Concrete Wall Test

- Demonstrated XM1069 integrated with XM1157 fuze & data link
- Defeated target in 2 shots



**Warhead integrated with
fuze defeats target**

MOUT standard 8" double reinforced wall



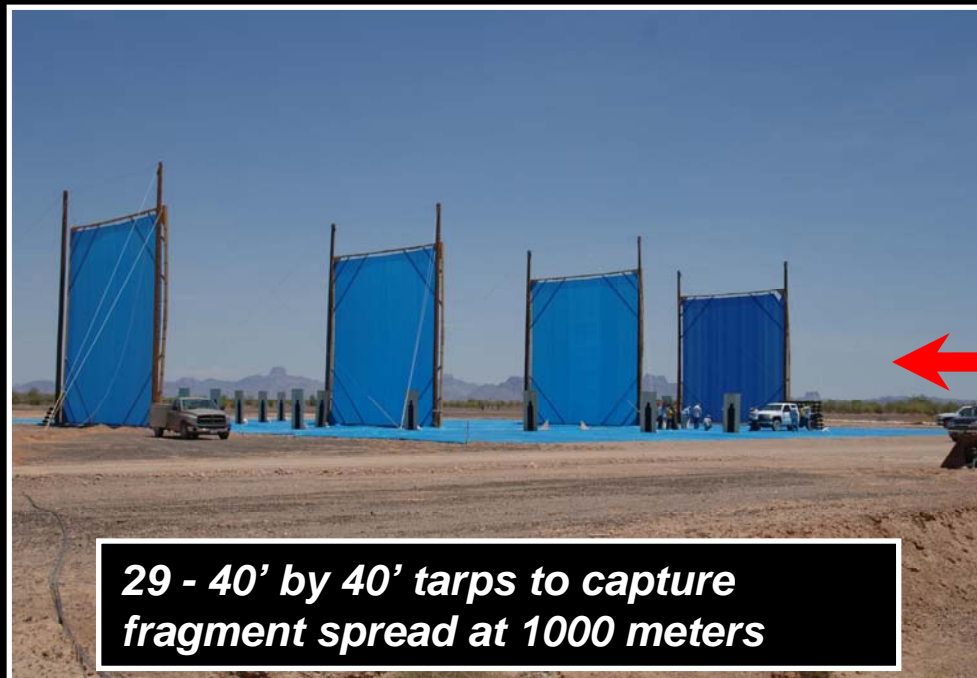
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TRL6: Anti-Personnel Test



- Demonstrated airburst performance between threshold and objective ranges



29 - 40' by 40' tarps to capture fragment spread at 1000 meters

**Performance shown at
1000 meters**



Sample silhouette from test:

- Large Dots: Body frag hits
- Small Dots: Nose frag hits

**Fired from Abrams SEP
Tank with Data link**



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Conclusion



- **LOS-MP TRL6 Exit Criteria has been met**
 - ✓ Double reinforced concrete wall
 - Hole size 30"x50" in 3 shots or less
 - ✓ Anti-Personnel:
 - 200-700 meters Threshold
 - 40-2000 meters Objective
- M&S reduced time and risk
- Testing validated and refined M&S
- LOS-MP technology transitioned to PM-Maneuver Ammunition Systems for potential Advanced Multi-Purpose SDD



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LOS-MP Team Acknowledgments



LOS-MP IPT Lead
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Contracting
Carol Yanavok

Systems
Matt Hall
Jesse Sunderland

PM MAS
Hugh MacMillan

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Dave Pfau

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Propulsion
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ARDEC Shop
Josh Gallagher

Warhead Modeling
Vladmir Gold
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John Moy
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