



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



120mm LOS-MP

LINE OF SIGHT MULTI-PURPOSE

Army Science Conference

Presented by
Eric Scheper LOS-MP IPT Lead
Matt Hall LOS-MP Engineer

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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

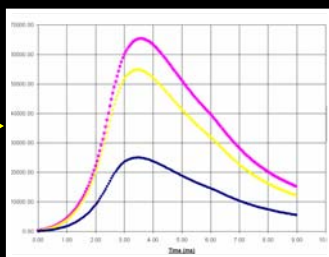
Define shortfalls of M&S: Fill gaps with test, experience

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

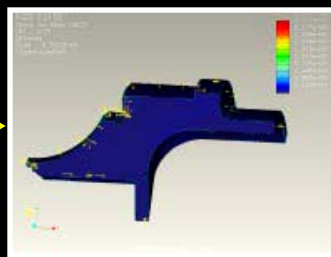
Modeling/ Configuration
Pro Engineer/ Intralink



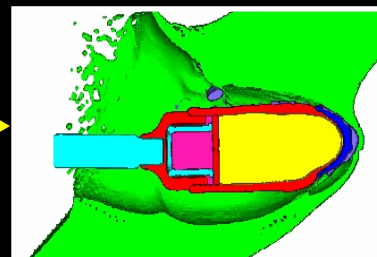
IB Simulation
IBHVG2



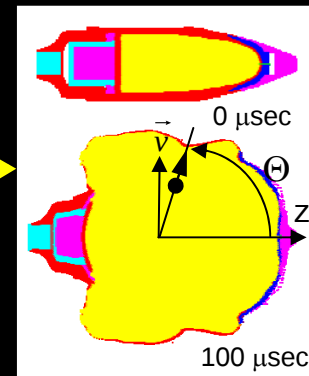
Structural analysis
FBD/ ANSYS



Target penetration
CTH



Fragmentation
CALE/PAFRAG



Failure in any model reiterates design process

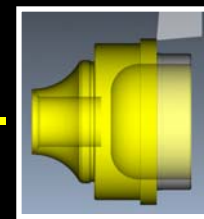
Flight Performance



Fragmentation



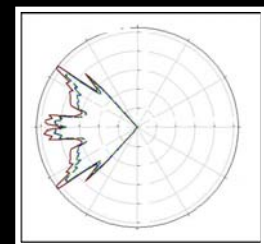
Verify models



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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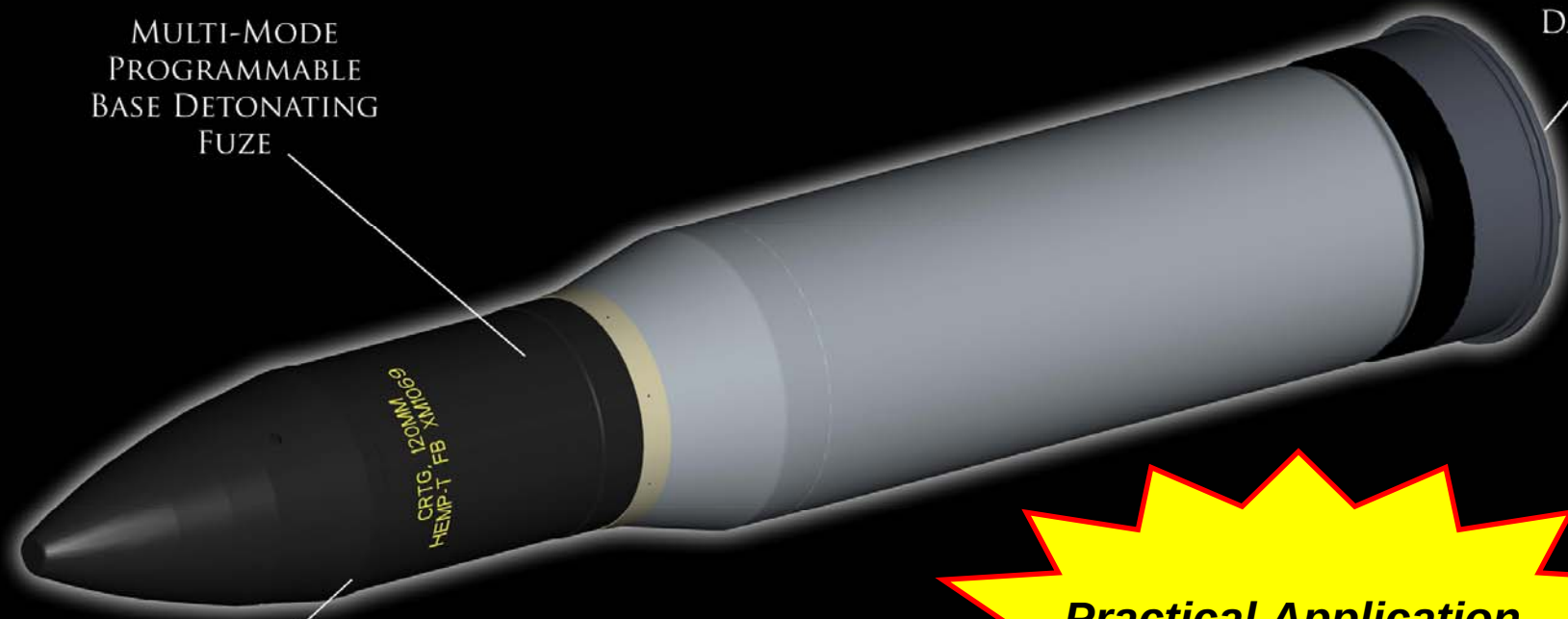


XM1069 CARTRIDGE



MULTI-MODE
PROGRAMMABLE
BASE DETONATING
FUZE

DATALINK



TARGET-PENETRATING
BLAST-FRAGMENTING
WARHEAD

***Practical Application
of
New Technology***



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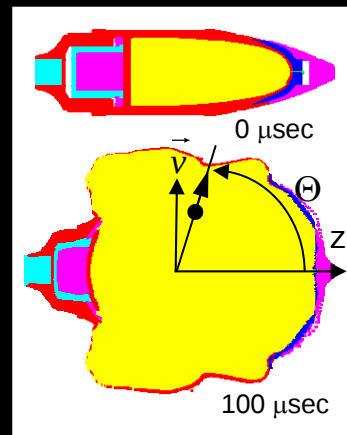


XM1069 Warhead Design

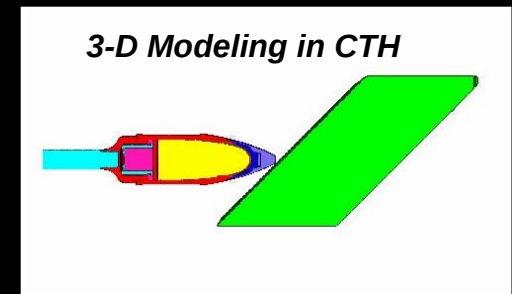


- **Blast fragmenting target penetrating**
 - Iteration of CTH/ CALE-PA FRAG modeling
 - Structural integrity for:
 - Concrete Wall
 - Earth and Timber Bunker
 - Delivers intact warhead and fuze to target sweet spot
 - Fragmentation:
 - ~20000 total fragments

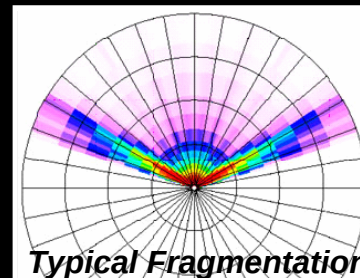
4 Patents Pending



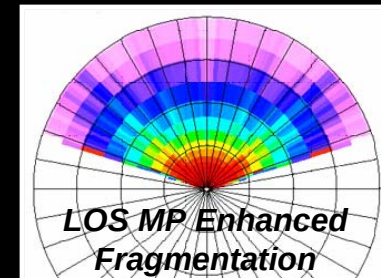
CALE/ PAFRAG predictions



X-ray after DRC



Typical Fragmentation



LOS MP Enhanced Fragmentation

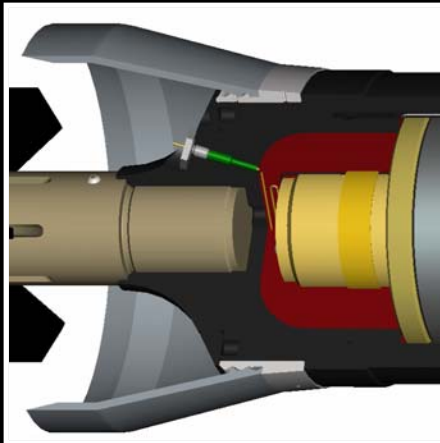
Survivable & Lethal



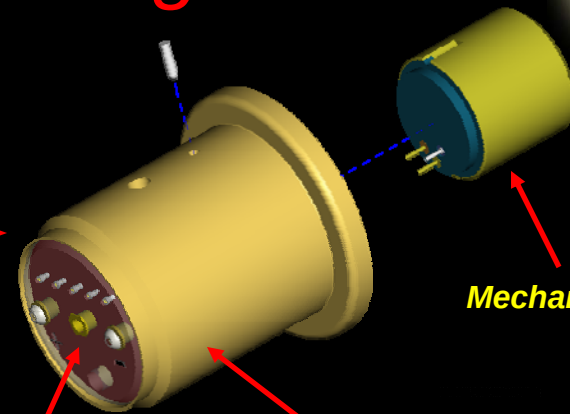
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XM1069 Fuze Design



Patent Pending



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

**Preliminary
AFSRB
approval**



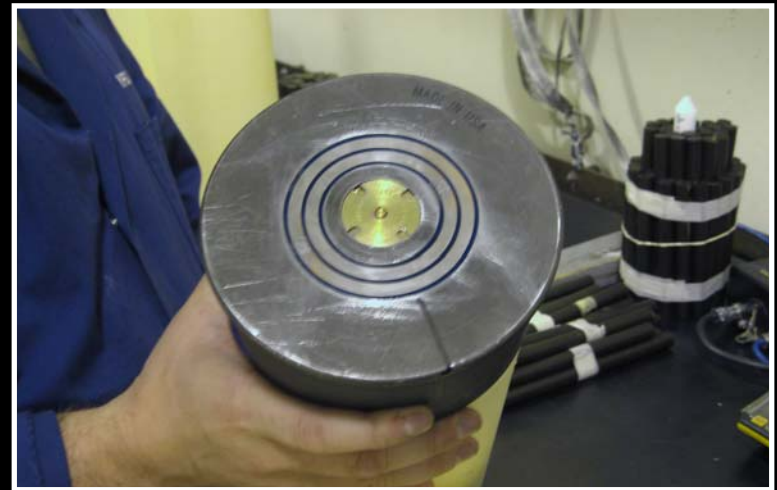
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XM1069 Data-Link



- 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***



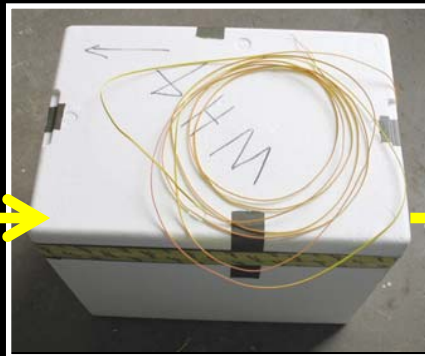
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Warhead Testing: Frag Recovery



- **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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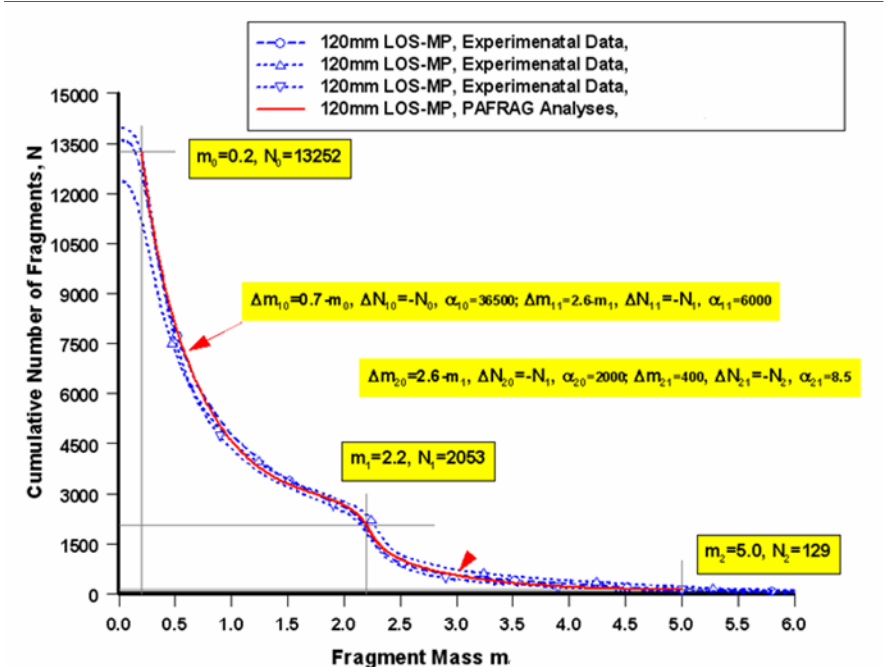
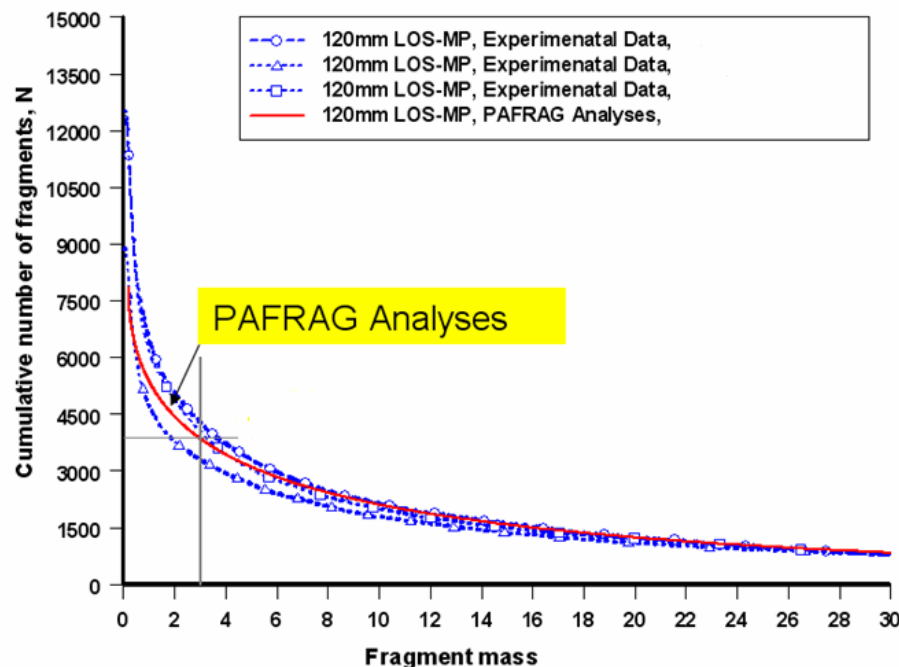
Fragment Recovery Data

Experimental vs CALE/ PAFRAG Analysis



Body Fragment # vs Mass

Nose Fragment # vs Mass



**Simulation predicted
experimentation**

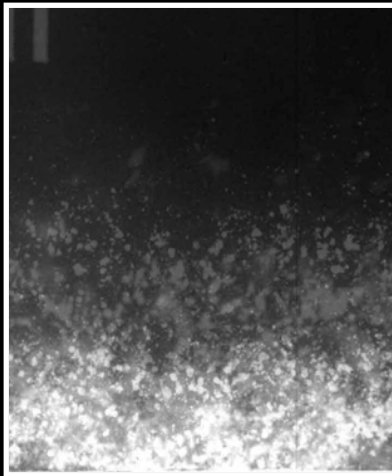


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Warhead Testing: Frag Velocity

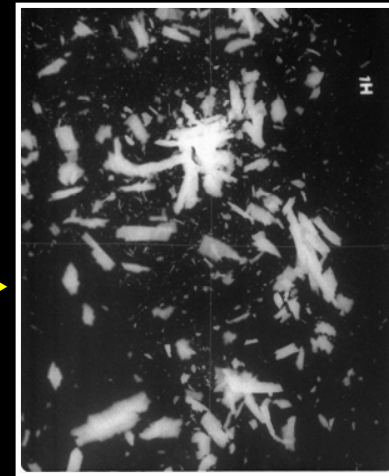
- **Fragment Velocity**
 - Determines static detonation fragment velocity
 - Fragmentation velocity results validate and refine PAFRAG/CALE modeling data



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

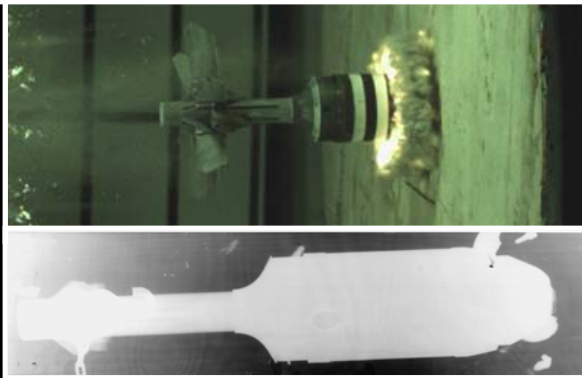


- XM1069 Structural Testing
 - Validate Propulsion models
 - Validate FEA models
 - Validate CTH model
 - Evaluate target deceleration (for fuze programming)
 - Concrete/ Double Reinforced Concrete: Equal difficulty
 - E&T Bunker hardest on airframe

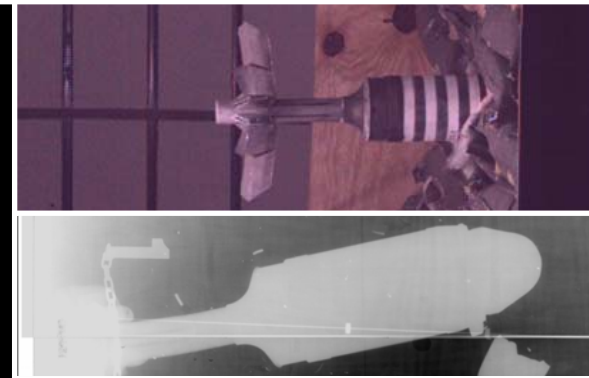


Muzzle Exit Integrity

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



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



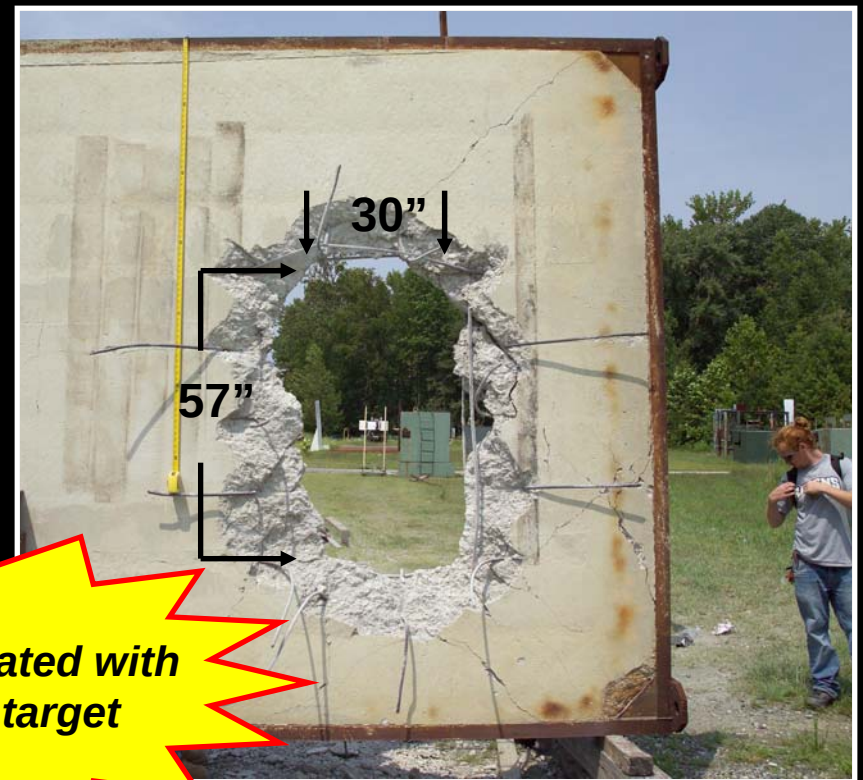
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TRL6: Concrete Wall Test



- 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



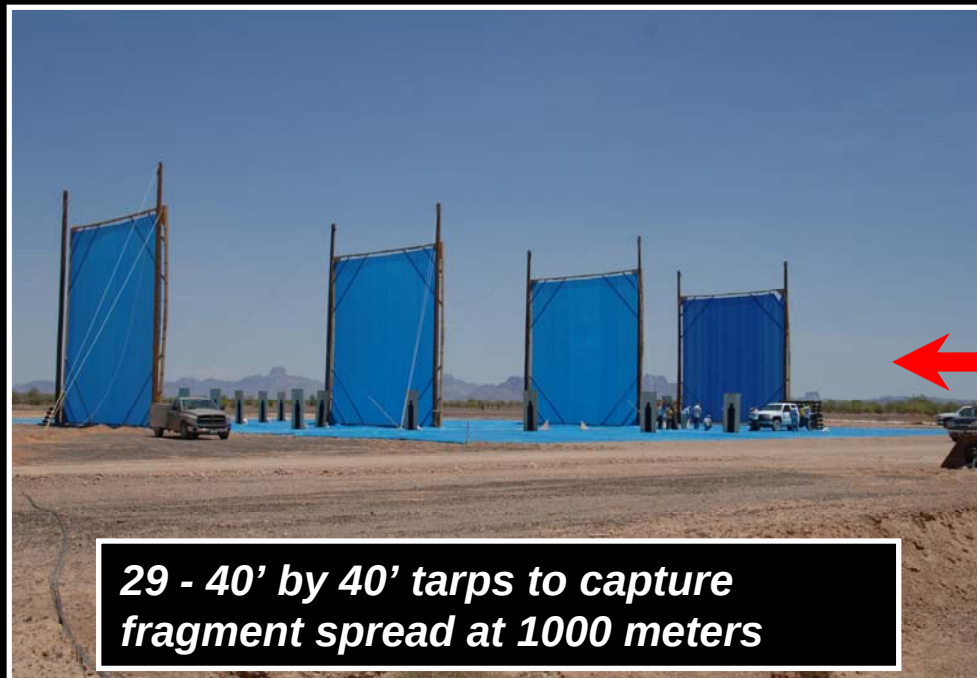
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TRL6: Anti-Personnel Test



- 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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Matt Hall
Jesse Sunderland

PM MAS
Hugh MacMillan

Warheads
Bill Poulos
Dave Pfau

Fuze
Bob Hubal
Barry Schwartz
Jason Friedberg
Olivier Nguyen
Lloyd Khuc

Aero
Tony Farina
Andy Ponikowski

Propulsion
Carlton Adam

Quality
Nidal Eid

Safety
Bob Kesselman
Elton Johnson

ARDEC Shop
Josh Gallagher

Warhead Modeling
Vladmir Gold
Jack Pincay
Chuck Chin

PQM
Tom Florek
John Moy
Larry Genereux

Packaging
Ed Mastov
Bill Ingold
Arifa Musalli

Analysis Support

ARL

Industry Support

ATK
GD-OTS
DZI
Action Manufacturing
Kulite
L3 COM

Testing Support

Yuma
ARL
ATC
ARDEC
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