



43rd Annual Guns & Missiles Symposium 21-24 April 2008

Analysis of Precision Mortar fires for the IBCT

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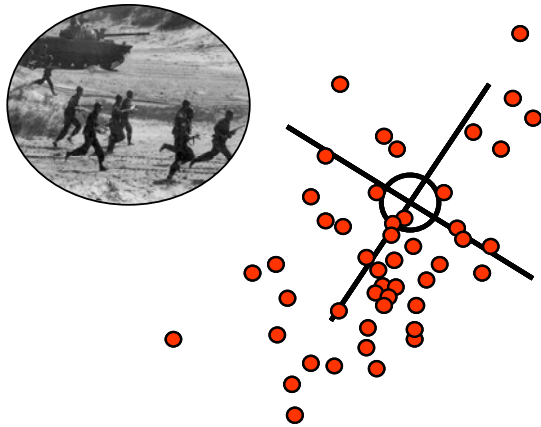




- PGMM Operational Analysis
- PGMM Description
 - PGMM Capability
 - PGMM How it Works
 - Operational Concept
 - Projectile Overview
- PGMM Program Plan
 - Program Status – PGMM in Shut Down
 - Program Schedule (GTH Tests, Subsystem Testing, Major Program Milestones)
- Test Program Results
 - PGMM Test Program
 - Lesson Learned – Aero Prediction, Thruster Jet Interaction
 - Results of GTH Tests
- Summary

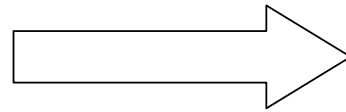


Suppression

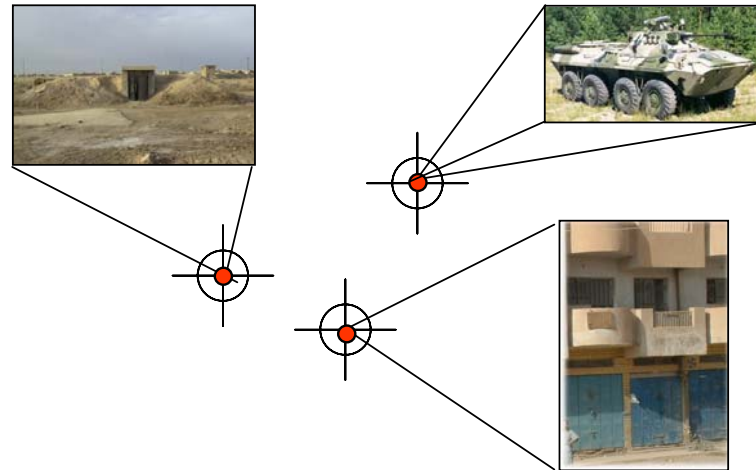


High Explosive

- Area Effects
- High Volume Fire
- Defeat Targets in the Open
- Suppress Personnel Under Cover



Destruction



Precision Guided

- Precision Effects
- 1-2 Rounds to Effect Target
- Incapacitate Personnel Under Cover
- Low Collateral Damage
- Reduced Logistics Footprint

PGMM gives Battalion Commanders Organic Precision Strike, Destructive Capability



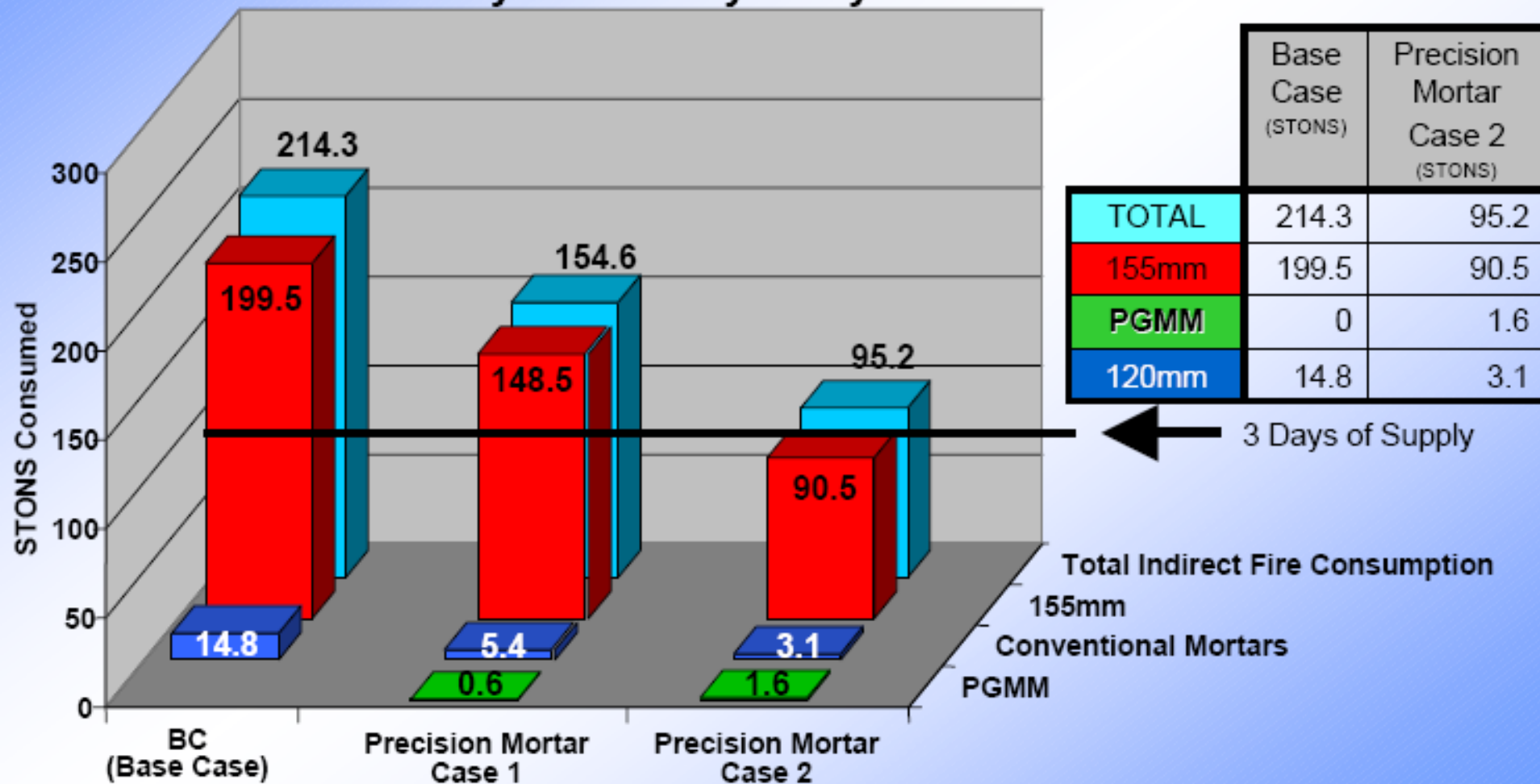


Precision Guided Mortar - Logistics



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Analysis of Early Entry Force Scenario

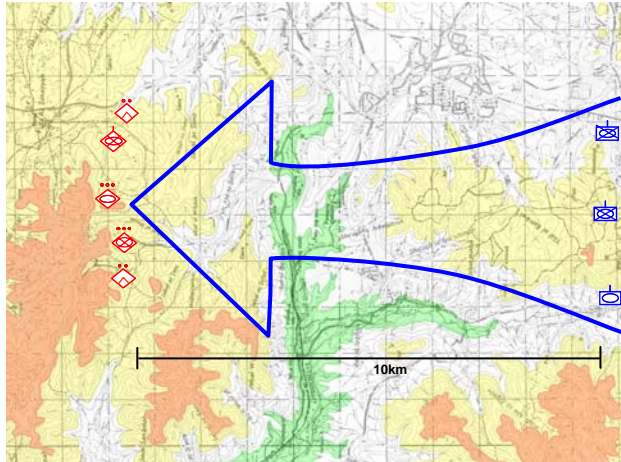


83 PGMMs reduced logistics burden of Indirect Fire Ammunition by 122 STONS (110.7 Metric Tons)!

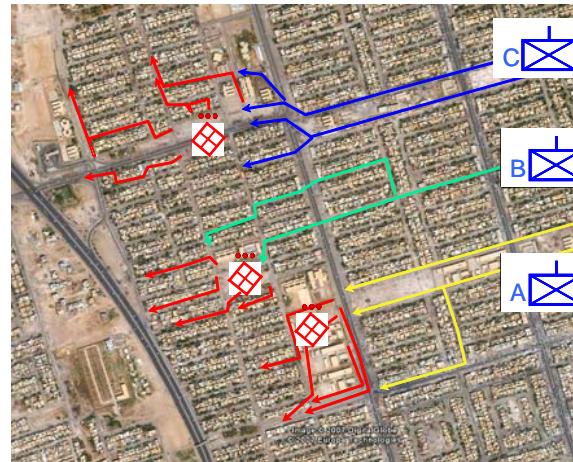




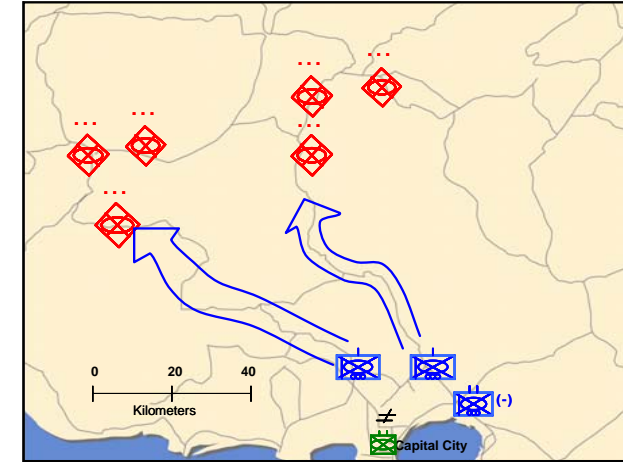
Nonlinear, Noncontiguous



Urban



Desert



- Precision Guided Mortar included in Force on Force Models to Show Impact on Force Effectiveness
 - Nonlinear, Noncontiguous:
 - US Heavy Brigade Combat Team in the Attack
 - Threat Defenders with heavy systems (tanks, mortars, artillery)
 - Urban:
 - US (3 Infantry Companies) in the Defense
 - Threat Attack with crew served weapons (hit and run)
 - Desert:
 - US Stryker Brigade Combat Team in the Attack
 - Threat Defenders with heavy weapons (Infantry Fighting Vehicles, RPGs, mortars)



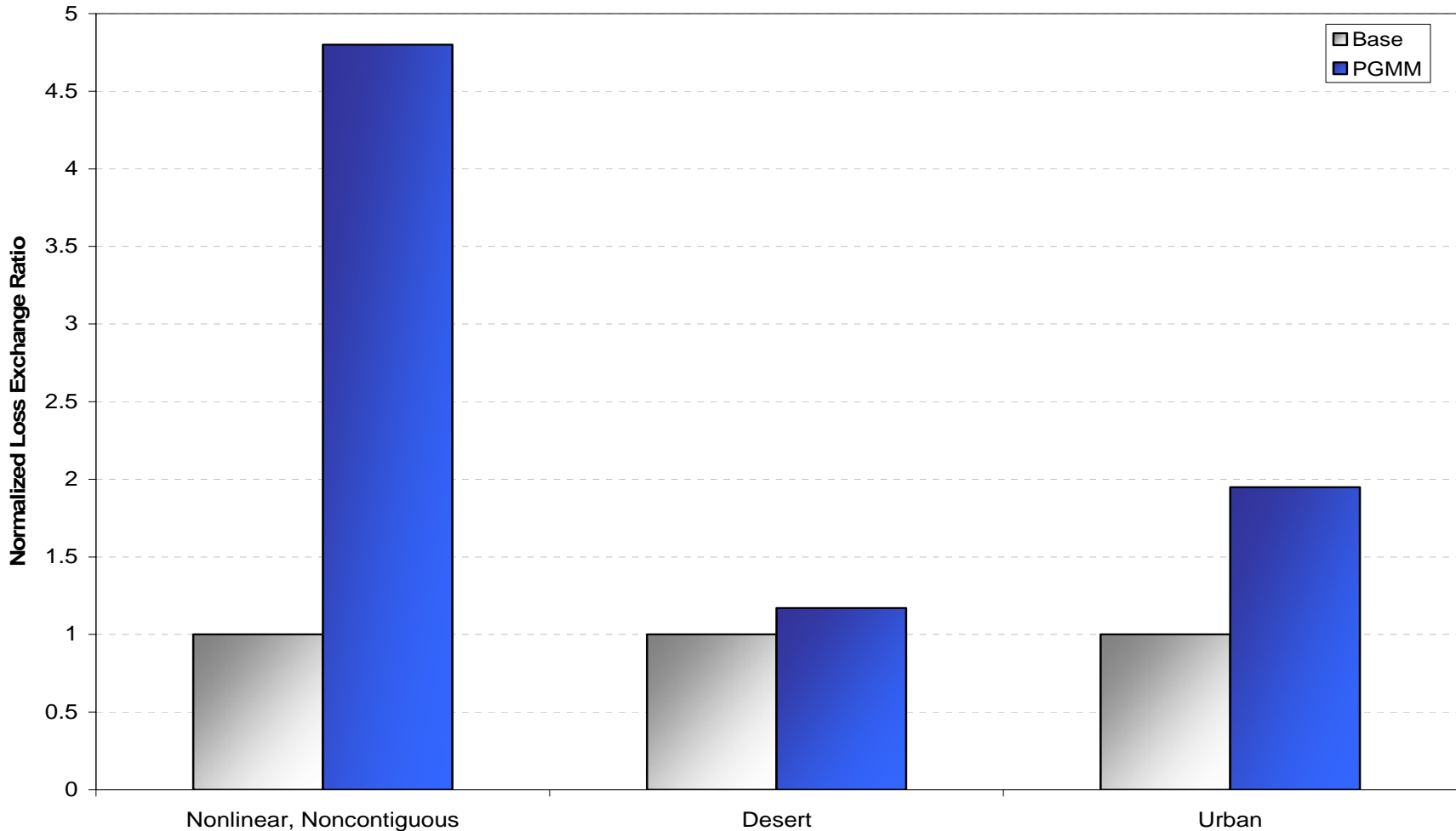


Precision Guided Mortar – Force Capability



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Force Capability



PGMM Provides Increased Force Capability In All Scenarios

Analysis Conducted By:



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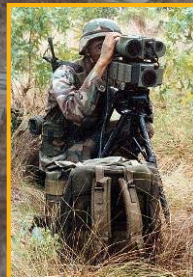
PGMM Operational Concept



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Ballistic Flight to Target Acquisition

Guided Flight to Hit Designated Target



Conventional Mortar Setting, Loading, Firing, and Ballistic Flight Minimize Logistics Burden

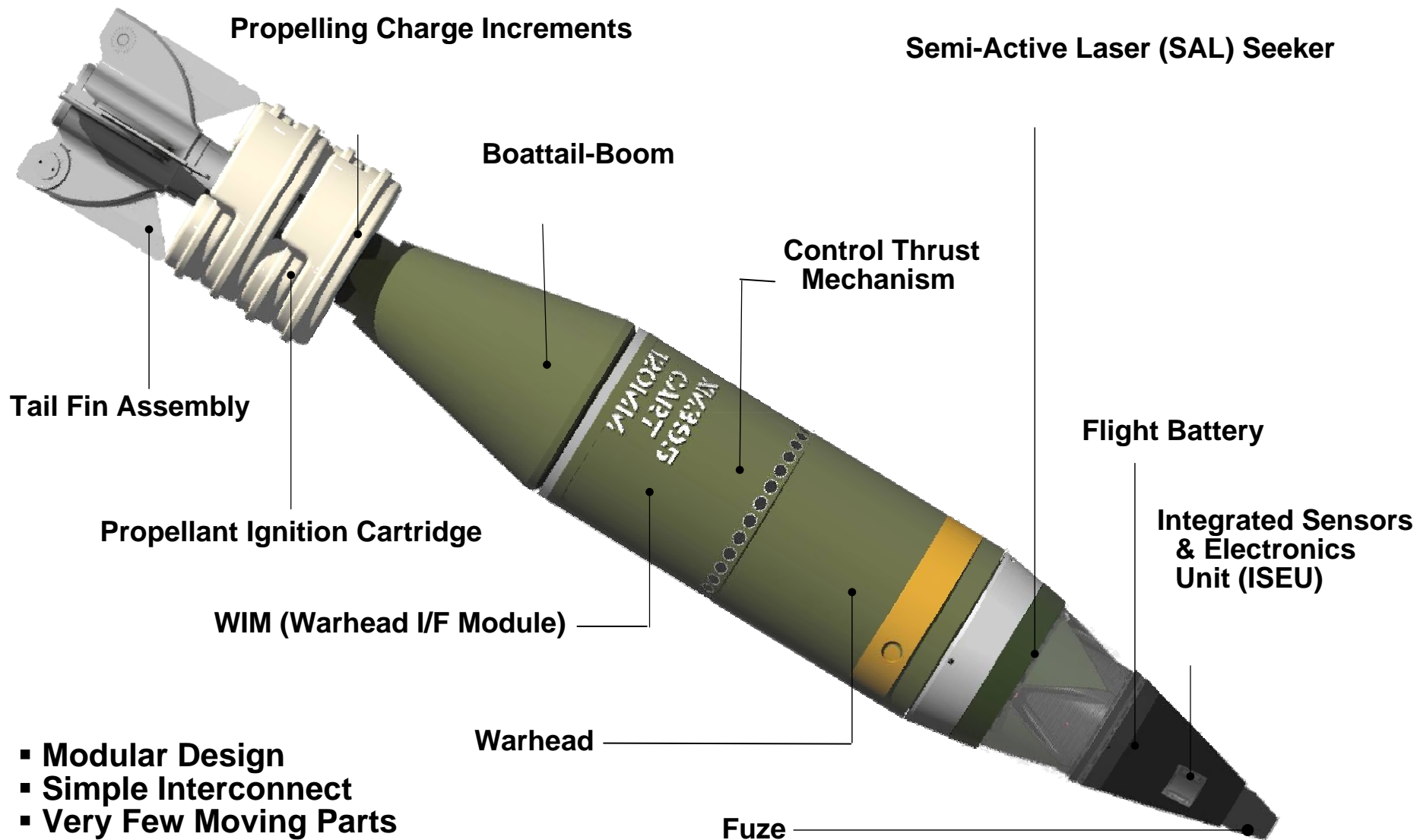




PGMM Projectile



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- Modular Design
- Simple Interconnect
- Very Few Moving Parts
- Low Cost
- Mature Subsystems

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- Army Headquarters Directed PM Mortars to End PGMM Development
 - Terminated due to Funding Constraints in Future Budget
 - PGMM's requirement is still Valid, but Unfunded

- PM Mortars & ATK are Executing an Orderly Shutdown of the program
 - Less costly and time consuming approach than outright Termination for Convenience
 - Have completed System CDR and Demonstrated Performance in Guide To Hit (GTH) series
 - Telemetry in place of Warhead to gather in flight information
 - Hit 12 of 16 targets

- Current Status:
 - Conducting GPS Integration Study
 - Two Operational Need Statements (ONS) Received from Theatre
 - PGMM being strongly considered as a solution in TRADOC's Precision Effects Studies

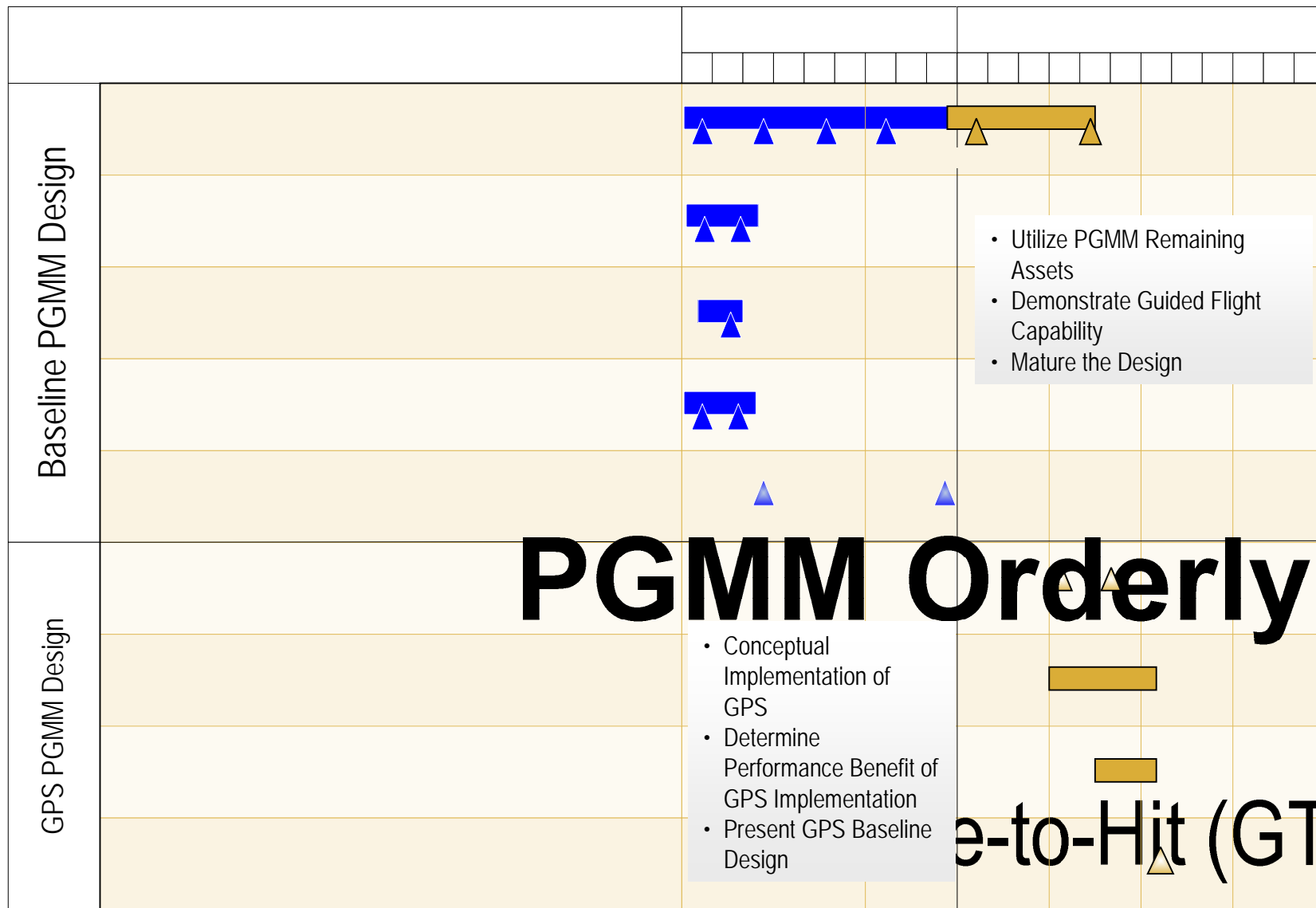


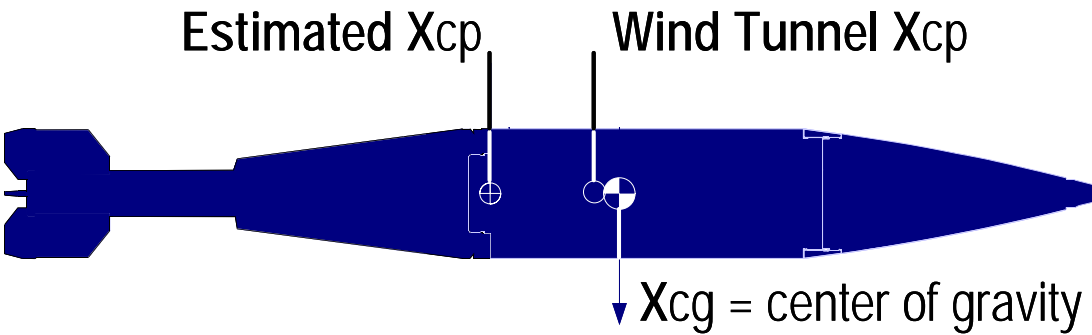


PGMM Program Plan – Orderly Shutdown



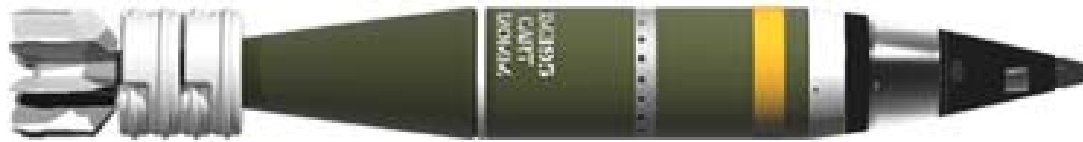
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Traditional Methods were used for PGMM Aeroprediction and included:

- Empirical Aero Prediction Codes
- Review of similar shapes
- CFD



PGMM Caliber Fin Design

All methods over predicted static margin

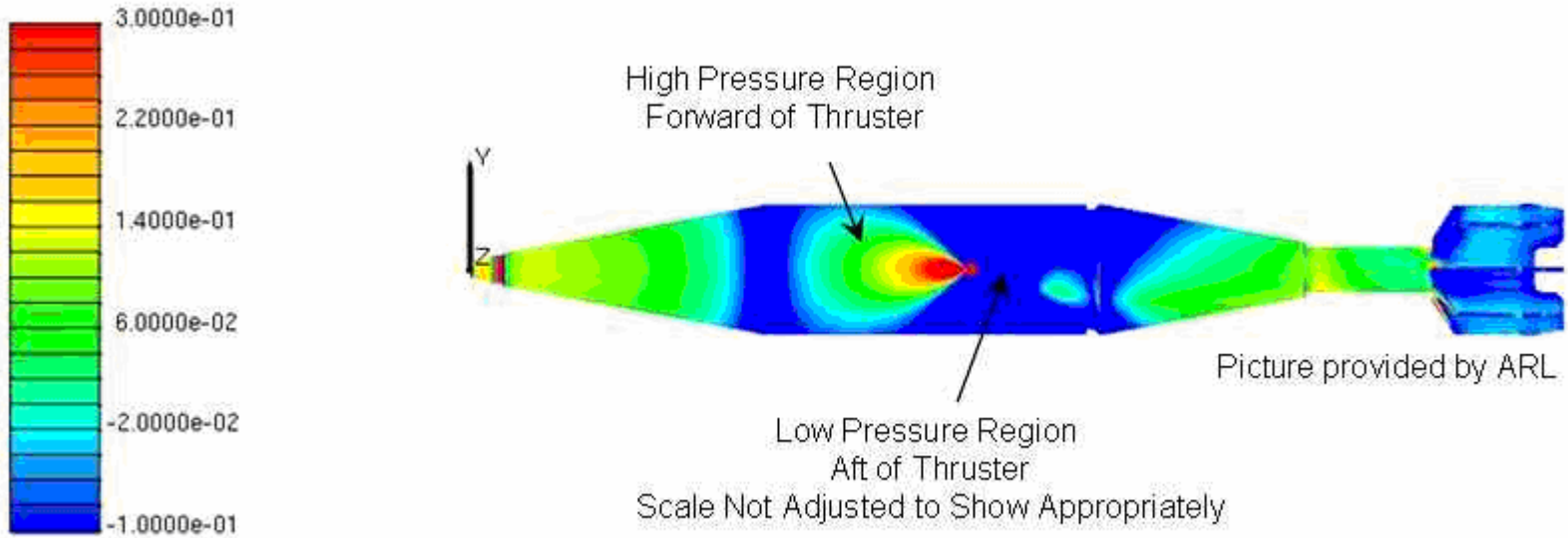


PGMM Super-Caliber Fin Design

Early wind tunnel testing identified issue and allowed rapid development of super-caliber fin solution



Jet Interaction is modeled as a force location offset of the thrusters causing a moment impulse at the same time as the thrust impulse.

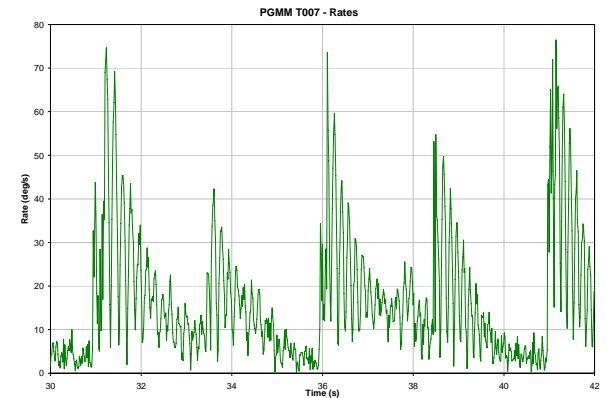


$$\Delta H = I_{trans} \cdot \omega = \int (T \cdot d) dt = I_{thrust} \cdot d$$

I_{trans} = Transverse Moment of Inertia, ω = angular velocity

T = Thrust, d = thrust distance from Xcg, I_{thrust} = Total Impulse from Thrust Event

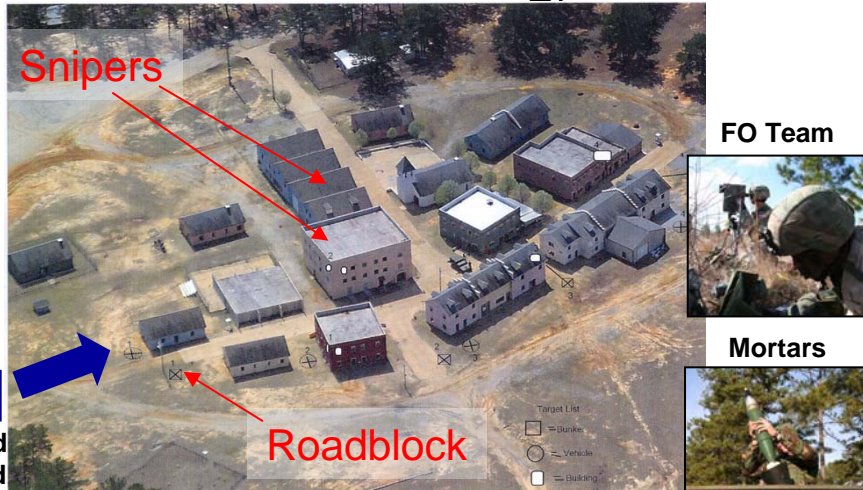
Conservation of Momentum



RSS of Rates - ITM



Location: Ft. Benning, GA



Scenarios / Participants

- Bunker, Sniper, Vehicle Targets
- Gun re-positioning during mission
- FO re-positioning (incoming enemy fire)
- Effects Day vs. Night
- BLUE Force: 22 Soldiers (mostly veterans OIF OEF)
 - FO Team w. Forward Observer System (FOS)
 - Infantry Mortar Section (w. MFCS modified for PGMM)
 - Rifle Squad attacking building shown
- RED Force: 6 defenders

USAIC Objectives:

- What impact did PGMM have on this urban fight?
- How difficult is it for the FO, FDC & Gun to work together with this new munition & mission?
- How will MFCS assist in re-positioning Guns or FOs to keep within Angle T ?
- What are the difficulties with "lase target" message / timing and how should we train these skills?

Results:

- ➔ Positive Impact. Troops were able to quickly take objectives with increased confidence
 - 47 Hits w. 1st round of 56 missions (balance hit w. 2nd rd
- ➔ Not a problem. All missions were done digitally and FO/FDC quickly became proficient working together
- ➔ MFCS at Mortar FDC had situational awareness of FO/Guns, were able to quickly re-position guns
- ➔ Identified time lags when sending digital messages (Designate) that needs additional work, work-around may be to send "Designate" by voice





Soldier Comments from TTP Demo



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- A precision round will give them more confidence to operate in MOUT.
 - 120mm HE “scares them to death”, don’t want to be anywhere near the impact area
 - Knowing that PGMM can quickly destroy targets of opportunity that “pop up” increases their survivability and confidence
 - The TTP maneuver squad felt that having the PGMM would make them at least 50% more survivable.
- FO will be more survivable. He can defeat a target in a few number of rounds versus firing many adjustments
- Learning how to use the round was easy, it is not very different than current procedures
- They couldn’t shoot HE in Iraq because of ROE. When an enemy was identified, they had to send a recon team which took about 30 minutes to organize and get to the target. By that time the enemy was gone. PGMM would give them the ability to quickly strike back.
- From time a target was identified to the time of PGMM impact was only about 2 minutes. A maneuver element would wait that long when a sniper was identified; PGMM would defeat it, then they continued moving into their objective area.
- Infantry goal in marksmanship (make the first round count) should be the same for its biggest weapon (120mm Mortar).





PGMM GTH Testing – Test 410B3



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Precision Guided Mortars (PGMM) can provide a force multiplier to the IBCT

- PGMM gives battalion commanders organic precision strike, destructive capability
- PGMM reduces the logistical burden providing a precision capability with no change to current tactics & procedures

PM-Mortars & ATK Team Addressed Several Technical Challenges Including

- Aero Prediction for novel airframes – Identified in Test and addressed with super-caliber fin design
- Thruster Jet Interaction – Characterized through test and analysis

PGMM has demonstrated performance

- TTP Demo showed tactical capability with soldiers
- 12 of 16 shots hit target in 1 year of testing
 - 6 Tests, 3 Zones, 2 Temperatures

PGMM – Lowest risk and quickest path to field precision indirect capability to the IBCT

