TRANSFORMING CANNON ARTILLERY
with
PRECISION GUIDED PROJECTILES

The XM982 Excalibur Program

2002 Gun & Ammunition Symposium
18 April 2002

Colonel Frank Hartline (USA, Ret)
Business Development Manager
Raytheon Guided Projectiles
GUIDED PROJECTILES IN THE
US ARMY TRANSFORMATION

• XM982 Excalibur Precision-Guided Projectile
  - Modernizes **Legacy Force** platforms
  - Transforms **Interim Force** fire support
  - Enables **Objective Force** transformation

• Provides high lethality, long range dominance with low collateral damage/logistics burden

• Returns Field Artillery to the Close Fight

• Matures GP technologies for MRAAS/FCS
  - gun-hardened projectile guidance electronics
  - Leverages the digital battlefield for FCS
  - 3-6X light platform battlefield effectiveness
Excalibur Description

Family of Fire & Forget GPS/IMU Guided Projectiles

Compatible with Digital 155mm Howitzers

Precision Accuracy (<20 m CEP) Independent of Range
  - Paladin & J LW155: 6 to 37Km
  - Crusader: 6 to 50Km

Single Projectile Design Accommodates Multiple Payloads

Supports Legacy, Interim, & Objective Force

Raytheon Proprietary
XM982 Excalibur
Operational Sequence

Ballistic Flight
- GPS Acquisition and Track
- IMU Initialization
- Initiation of System
  - Paladin
  - JLW155
  - Crusader

Guided Flight
- Deploy Canards at Apogee
- Midcourse Trajectory Guidance
  - Precision Delivery Regardless of Range
  - Eliminates Dispersion Caused by Inherent Errors
  - Limits Collateral Damage
  - Decreases Logistics Footprint
  - Enhances Soldier Survivability
- Terminal Trajectory Optimized for Payload Type

Payload Types:
- Crusader: 50Km
- Paladin / LW155: 40Km

Mission Planning
- Target: Latitude / Longitude / Altitude

Inductive Setting
- Gun/Target Locations
- GPS Crypto Keys
- GPS Precise Time

Targeting Systems

Dual Mode Unitary Warhead
- Structure Penetration
- Fragmentation (Area Targets)

Precision Guided Extended Range Artillery Projectile
Industry Team

Precision Guided Extended Range Artillery Projectile

Raytheon (Prime)
(Guidance, Navigation & Control)

L3
(Inertial Navigation)

Interstate Electronics Corporation
(GPS Receiver)

Micropulse
(GPS Antennas)

Eagle Picher
(System Battery)

Alliant TechSystems
(Data Hold Batteries)

KDI Precision Products
(Safe/Arm)

General Dynamics Ordnance & Tactical Systems
(Airframe)

General Dynamics Ordnance & Tactical Systems
(Payload)

General Dynamics Ordnance & Tactical Systems
(Canard Control Actuators)

Raytheon
(Guidance, Navigation & Control)
# TEAM EXCALIBUR

## GOVERNMENT
- PEO-GCSS, OPM-ARMS
- Excalibur Product Office
- ARDEC
- TSM-Cannon
- DCMC-Raytheon

## LOCATION
- Picatinny Arsenal, NJ
- Ft. Sill, OK
- Tucson, AZ

## ROLE
- Functional Management
- Program Management
- Technical Support
- User Representative
- Contractual Support

## CONTRACTOR

### Raytheon Missile Systems
- General Dynamics - OTS

### LOCATION
- Redmond, WA
- Niceville, FL
- St. Petersburg, FL
- Red Lion, PA
- Redmond, WA
- Horsham, PA
- Healdsburg, CA
- Anaheim, CA
- Broomfield, CO
- Parsons, KS
- Joplin, MO
- Cincinnati, OH
- Camarillo, CA

### ROLE
- System Integrator
- Payload Dispense
- Unitary Payload
- Structure and Payload
- Airframe
- Inertial Measuring Unit
- Initialization/Fuze
- Control Actuator Sys
- GPS Guidance
- TM Antenna
- Submunition
- System Battery
- Safe and Arm Device
- GPS Antenna

---

*Precision Guided Extended Range Artillery Projectile*
Soft Recovery Projectile Validated!

- Developmental Tool
- Guidance, Navigation & Control
- Aero Models Validated

Precision Guided Extended Range Artillery Projectile
# Test Results

<table>
<thead>
<tr>
<th>Component</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Despinning Obturator</td>
<td>✓</td>
</tr>
<tr>
<td>Payload Static Dispense</td>
<td>✓</td>
</tr>
<tr>
<td>GEU &amp; CAS Structure</td>
<td>✓</td>
</tr>
<tr>
<td>Airframe Joints</td>
<td>✓</td>
</tr>
<tr>
<td>Base Structure Eval</td>
<td>✓</td>
</tr>
<tr>
<td>Soft Recovery System</td>
<td>✓</td>
</tr>
<tr>
<td>Tactical Base Structure</td>
<td>Nov 01</td>
</tr>
<tr>
<td>Electronics Gun Hardening</td>
<td>Feb 02</td>
</tr>
</tbody>
</table>
The Benefits of Accuracy

- Keep More Lethal Fire on Target Longer
- Less Lift and Shift Required
- Risk Estimated Distances Shortened
- Limits Collateral Damage
- Decreases Logistics Footprint
ARTQUIK Results

Number of Volleys Required to Achieve 20% EFD Against the ORD Target

**Excalibur DPICM**

1 - volley

**M864**

25 km - 6 - volleys
20 km - 3 - volleys
15 km - 2 - volleys
Guided Projectiles And The Close Fight
MG Carl Ernst, FA Journal, Sep-Oct 1999

“...artillery and mortar fires must be able to support maneuver at much closer ranges than currently imagined.”

“(because of minimum safe distances) the maneuver commander must stop the firing of indirect systems long before it would be tactically prudent on the battlefield.”

“...the issue (is) logistics. It will come down to a matter of trucks and projectiles.”
Guided Projectiles And The Close Fight

Risk Estimate Distances (RED) (.1% PI, 1/3 - Max range)

- 81mm Mortar (M29)
- 105mm Howitzer Unitary (M102/M119)
- 155mm Howitzer Unitary (M109/M198)
- 155mm Howitzer DPICM (M109/M198)
- XM982 Unitary
- XM982 DPICM
- GEM 81
- G105

Precision Guided Extended Range Artillery Projectile
Guided Projectiles And The Close Fight

Echelon Fires for the Light Infantry Attack/Defense*

* Close Fire Support (RED, 0.1% PI, Max Range

**Precision Guided Extended Range Artillery Projectile**
Guided Projectiles And The Close Fight

Echelon Fires for the Light Infantry Attack/Defense*

* Close Fire Support (RED, 0.1% PI, Max Range

Precision Guided Extended Range Artillery Projectile

Raytheon
Guided Projectiles And The Close Fight
Echelon Fires for the Light Infantry Attack/Defense*

* Close Fire Support (RED, 0.1% PI, Max Range

Precision Guided Extended Range Artillery Projectile
A command post in an urban environment.

A 20m X 20m structure.

10m Target Location Error
Current M549 vs 20X20 structure: 147 rounds
XM982 vs 20X20 structure: 3 rounds

Precision Guided Extended Range Artillery Projectile
Towed Artillery/Crew Target (10m TLE)
Current M549 vs Towed artillery target: 39 rounds
XM982 unitary vs towed artillery target: 3 rounds
Future Combat System Guided Projectiles

Direct/Indirect Gun System
- Dual-Purpose, Advanced Propulsion
- Maximum Lethality/Weight Ratio
- System of Systems Design, Including projectiles/C3I/Log
- Extended Range, Dominant Platform
- Very High Stowed Kill Capability
- Deployable, 3-6 Times Less Logistical Burden

Excalibur FCS
- Max Range: 50-100 km
- GPS/IMU 20 Meter Accuracy
- Family of Munitions
  - DPICM
  - SADARM
  - Unitary
- Digitized Battlefield Targeting System
- Advanced XM982/EX171 Design
- 3-6 Times Less Logistical Burden

Tank Extended Range Munition (TERM)
- 0-20 km Range
- Pk>.9 Against Future Threat Tank
- Advanced Tri-mode (MMW, LARAD, IR) Seeker
- Counter Armor Protection System (CAPS)
- Aim Point Selection
- In-Flight Re-targeting
- 3-6 Times Less Logistical Burden!

Precision Guided Extended Range Artillery Projectile
XM982 Excalibur Precision-Guided Projectile

• Modernizes Legacy Force platforms
• Transforms Interim Force fire support
• Enables Objective Force transformation
• Provides high lethality, long range dominance with low collateral damage/logistics burden
• Returns Field Artillery to the Close Fight
• Matures GP technologies for MRAAS/FCS
  - gun-hardened projectile guidance electronics
  - Leverages the digital battlefield for FCS
  - 3-6X light platform battlefield effectiveness