40th Annual Armament Systems
Guns-Ammunition-Rockets-Missiles
Conference and Exhibition
April 25 – 28, 2005

40mm CTWS Supporting
UK and France
CTA International

- CTA International (CTAI) is a joint venture company 50/50 BAE Systems and Giat Industries.
- Dedicated team, 40 strong, British and French engineers and scientists based in Bourges, France.
- Whole company focused on development of 40mm Cased Telescoped Weapon System.
- Technology Background funded from industrial investment.

Private Venture Investment since 1994 - >€52M
Cased Telescoped Technology

Principle of Technology
‘Telescoped’ ammunition

- 30% saving in volume for the same performance
- 30% more performance for the same volume
Cylindrical cartridges enable a much simpler Cannon mechanism. As a consequence, the overall cannon system is substantially smaller.

Rotating chamber and ‘push through’ concept.

25mm M 242 Bush I
30mm Mk 44 Bush II
35mm Bush III
40mm CT 40
Linkless Ammunition Feed Technology

- Compact
- Reduced gunner workload
  > Easy loading and unloading
  > Remote operation
CTWS Route Map

- 2002: Industrial Development Ends TRL 5/6
- 2003: OFCP
- 2004: Weapon system TRL 7
- 2005: Turret Integration
- 2006: Weapon system SRL 6
- 2007: Platform Development Industrialisation
- 2008: Series Manufacture

Today: 27th April New Orleans LA USA
The Objective Future Cannon Programme (OFCP)

• Started in September 2002; joint funded by UK MoD, French DGA and CTAI

• Preceeded by a system lethality system trade study which selected 40mm CTWS as the optimal cannon system to satisfy the future lethality requirements of UK and France.

• In 2002 UK and French Governments co operate on 40mm CTWS

• Driven by the Requirements of:
  • UK Warrior, FRES
  • DGA VBCI, EBRC

• Objective was to demonstrate TRL7 by the end of 2004 total - budget 9M€

• Customers are committted to share deliverables with other nations
TRL 7 Definition
‘System technology prototype demo in an operational environment’

Cannon – 40mm CTWS

Ammunition Feed System

‘The System’

Ammunition: APFSDS, GPR-PD, TP-T
‘The Environment’
‘OFCP’ Approach – UK MoD / French DGA / CTAI

• Define Requirement
  > Performance
  > Use – i.e. the 48hr Battlefield Mission
  > Maintenance and Support

• Define a set of assessment criteria
  > Safety
  > Environmental robustness
  > Reliability
  > Performance

• Develop test and assessment programme to deliver objective evidence

• Execute the programme
Requirements

- **Rate of Fire** 200 Shots per minute
- **Fire two ammunition types**
  selectable <3s
- **Remote operation**
- **Low integration volume** <80 litres total swept volume
- **Dispersion**
  > <0.35 mil APFSDS
  > <1 mil GPR
- **Minimum Fatigue Safety Life** 10,000 rounds
- **Operates in safety** –46°C to +63°C
- **Satisfies prevailing UK MoD and French DGA safety standards**
- **Reliability** >98%
- **Supports ‘coincidence’ fire control solution**
Before We Talk about Reliability!

Equivalent Stowed Kills

More ‘capable’ systems need to complete less cycles to complete the mission..... therefore their MRBF requirements are less.

Required MRBF for 98% Reliability Equivalent Stowed Kills

Achieving MRBF costs time, money and adds system level risk!
- Built new weapon
- Used AMSAA model to measure and report reliability
- Complete 10,000 round test programme in all BFM modes
• Fatigue Safety Testing
• 30,000 cycles completed on all safety critical components
  > Barrel
  > Breech Ring
  > Recoil system
  > Chamber
• 3x samples of each component tested in series to destruction
• Cumulative total of 360,000 test cycles completed
• Simulation techniques developed with UK MoD DOSG
• **Warrior Feed System**
  > Designed
  > Built
  > Integrated
  > Tested

• **Full dynamic vibration test programme completed on full mission load.**
Ammunition TRL Assessment Objectives and Approach

- **TRL 7**
  - > APFSDS
  - > TP-T
  - > GPR (PD)

- **Freezing of Build Standard**
  - > For GPR the development of a Point Detonating fuze

- **Production of test Quantities**
  - > Nominally 900 rounds of each

- **Completion of a sequential environmental test programme**

- **Completion of IM assessment**

- **Performance assessment**

APFSDS and TP-T sectioned ammunition
• UK MoD DOSG test Programme based OB Proc 43060
• Sequential Environmental Test
  > Hot Cold Streams -46°C & +63°C
  > Logistic Shock and Vibration
  > C130 transport
  > 2.1m Pallet Drop
  > Hot Diurnal Cycling
  > Cold Diurnal Cycling
  > Sequential Rough Handling
  > Tactical Vibration
  > Inspection
  > Test Firing
• Propelling Charge Evaluation
• Noise / Muzzle Blast
• Projectile Strength of Design
• 12m Drop Test
As always testing was not without some minor problems, but all environmental tests were completed and the firing programme concluded; 100%
……but still Shots Great!

Effective Breaching Brick Walls

GPR PD Firing Oct 2004
From Warrior IFV Turret

Defeat of Armoured Concrete with Behind Armour Effects

…while sensitive Against very light targets
Insensitive Munition (IM) Testing

- Tested to Requirements of STANAG 4439
- Only APFSDS tested to date
- Tests completed
  > Fuel Fire
  > Slow heating
  > Bullet Attack
  > Sympathetic Reaction
  > Shaped charge
Airburst TRL 5 Demonstration

- Completed over 200m (closed tunnel firing)
  - Safe and Arm function confirmed
  - Point Detonating Function Confirmed
  - Airburst function confirmed
  - Last multiple round trial 100% functional
• BAE Systems PV investment provided opportunity to design and build a turret which was used as part of OFCP maturity assessment

• Principal objectives

  • Demonstrate physical integration of weapon
  • Demonstrate management of CTWS out of balance
  • Demonstrate ‘User’ functionality of Weapon System with confines of turret.
    > Loading
    > Unloading
    > Firing

**40mm CTWS Weapon Stabilisation**
CTWS Route Map

- 2002: Industrial Development Ends TRL 5/6
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- 2005: Turret Integration
- 2006: UK MoD Manned Turret Demonstrator
- 2007: French DGA Unmanned Turret Demonstrator
- 2008: Platform Development Industrialisation
- 2009: Series Manufacture

Today:

- MTIP
- TOUTATIS

Funded
UK and French Government Collaboration

Warrior = VCI

EBM = FRES

UK TDP
Manned Turret Integration Programme

UK/FR OFCP

French DGA TDP Toutatis

Prototyping and Demonstrator Phase

Shared Programme Data
Investment from each gov’t
Gets access to the whole

EMD & PROD’N

CTA INTERNATIONAL
CTAI Turret Demonstrator Programmes

MTIP
4 Tonne Conventional Manned Turret

Toutatis
1,5 Tonne Unmanned Turret
Manned vs Unmanned

Mechanical Integration Considerations
40mm CTWS Feed system Modularity

MTIP
42 Rounds
2 Natures

VBCI
70 Rounds
2 Natures

Toutatis
68 Rounds
3 Natures
Manned vs Unmanned

Manned Turret
3.8 tonnes
Protection Level 4

Unmanned Turret
1.5 tonnes
Protection Level 3
Manned vs Unmanned
Electronic Architecture Considerations
Electronic Architecture Functionality against KUR

**KURs** (defined by Capability demands)

- **FIREPOWER**
  - Exploit the Data Management System
  - Inform the Crew Members
  - Operate the Radio Comms
  - Command the movements of the Vehicle
  - Use the Observation System
  - Exploit the Auto-Surveillance Suit
  - Exploit the IFF system
  - Operate the Fire Function
  - Operate the Defense Aids Suit

- **SURVIVABILITY**
- **MOBILITY**
- **CAPACITY**
- **C 3**
- **STA**
- **SUSTAINABILITY**
Unmanned solution ultimately demands confidence in Indirect Situational Awareness with a consequential impact on the EA.

French Army Leclerc Gunner Operating Toutatis MMI prototype; Bourges March 2005
Fire Function EA Drivers

Data Network (MILCAN)
- Bandwidth and rate
- Determinism

Video Network
- Sensors
- HD Display / Virtual reality
- Video mixing

Power Network
- Low/High
- EMC
- Autonomy
- Protection

Safety Network
- Technology
- Redundancy
‘Translating Lessons Learned into Systems Requirements’
Black Watch Warriors prepare to advance to set up a Forward Operating Base to the east of the Euphrates.
Conclusions

• Highest lethality at lowest system integration burden

• Overmatch provides best insurance against Asymmetric Target Sets for the next 30 years
  > APFSDS old generation vehicles
  > GPR Airburst suppression

• CTWS as a weapon system technology is at TRL 7

• 2006 will see Turret Demonstrators (Manned and Unmanned) at SRL 6

CTWS an ‘Enabling Technology’ for all future medium calibre lethality requirements