

# **Studies on Germany's Future 140 mm Tank Gun Systems - Conventional and ETC -**

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2) TZN Unterlüß GmbH

### *Overview*

- **Introduction**
  - **Protection of Main Battle Tanks**
  - **Effectiveness of Tank Gun Systems**
  - **Conventional Weapons**
  - **ETC-Technologies**
  - **Options for a FTMA**
  - **Conclusion**
-

### *Joint Venture RGR*

#### **The companies**

- **Royal Ordnance (UK)**
- **GIAT Industries (F)**
- **Rheinmetall W&M GmbH (D)**



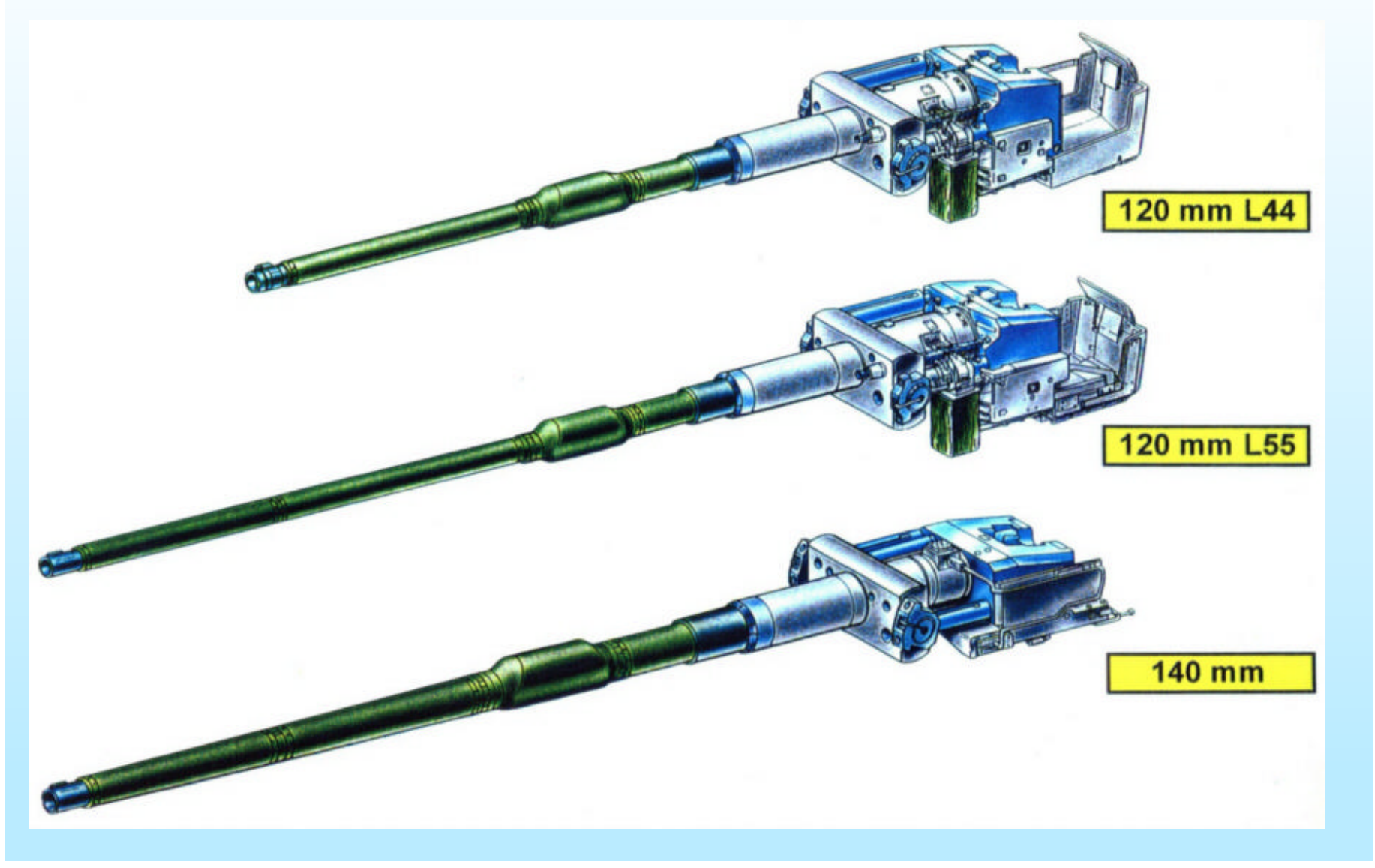
**all capable of providing a 140mm tank gun, have joined together in a european JVC, named RGR, to most effectively meet the FTMA challenge.**

### *Options for a FTMA*

**Three future tank weapon and ammunition systems are currently the subject of technology investigations within Europe and the USA:**

- **conventional 140 mm tank gun systems**
  - **Electro-Thermal Chemical (ETC) gun systems**
  - **Electro-Magnetic Gun systems**
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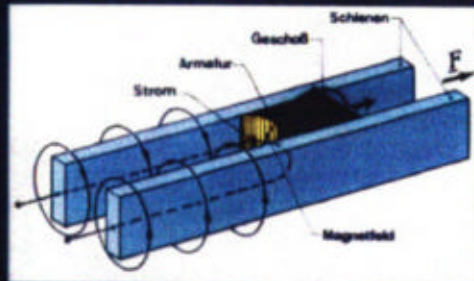
*Conventional MBT-Weapons*



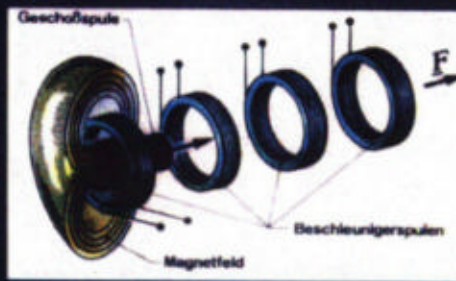
*Electric Guns - Physical Principles*

## Pure Electric Guns Physical Principles and Characteristics

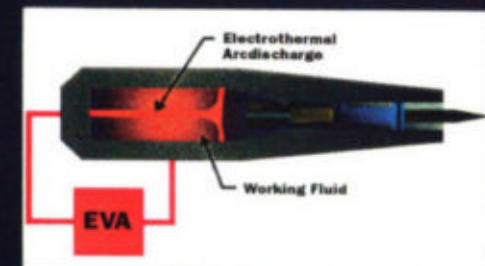
**Rail Gun**



**Coil Gun**



**Electrothermal Gun**



### Characteristics

- High Muzzle Velocity
- High Ballistic Efficiency
- High Repetition Rate

- High Muzzle Velocity
- High Ballistic Efficiency
- Low Barrel Wear

- High Muzzle Velocity
- Wellknown Projectile Technology
- Wellknown Barrel Technology

### Technical Risks

- High electric Energy Consumption
- Complicated Barrel Design
- Armature Technology

- High electric Energy Consumption
- Complicated Barrel Design
- Complicated PPS-Technology

- High electric Energy Consumption

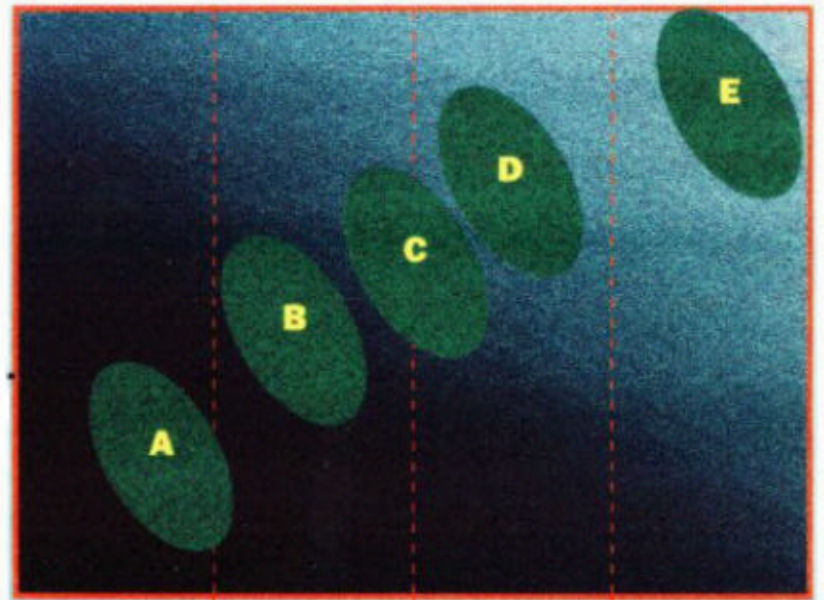


Basic Considerations on Interior Ballistic Processes

# Classification of ETC Technologies

## Powder Charge Modifications and Electrical Energy Consumption

- Inert Propellants (ETK)
- ETC propelling Gas Conversion
- ETC Combustion Control
- ETC Ignition of Charge with increased L.-Dens.
- ETC Ignition of conventional Powder Charge



0.1      1      10      100  
**Electrical Energy [MJ]**

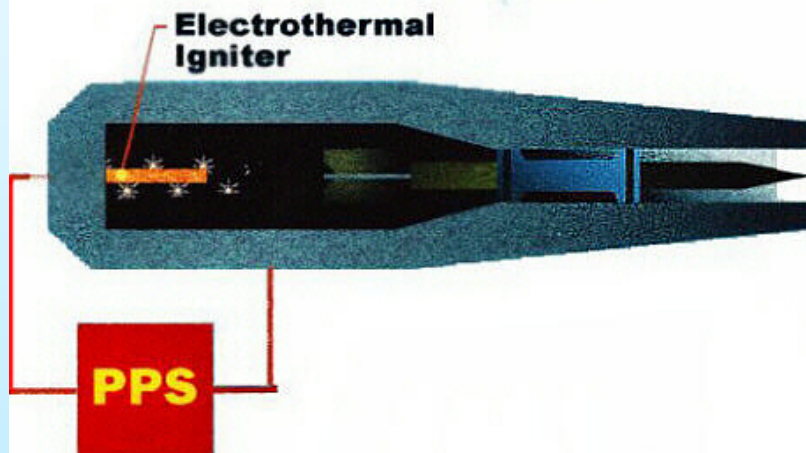
## Interior Ballistic Results

Type	Measure	Wo	Vo
A	electrical Ignition		
B	electrical controlled Ignition	++	+
C	electrical controlled combustion	++	+
D	electrical initiated H2-Addition	++	++
E	electrical evaporation of inert propellants	++	+++

ETC - Basic Considerations on Interior Ballistic Processes 1

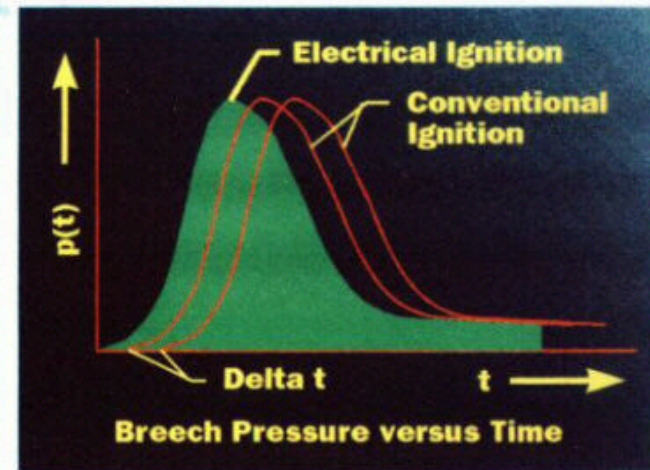
### Type A: Electrical Ignition of conventional Powder Charges

#### Modification



**Modification of Igniter**  
**PPS: < 100 kJ**

#### Interior Ballistic Result

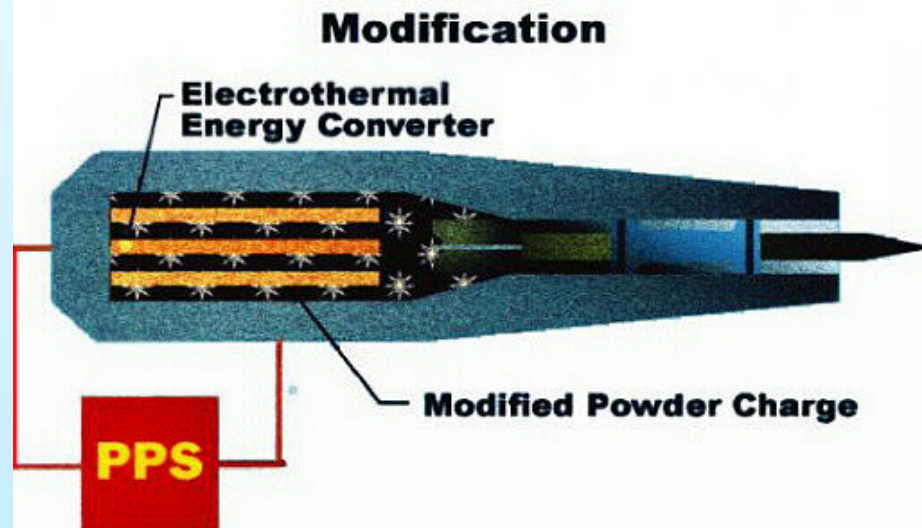


**Decrease of Ignition Jitter**  
↓ ↓ ↓  
**Precision Improvement**



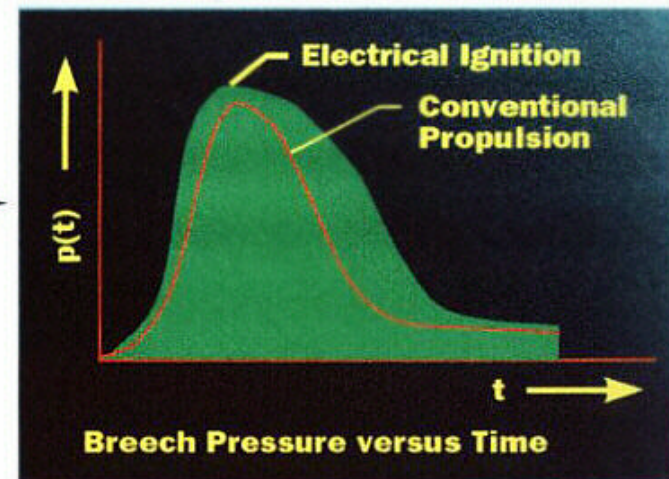
*ETC - Basic Considerations on Interior Ballistic Processes 2*

**Type B:  
Electrical controlled Ignition of Powder Charges  
with increased Loading Density**



**Modification of Powder Charge**  
**Absorption of electrothermal Energy**  
**PPS: 300 kJ up to 600 kJ**

**Interior Ballistic Results**



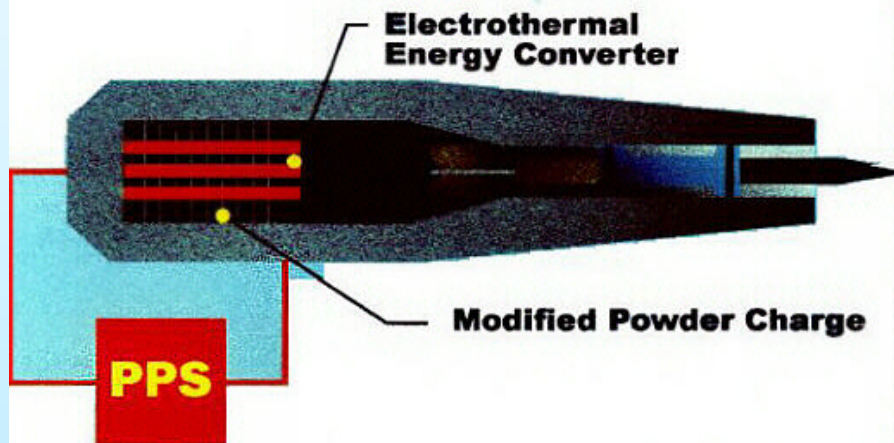
**Increase of Propulsion Energy**

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**Increase of Muzzle Energy**

ETC - Basic Considerations on Interior Ballistic Processes 3

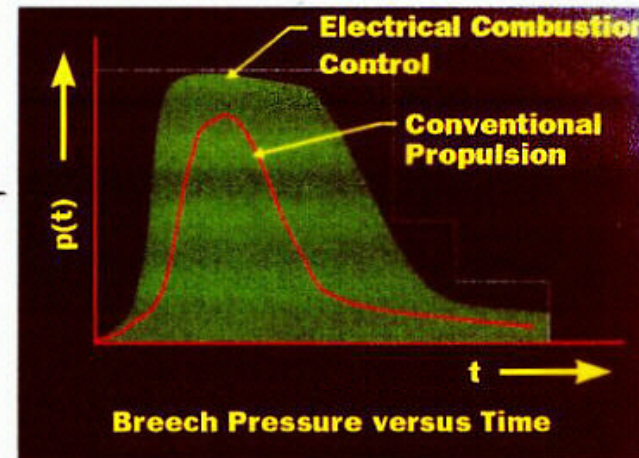
### Type C: Electrical controlled Combustion of Powder Charges with increased Loading Densities

#### Modification



**Modification of the Powder Charge**  
**Absorption of electrothermal Energy**  
**PPS: 0.9 MJ up to 1.8 MJ**

#### Interior Ballistic Results



**Increase of Propulsion Energy**  
**Decrease of Temperature Coefficient**

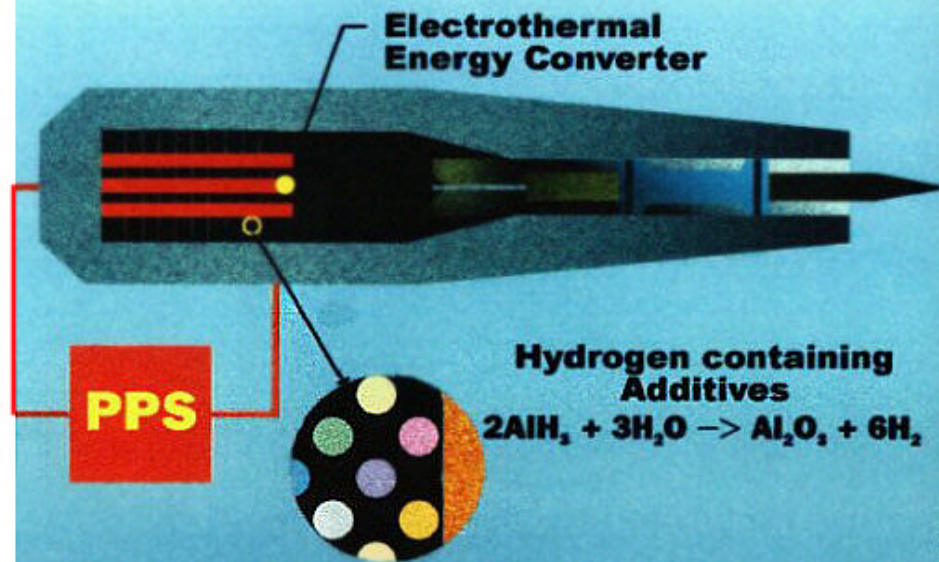
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**Increase of Muzzle Energy**



ETC - Basic Considerations on Interior Ballistic Processes 4

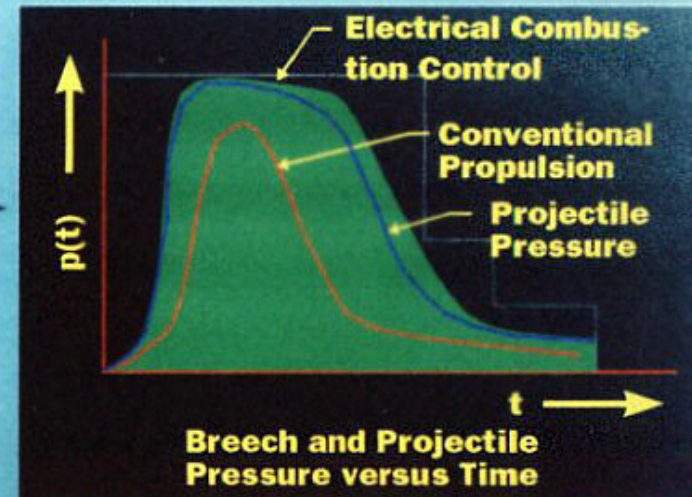
# Type D: Electrical controlled Combustion of Powder Charges with increased Loading Densities and integrated Additives

## Modification



Modification of Powder Charge  
Absorption of electrothermal Energy  
PPS: 2.5 MJ up to 5 MJ

## Interior Ballistic Results



Increase of Propulsion Energy, Decrease of Temperature Coefficient, Conversion of propelling Gas

↓ ↓ ↓  
Increase of Muzzle Energy and Muzzle Velocity

## Options for a FTMA



Characteristics	Options		
	140mm Tank Gun	120mm ETC Gun	EM Gun
<b>Performance</b> <b>Energy at muzzle</b> (Total shot): MJ <b>Penetrator</b> (Effective Energy): MJ	23  14	16  9	23  14
<b>Timeframe</b> (for developed system)	2007	> 2017	>> 2030
<b>Technical Risk</b>	<b>Low</b> - conventional technology available now	<b>High</b> - best case performance estimate - technology not yet available	<b>Very High</b> - technology not available (power supply, gun configuration, armature issues)
<b>Integration Issues</b>	<b>Compliance with existing and new MBTs</b>	<b>Severe constraints for integration into existing and future vehicle systems: power supply, weight, volume, configuration</b>	



### *Conclusions (1)*

**Developments in tank protection levels require a new tank main armament weapon and ammunition system.**

**Options are:**

- **Conventional 140 mm**
  - **ETC as an optional upgrade**
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*Conclusions (2)*

**Conventional 140 mm**

- offers a low-risk option dependent only on technologies that will mature with certainty by the Millennium.
- is retrofittable to existing tank platforms with acceptable integration and usage risks and with operating characteristics familiar to users of current tank gun systems.

### *Conclusions (3)*

#### **ETC:**

- **offers a medium-risk option dependent on technologies that will mature within the next ten years.**
  - **is an optional enhancement of a conventional weapon independent of the caliber.**
  - **fittable to tank platforms with considerable implication on integration and system layout.**
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*More Information*

**In case you would like to have more information,  
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