105 mm HEP-IM

Reduced Vulnerability / Enhanced Lethality
Direct Fire Large Caliber HE Ammunition for MGS

Presented by Roger Gelinas

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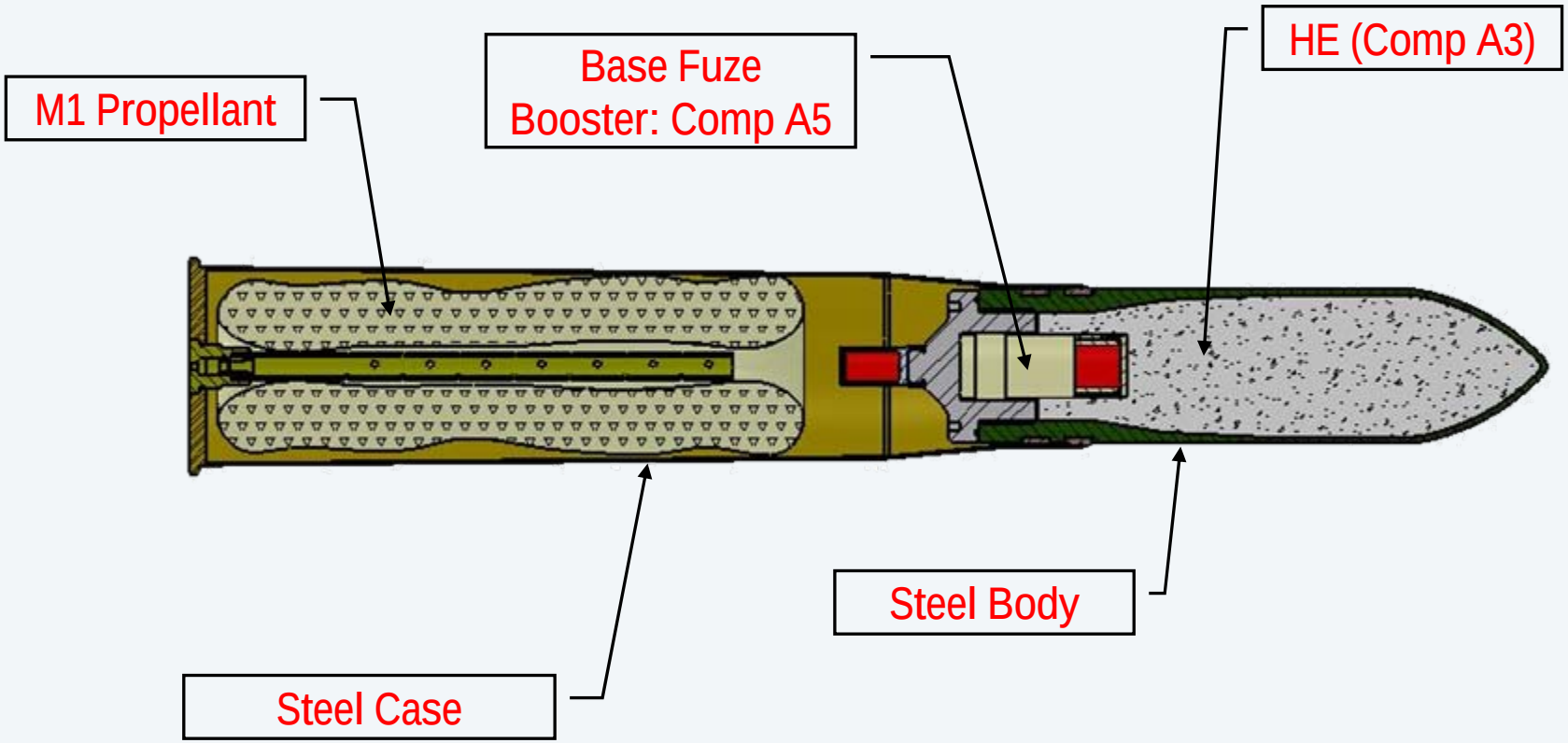
GENERAL DYNAMICS
Ordnance and Tactical Systems–Canada

105 mm HEP-IM Cartridge

- Vulnerability of the 105 mm HEP cartridge to external threats compromises the MGS crew survivability
- GD-OTS Canada developed a low vulnerability version of the 105 mm HEP cartridge compatible with the MGS platform to meet these needs

Standard 105 mm HEP M393



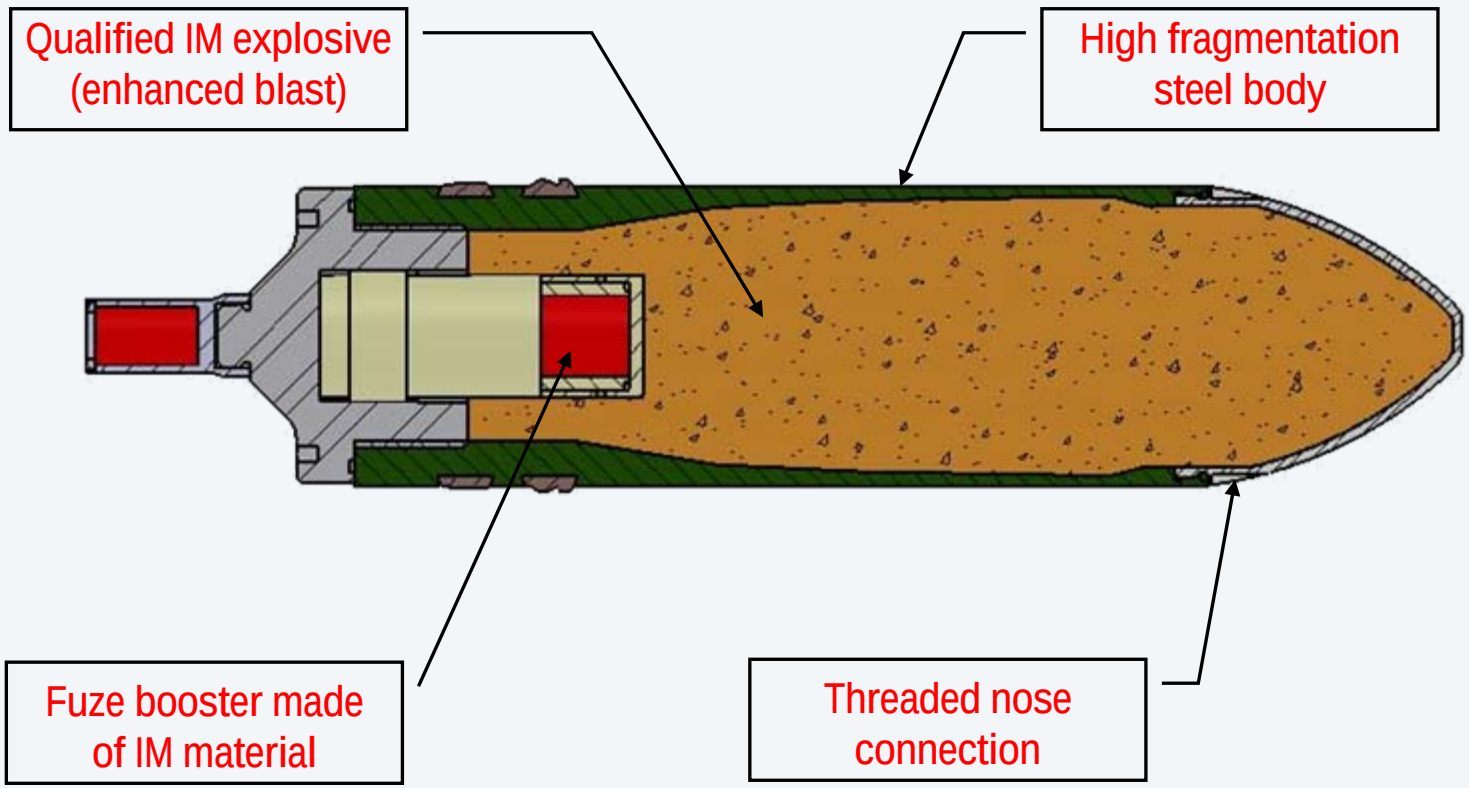
Design Constraints

- Maintain performance level with current HEP ammunition
- Maintain ballistic compatibility
- Development should not require full qualification of the cartridge
- Production cost competitive with current HEP ammunition

Technical Roadmap

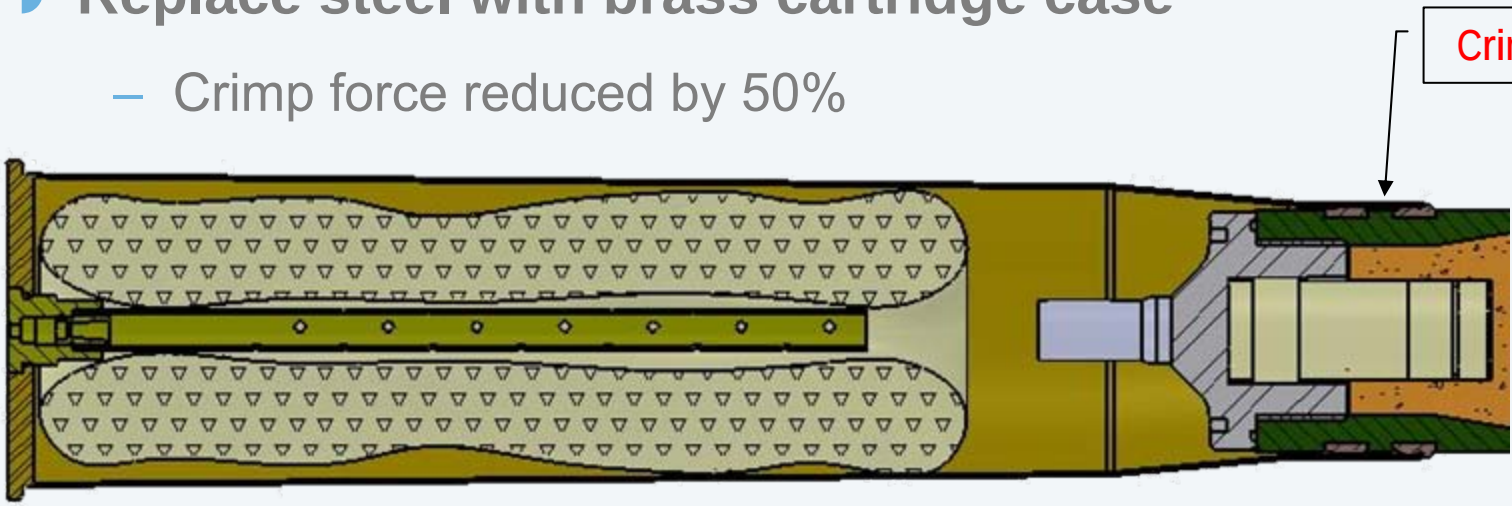
Approach	Rationale
Focus on HE projectile	Projectile is the main contributor to the reaction violence to stimuli
No change to the propelling charge system	Lower reaction than projectile Avoid extensive qualification

Changes to Projectile



Changes to Cartridge Case

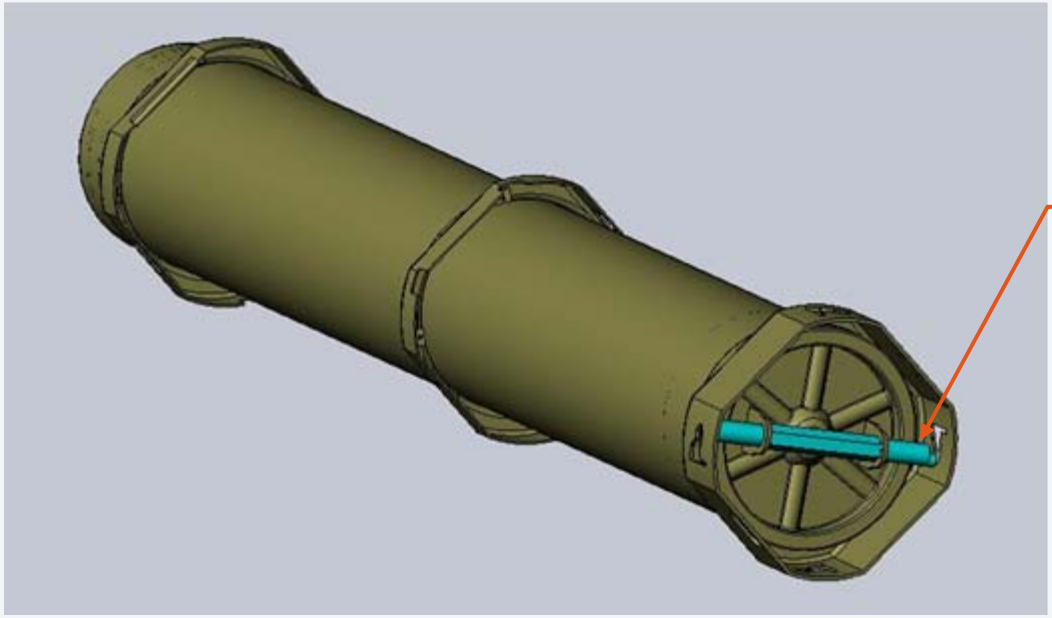
- **Replace steel with brass cartridge case**
  - Crimp force reduced by 50%



- **Reduces confinement of propellant for lower reaction to FCO**
- **Successful testing in MGS autoloader**

Changes to Packaging (PA 117 cont'd)

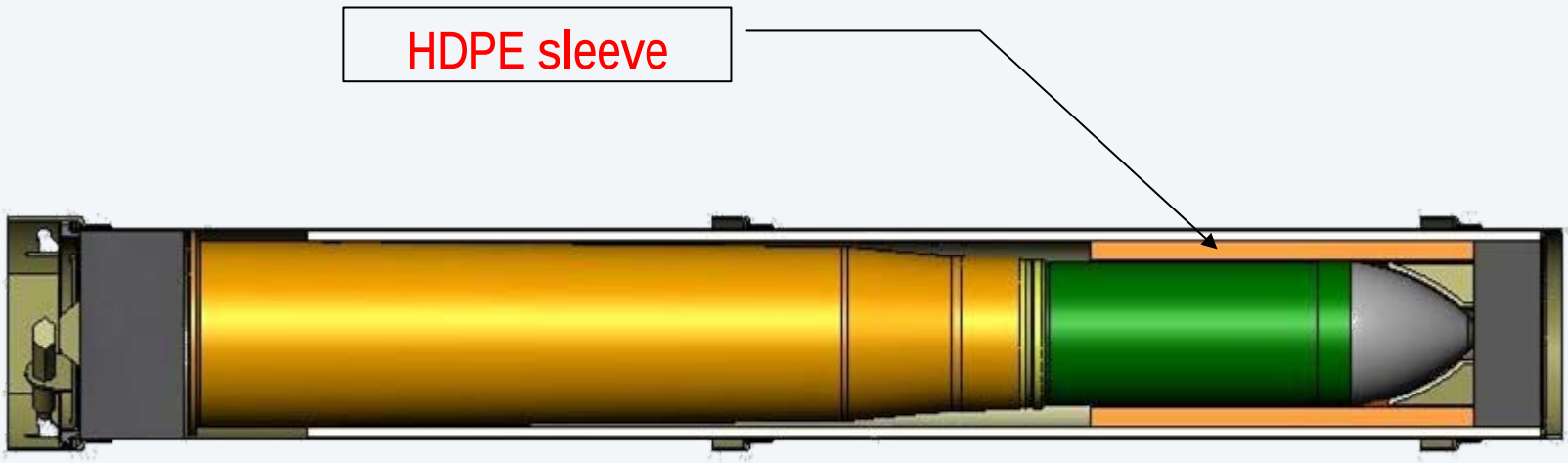
- **Reduce strength of cover locking pin**
  - Allows separation of case to projectile during Cook-Off (reduces propellant confinement)



- **Withstands 2.1m drop test**

Changes to Packaging (PA 117 cont'd)

- Use HDPE sleeve around warhead to avoid sympathetic detonation



Bullet Impact on HEP-IM Projectile Test Results

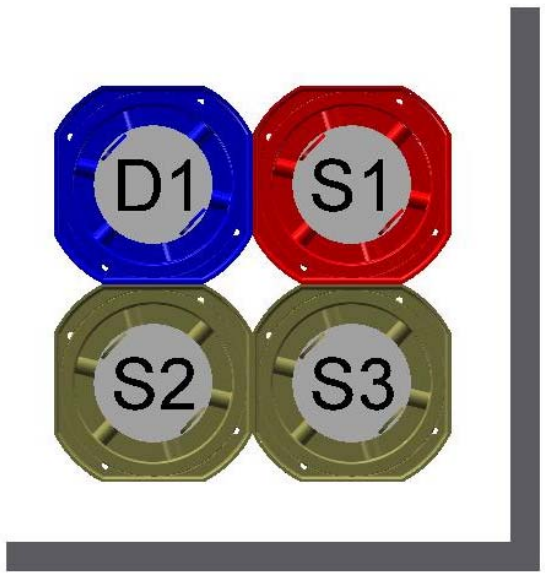
Type IV Reaction

Fast Cook-Off on HEP-IM Cartridge Test Results

Type IV Reaction

Sympathetic Detonation on HEP-IM Cartridge – Test Set-up

- Red detonates (donor)
- Green are receivers
- Blue is a dummy



Sympathetic Detonation on HEP-IM Cartridge – Test Results

Type III Reaction

- No indentation into witness plate
- IM explosive dispersed around test site
- Projectile metal parts broken in pieces without evidence of fragmentation

Warhead Terminal Effects

- Demonstrated capability to breach the 8- inch thick DRCW target

		Size of opening	# of rounds
Requirements	Minimum	24'' x 48''	5 rounds
	Objective	30'' x 50''	3 rounds
Results of gun firings		**32'' x 72''**	**3 rounds**

Warhead Terminal Effects

2 shots

27'' x 55'' Opening

3 shots

32'' x 72'' Opening

Warhead Terminal Effects (Lethality)

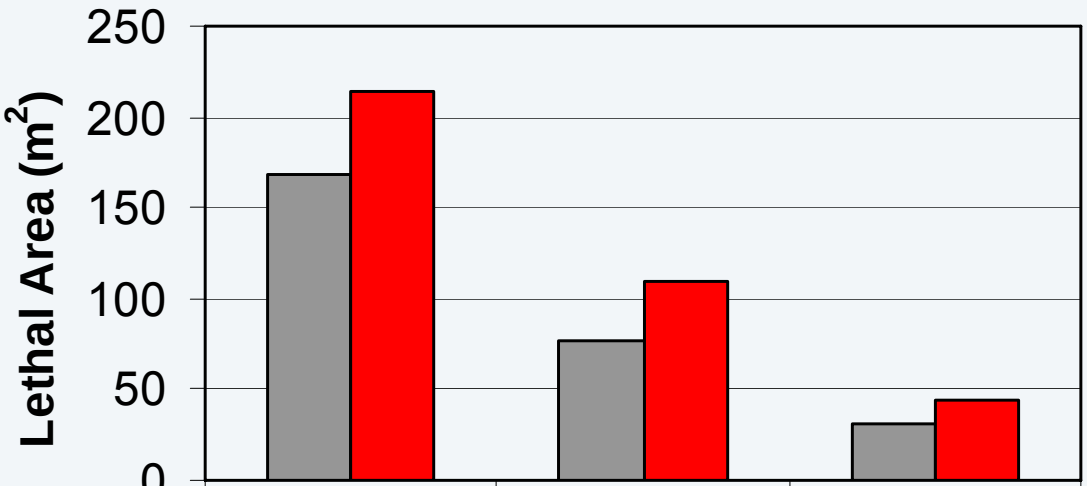
- **40% increased lethal area against personnel in the open vs current HEP**

- **Contributors**
  - High-frag steel
  - Enhanced blast explosive

Warhead Terminal Effects (Lethality)

Comparative simulation based on:

- 50% probability of kill
- Protected personnel
  (Helmet and US winter clothing)
- Standing personnel
- Ground impact



	Pk ≥ 10%	Pk ≥ 50%	Pk ≥ 90%
105mm HEP	169	76	32
105mm HEP-IM	214	109	43

105 mm HEP-IM Cartridge

	REACTION TYPES	
	HEP-IM (actual testing)	MIL-STD-2105 C
BULLET IMPACT (0.50 AP) ON PROJECTILE	IV	V
FAST COOK-OFF	IV	V
SYMPATHETIC DETONATION	III	III

105 mm HEP-IM (Conclusions)

- **Improved MGS crew survivability**
  - HE-IM explosive
- **Increased terminal effect**
  - Breaching 8'' DRCW (exceeds requirements)
  - Anti-personnel increased by 40%
- **Low risk development program approach**
  - Modification of existing cartridge
- **Propelling system does not need to be re-qualified**

Questions