Defensive Armament for the V-22
Selection, Integration, and Development

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History

- **Defensive weapon requirements developed by HQMC (ORD)**
  - Gun is Threshold requirement
  - Helmet Tracker was an Objective requirement, Jul 2001 review upgraded it to a Threshold requirement.

- **Gun Study, an element of government funded Forward Fuselage Configuration Study, conducted May 98 – Oct 99**
  - Determine the characteristics and requirements for a turreted, defensive gun system that comply with the CV-22 and MV-22 airframe and mission requirements. Define the major airframe and system integration tasks required for implementing the gun system into the MV & CV-22 aircraft.

- **Gun vendor competition conducted Dec 99 – Aug 00**
  - GDAS GAU-19 announced as selected system Aug 00

- **SD 572-1 Detail Specification Requirement**
  - Rotary, three-barrel 50-caliber, turreted, nose gun
Characteristics Requirement

• **Caliber/Ammunition Capacity/Sustained Firing Rate**
  – Obtain and maintain a 90% suppression level against 10 troops
  – Obtain within 3 seconds of engagement initiation
  – Sustained without reload for 60 seconds minimum
  – Randomly distributed in a building 10 m tall X 20 m wide
  – From 500 meters

• **System Weight**
  – System (empty weight) \( \leq 460 \text{ lbs} \)
  – Portable Magazine \( \leq 37 \text{ lbs} \)
  – Ammunition Storage & Feed System
  – No FOD/Linkless system
  – In-flight Reload Capability (20% capacity in 60 seconds)

• **Recoil Force, \( \leq 900 \text{ lbs} \)**

• **Reliability**
  – Turret and Gun Assembly
    • MRBF \( \geq 30,000 \) rounds minimum
FOD Design Analysis

• SOF Configuration Trade Study, Phase 1, Oct. 1993
  – Point of ejection was assumed to be at station 264
  – In a worse case maneuvering condition, the spent shell and links will:
    • not strike the aircraft in helicopter mode
    • strike the aircraft underside of the fuselage in airplane mode at very low energies (no damage)
  – In hover in ground effect, re-circulation of rotor downwash occurs
  – Spent cartridge may be lifted into the rotor or the engine inlet, causing FOD
  – Conclusion
    • Provisions will be made to retain the spent brass
Flow Field
### Comparison Matrix

**NDIA Guns & Ammunition Symposium**

*From FFCS TIM #1 - 3 Dec 98*

<table>
<thead>
<tr>
<th>System</th>
<th>Contractor/Platform</th>
<th>Type</th>
<th>ROM Rec Cost (^1) ($k)</th>
<th>Weight Impact (^2) (Lbs)</th>
<th>MRBF (^3)</th>
<th>Electrical</th>
<th>Recoil Force (Lbs)</th>
<th>Firing Rate (spm)</th>
<th>Ammo Capacity per load (Rds)</th>
<th>Dispersion (^4) 3 (\sigma) (Mils)</th>
<th>Pointing Accuracy 3 (\sigma) (Mils)</th>
<th>FOD/NO FOD Design</th>
<th>In-Flight Reload</th>
<th>Fires 750 rds w/o cooling (for 20mm or smaller)</th>
<th>Muzzle Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Guideline</td>
<td>N/A</td>
<td>Turreled Gatling</td>
<td>N/A &lt;458</td>
<td>30,000</td>
<td>115 VAC 400 Hz or 28 VDC</td>
<td>&lt; 900 (goal)</td>
<td>750 (1000, 1200)</td>
<td>750 for 20mm or smaller</td>
<td>&lt; 8</td>
<td>&lt; 3</td>
<td>NO FOD, Linkless</td>
<td>REQ</td>
<td>REQ</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>GAU-2A Or M134 7.62 mm</td>
<td>GD UH-1N (^5) AH-1G CH-47D UH-60A (^6)</td>
<td>Turreled 6 barrel Gatling 3.15 ft</td>
<td>312 K</td>
<td>432</td>
<td>30,000</td>
<td>270 VDC 50 Amps</td>
<td>N/A</td>
<td>2,000 to 6,000</td>
<td>700 to 2,000</td>
<td>7</td>
<td>3.0</td>
<td>NO FOD, Linkless</td>
<td>YES</td>
<td>YES</td>
<td>2,750 ft/sec</td>
</tr>
<tr>
<td>GAU-19A .50 Cal (12.7 mm)</td>
<td>GD UH-60A (^6)</td>
<td>Turreled 3 barrel Gatling 3.87 ft</td>
<td>312 K</td>
<td>454</td>
<td>30,000</td>
<td>270 VDC 60 Amps</td>
<td>800 @ 1,000 spm, 1000 @ 2,000 spm</td>
<td>1,000 to 2,000</td>
<td>772 to 1,428</td>
<td>6.7</td>
<td>3.0</td>
<td>NO FOD, Linkless</td>
<td>YES</td>
<td>YES</td>
<td>2,770 ft/sec</td>
</tr>
<tr>
<td>M-197 20 mm</td>
<td>GD AH-1W</td>
<td>Turreled 3 barrel Gatling 5 ft</td>
<td>380</td>
<td>512</td>
<td>30,000</td>
<td>28 VDC, 60 Amps</td>
<td>1,450 @ 750 spm</td>
<td>650</td>
<td>750</td>
<td>6.7</td>
<td>3</td>
<td>FOD</td>
<td>YES</td>
<td>YES</td>
<td>3,380 ft/sec</td>
</tr>
<tr>
<td>XM-301 20 mm</td>
<td>GD RAH-66</td>
<td>Turreled 3 barrel Gatling 5.08 ft</td>
<td>360 K</td>
<td>280</td>
<td>N/A</td>
<td>270 VDC TBD Amps</td>
<td>1,500 @ 750 spm</td>
<td>750 to 1,500</td>
<td>500</td>
<td>6.7</td>
<td>3.0</td>
<td>FOD, Linked</td>
<td>YES</td>
<td>NO (Reload required)</td>
<td>3,380 ft/sec</td>
</tr>
<tr>
<td>XM-301 20 mm</td>
<td>GD RAH-66</td>
<td>Turreled 3 barrel Gatling 5.08 ft</td>
<td>360 K</td>
<td>280</td>
<td>N/A</td>
<td>270 VDC TBD Amps</td>
<td>1,500 @ 750 spm</td>
<td>750 to 1,500</td>
<td>500</td>
<td>6.7</td>
<td>3.0</td>
<td>FOD, Linked</td>
<td>YES</td>
<td>NO (Reload required)</td>
<td>3,380 ft/sec</td>
</tr>
<tr>
<td>THL20 20 mm</td>
<td>GIAT</td>
<td>Turreled Single barrel</td>
<td>250 K</td>
<td>501</td>
<td>30,000</td>
<td>115 VAC 400 Hz and 28 Vdc</td>
<td>562 @ 800 spm</td>
<td>700 to 900</td>
<td>860</td>
<td>7.5</td>
<td>3.0</td>
<td>FOD, Linked</td>
<td>YES</td>
<td>NO</td>
<td>Data Not Available</td>
</tr>
<tr>
<td>THL30 30mm</td>
<td>GIAT</td>
<td>Turreled Single barrel</td>
<td>440 K</td>
<td>567</td>
<td>30,000</td>
<td>200 VAC 400 Hz and 28 Vdc</td>
<td>1,461 @ 720 spm</td>
<td>720</td>
<td>450</td>
<td>7.5</td>
<td>3.0</td>
<td>FOD, Linked</td>
<td>YES</td>
<td>NO (Reload required)</td>
<td>2,494 to 2,658 ft/sec</td>
</tr>
<tr>
<td>RMK-30 30 mm</td>
<td>Global Marketing</td>
<td>POD Mounted Single barrel</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.5</td>
<td>3.0</td>
<td>FOD, Linked</td>
<td>NO</td>
<td>NO</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>M230 30 mm</td>
<td>Boeing Mesa Apache LB</td>
<td>Turreled Single barrel</td>
<td>395 K</td>
<td>466 or 396 (^7)</td>
<td>N/A</td>
<td>DC System</td>
<td>3,000 @ 625 spm</td>
<td>600 to 650</td>
<td>1150 or 600 (^8)</td>
<td>3.0</td>
<td>3.0</td>
<td>FOD, Linked</td>
<td>YES</td>
<td>NO (Reload required)</td>
<td>2,640 ft/sec</td>
</tr>
</tbody>
</table>

\(^1\) Gun system only, unburdened

\(^2\) Includes gun, turret assembly, feed assembly, electronic control unit, ammo container (Uninstalled Weight).

\(^3\) Required weight is based on previous gun study. 80% of rounds fired.

\(^4\) Mean Rounds Before Failure.

\(^5\) Pintle mounted.

\(^6\) 466 lbs with the 1200 rds Apache magazine, 396 lbs with a new 600 rds V-22 magazine.
Objective

- Install the weapon in the undernose area of the aircraft
- TGS field-of-fire controlled by:
  - Existing FLIR via the track handle
  - Left/right crew helmet using the added HTS.
- HTS will provide point-and-shoot capability for the TGS in both day and night mode operations.
- Hit a target (20m wide x 10m tall) at 500 meters
- No moving targets
- Urban warfare landing zone
- No Air-to-Air
TGS Characteristics

- **GDAS GAU-19**
  - Three barrel .50 cal gattling gun
- **Turreted - Undernose installation**
- **Percussion-fired**
- **Firing Rate - 1200 to 1500 spm**
- **Turret Angular Coverage**
  - Azimuth = ± 110° Max
  - Elevation = 50° down, 20° up
- **Slew Rate - 100° /sec**
- **Recoil Force ≤ 550 lbs**
- **Uninstalled Weight - 456 lbs**
- **MRBF > 30,000 rounds**
- **Linkless/NoFOD System**
- **Electrically Driven**
- **750 round capacity in Ammunition Handling System**
- **In-flight reloadable**
TGS Installation

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Symposium

AVSS

MMR

FLIR

Turret
Fairing

Turret
Support

Refueling
Probe

Fixed Ammunition
Feed Chutes

Ammunition
Magazine

Reloading Module

736-023
Conclusion

A TOTAL SYSTEM SOLUTION FOR THE V-22:

• Low Cost of Ownership
• Affordable and Supportable
• Survivability Exceeds Mission Requirements
• Lethality and Accuracy Out to 1800 Meters
• High Reliability – MRBF ≥ 30,000
• Simplified Maintenance – Low Aircraft Burden
• Rapid Inflight Reload Capability
• Shipboard Compatibility