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

Vance Barton, BHTI

Edwin J. De Pasqual, GDAS

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

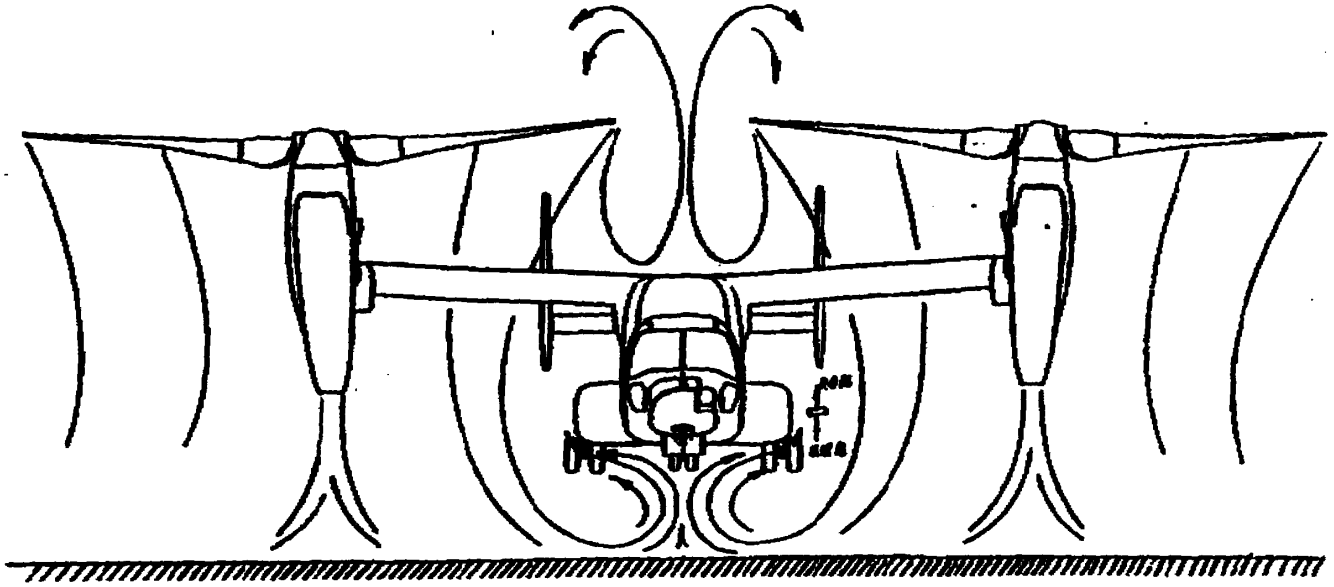
Characteristics Requirement

- **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) ≤ 460 lbs
  - Portable Magazine ≤ 37 lbs
  - Ammunition Storage & Feed System
  - No FOD/Linkless system
  - In-flight Reload Capability (20% capacity in 60 seconds)
- **Recoil Force, ≤ 900 lbs**
- **Reliability**
  - Turret and Gun Assembly
    - MRBF ≥ 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
(From FFCS TIM #1 - 3 Dec 98)

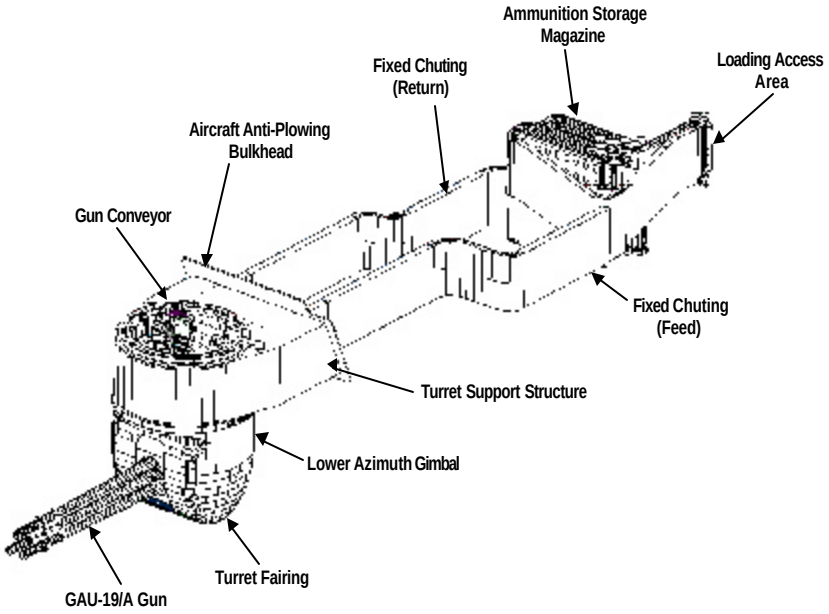
System	Contractor/ Platform	Type	ROM Rec Cost[1] (98$)	Weight Impact[2] (Lbs)	MRBF[4]	Electrical	Recoil Force (Lbs)	Firing Rate (spm)	Ammo Capacity per load (Rds)	Disper-sion[3] 3 s (Mils)	Pointing Accuracy 3 s (Mils)	FOD/ NO FOD Design	In-Flight Reload	Fires 750 rds w/o cooling (for 20mm or smaller)	Muzzle Velocity
Required/ Guideline	N/A	Turreted Gatling	N/A	<458	30,000	115 VAC 400 Hz or 28 VDC	< 900 (goal)	750, 1000, 1200	750 for 20mm or smaller	< 8	< 3	NO FOD, Linkless	REQ	REQ	N/A
GAU-2A Or M134 7.62 mm	**GD** UH-1N[5] AH-1G[5] CH-47D[5] UH-60A[5]	Turreted 6 barrel Gatling 3.15 ft	312 K	432	30,000	270 VDC 50 Amps	N/A	2,000 to 6,000	700 to 2,000	7	3.0	NO FOD, Linkless	YES	YES	2,750 ft/sec
GAU-19/A .50 Cal (12.7 mm)	**GD** UH-60A[5]	Turreted 3 barrel Gatling 3.87 ft	312 K	454	30,000	270 VDC 60 Amps	800 @ 1,000 spm, 1000 @ 2,000 spm	1,000 to 2,000	772 or 1,428	6.7	3.0	NO FOD, Linkless	YES	YES	2,770 ft/sec
M-197 20 mm	GD AH-1W	Turreted 3 barrel Gatling 5 ft	380	512	30,000	28 VDC, 60 Amps	1,450 @ 750 spm	650	750	6.7	3	FOD	YES	YES	3,380 ft/sec
XM-301 20 mm	**GD** RAH-66	Turreted 3 barrel Gatling 5.08 ft	360 K	280	N/A	270 VDC TBD Amps	1,500 @ 750 spm	750 to 1,500	500	6.7	3.0	FOD, Linked	YES	NO (Reload required)	3,380 ft/sec
XM-301 20 mm	**GD** RAH-66	Turreted 3 barrel Gatling 5.08 ft	360 K	280	N/A	270 VDC TBD Amps	1,500 @ 750 spm	750 to 1,500	500	6.7	3.0	FOD, Linked	YES	NO (Reload required)	3,380 ft/sec
THL20 20 mm	**GIAT**	Turreted Single barrel	250 K	501	30,000	115 VAC 400 Hz and 28 Vdc	562 @ 800 spm	700 to 900	860	7.5	3.0	FOD, Linked	YES	NO	Data Not Available
THL30 30mm	**GIAT**	Turreted Single barrel	440 K	567	30,000	200 VAC 400 Hz and 28 Vdc	1,461 @ 720 spm	720	450	7.5	3.0	FOD, Linked	YES	NO (Reload required)	2,494 to 2,658 ft/sec
RMK-30 30 mm	**Global Marketing**	POD Mounted Single barrel	N/A	N/A	N/A	N/A	Recoil-less	N/A	N/A	4.5	3.0	FOD, Linked	NO	NO	N/A
M230 30 mm	**Boeing Mesa** Apache LB	Turreted Single barrel	395 K	466 or 396[6]	N/A	DC System	3,000 @ 625 spm	600 to 650	1150 or 600[6]	3.0	3.0	FOD, Linkless	YES	NO (Reload required)	2,640 ft/sec

[1] Gun system only, unburdened
[2] Includes gun, turret assembly, feed assembly, electronic control unit, ammo container (Uninstalled Weight). Required weight is based on previous gun study. [3] 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

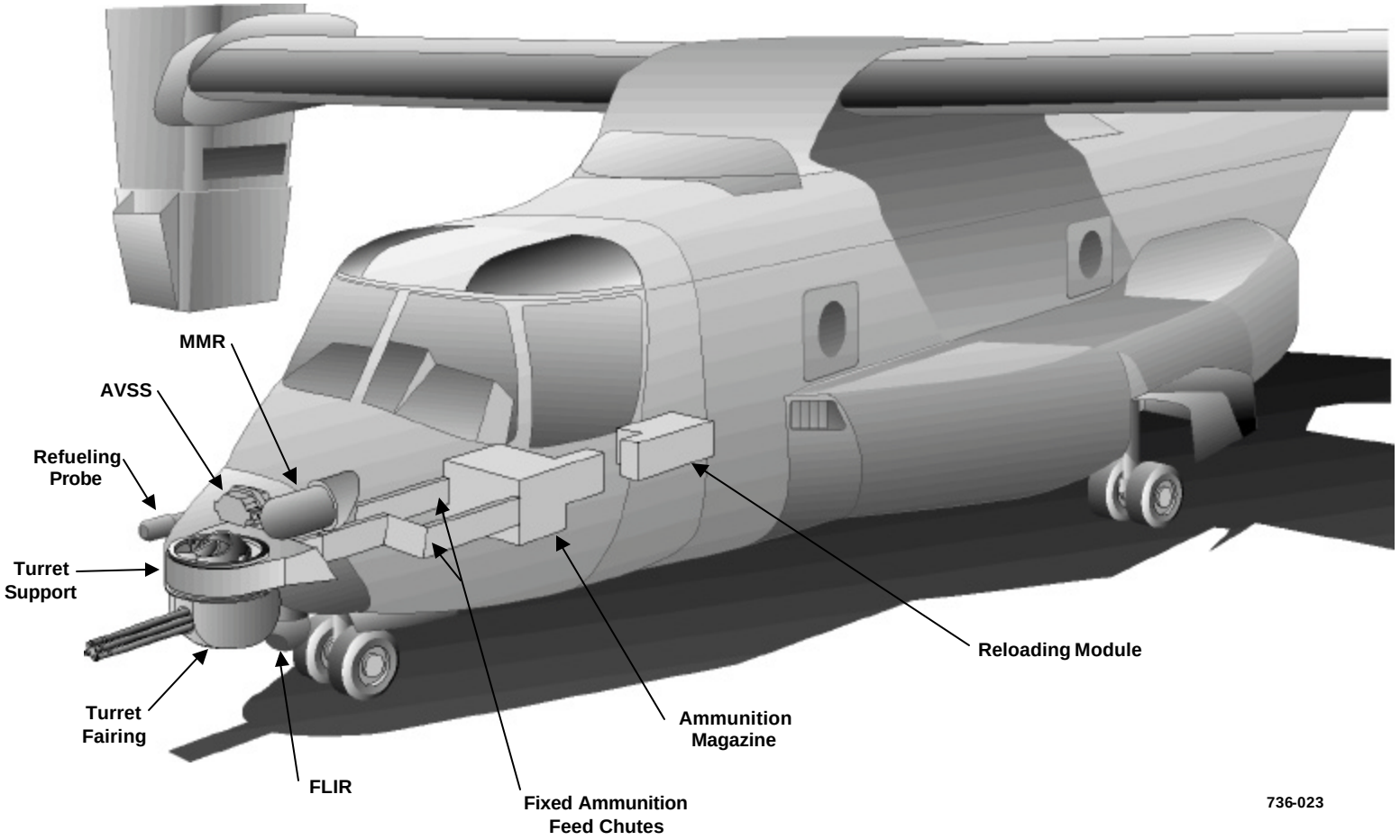
- **Install the weapon in the undernose area of the aircraft**
- **TGS field-of-fire controlled by:**
  - Existing FLIR via the track handle
  - Left/right crew helmet using the added HTS.
- **HTS will provide point-and-shoot capability for the TGS in both day and night mode operations.**
- **Hit a target (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 = ± 110º Max
  - Elevation = 50º down, 20º up
- **Slew Rate - 100º /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



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 $\geq$ 30,000
- Simplified Maintenance – Low Aircraft Burden
- Rapid Inflight Reload Capability
- Shipboard Compatibility