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Preliminary Design of Viking Armored Gun System

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C-Group / Physics Department

October 24, 1990

Mr. Andrus Viilu
Assistant Deputy Under Secretary of Defense
Tactical Warfare Programs (Land Warfare)
Office of the Secretary of Defense
Room 3E1016
The Pentagon
Washington, D.C. 20301

Dear Andy;

This report

We have completed the preliminary design of our third lightweight armored fighting vehicle -- the Viking Armored Gun System (AGS). The AGS vehicle features a two-man crew, the Ares 75mm Universal Turret System, and the John Deere 4026R Rotary Engine. In the spirit of our earlier AFV designs (Reference 1), our primary concern is to provide the AGS with sufficient firepower and survivability while utilizing "off-the-shelf" sub-systems and components in order to reduce developmental time and acquisition cost. We still envision that prototypic vehicles could be built within a thirty (30) month developmental/demonstration program. We still believe that vehicles of this class should be built and tested soon to assess their full tactical, operational, and strategic utilities. (SLOW)

Figure 1 displays a three dimensional perspective of the Viking Armored Gun System. A composite view of the AGS vehicle displaying internal and external components is shown in Figure 2. The vehicle's height, width, and length are 2.5 m, 2.8 m, and 4.9 m respectively; these are within the envelope of the M551 Sheridan Light Tank.

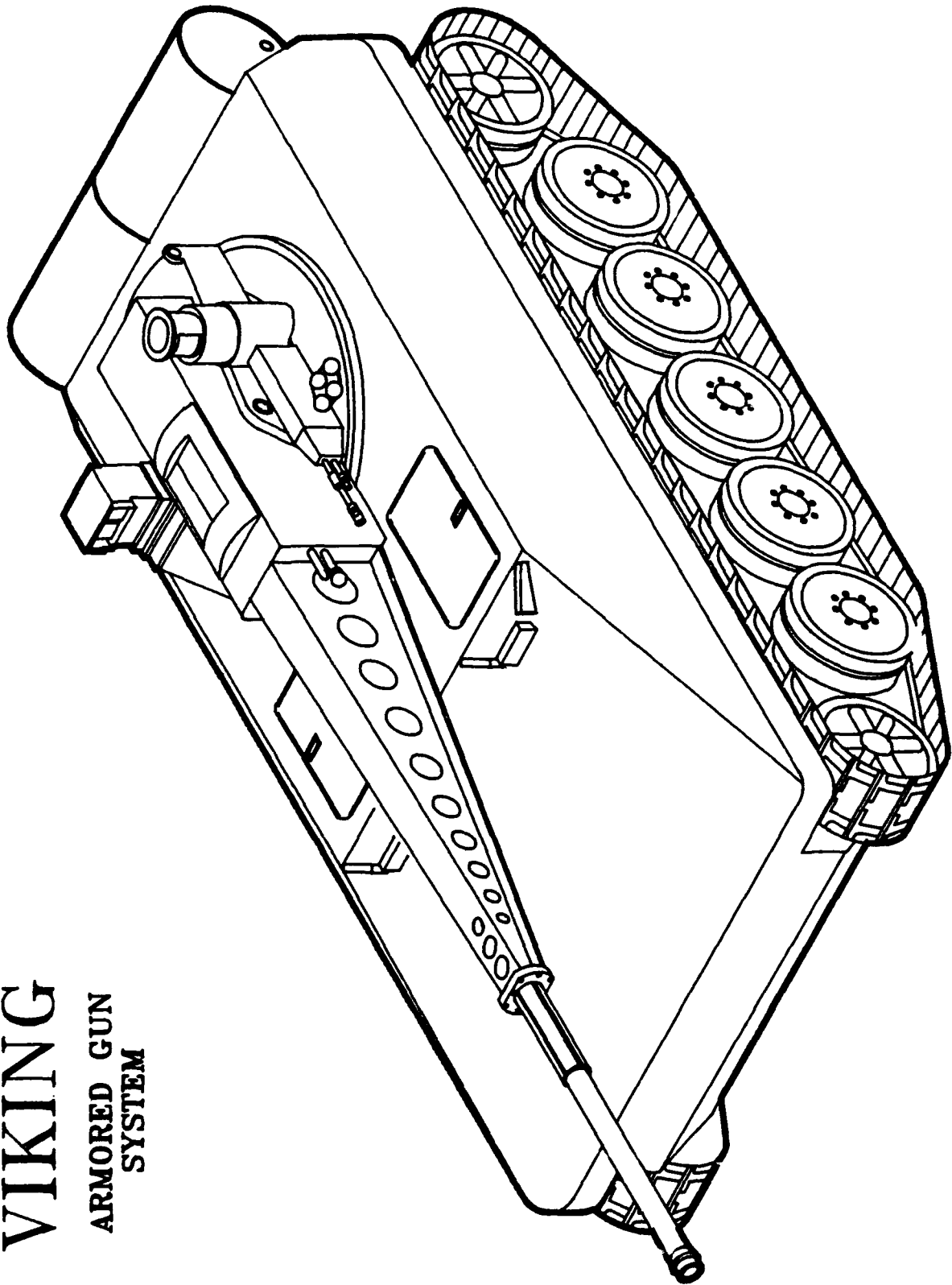
As shown in Figure 3, we have selected the ARES 75mm Universal Turret System to provide firepower for the AGS vehicle. The turret system contains the XM274 75mm automatic cannon, a M240 7.62mm machine gun with turret-stored ammunition, two M243 grenade launchers, an autoloader, and, in the version we selected, a 22 round modular magazine of 75mm cannon ammunition. In addition, the cannon elevation and traversing mechanisms, emergency back-up systems including a battery powered hydraulic system and a hand-operated sighting, feed and firing controls are contained within the system. Turret thermal image sighting systems consist of a rotating, retractable surveillance sight and a coaxial daylight sight.



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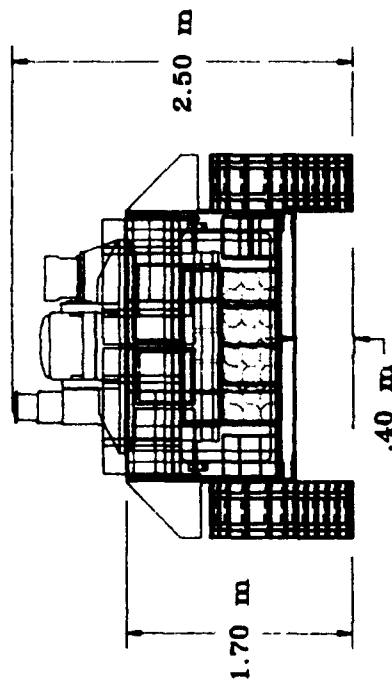
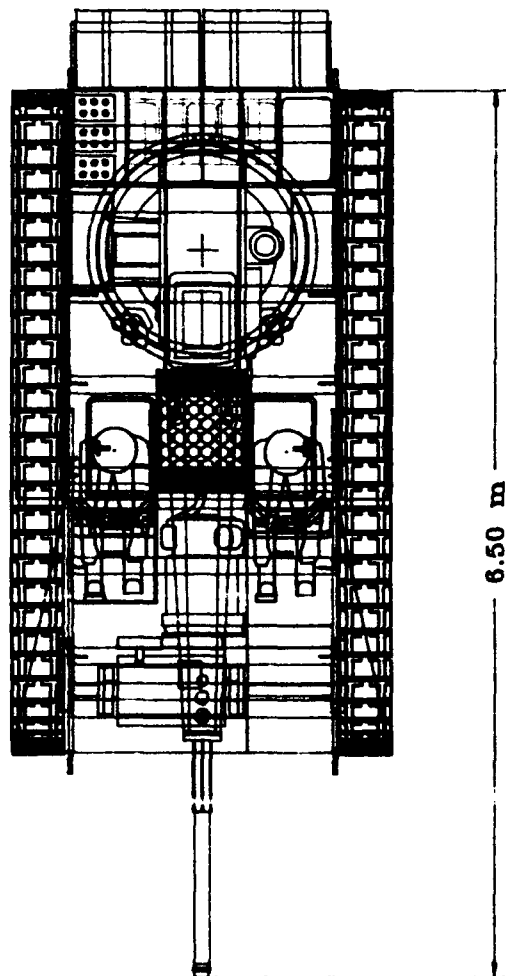
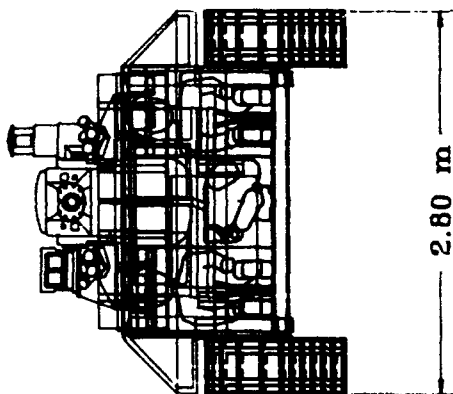
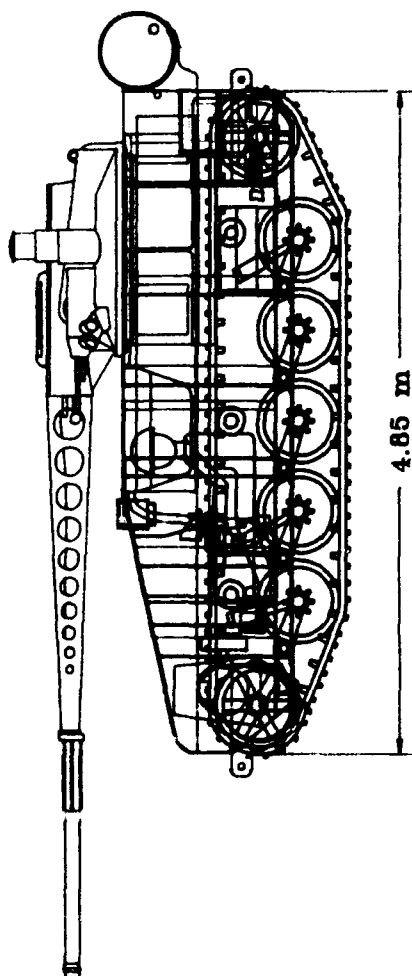
VIKING

ARMORED GUN
SYSTEM



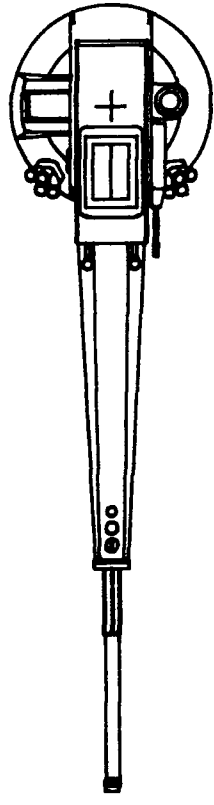
VIKING ARMORED GUN SYSTEM

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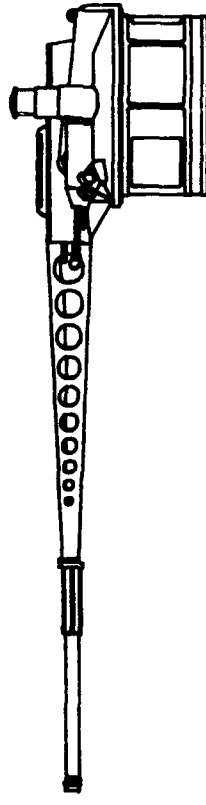


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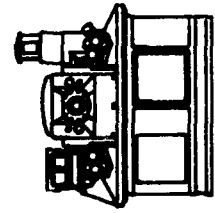
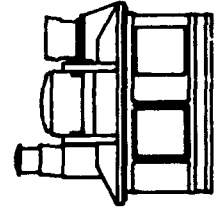
ARES 75 MM UNIVERSAL TURRET SYSTEM



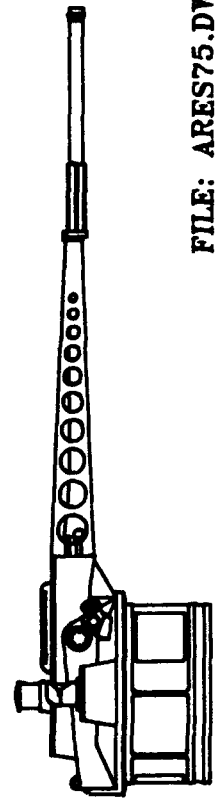
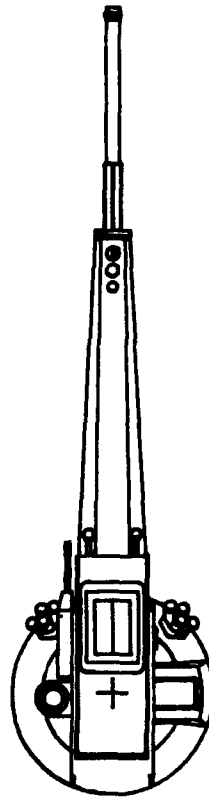
RIGHT VIEW



FRONT AND REAR



LEFT VIEW



FILE: ARES75.DWG

Below and behind the turret system are stored 24 additional 75mm cannon rounds and 2500 7.62mm rounds as displayed in Figure 4. The commander and the AGS driver sit side-by-side behind the commander's fire control console and the driver's instrument panel respectively. Redundant electronics are located on each side of the vehicle. The commander's fire control system for the 75mm cannon utilizes a fully modular digital ballistics computer and suite of advanced sensors for effective engagement of targets at range. Main cannon ammunition is divided between HVAPFSDS kinetic energy projectiles and high explosive multi-purpose projectiles. Figure 5 displays the thicknesses of armor for the AGS vehicle. The front upper glacis consists of armor that is 50mm thick and sloped at an obliquity of 78° . This provides a line-of-sight thickness of 240mm. The high angle of obliquity may be sufficient to produce ricochet of impacting kinetic energy penetrators, premature damage to missile bodies, and disruption of the fuzing process for missile and projectile shaped charge warheads. In addition, attachment points have been included on the front upper glacis and other highly exposed vehicle surfaces in order to place reactive or non-explosive reactive armor applique, if needed, to insure defeat of man-portable anti-tank projectiles or guided missiles. Contemporary armor technologies provide alternative armor systems with space efficiencies of one and mass efficiencies greater than one for the modular, primary armor.

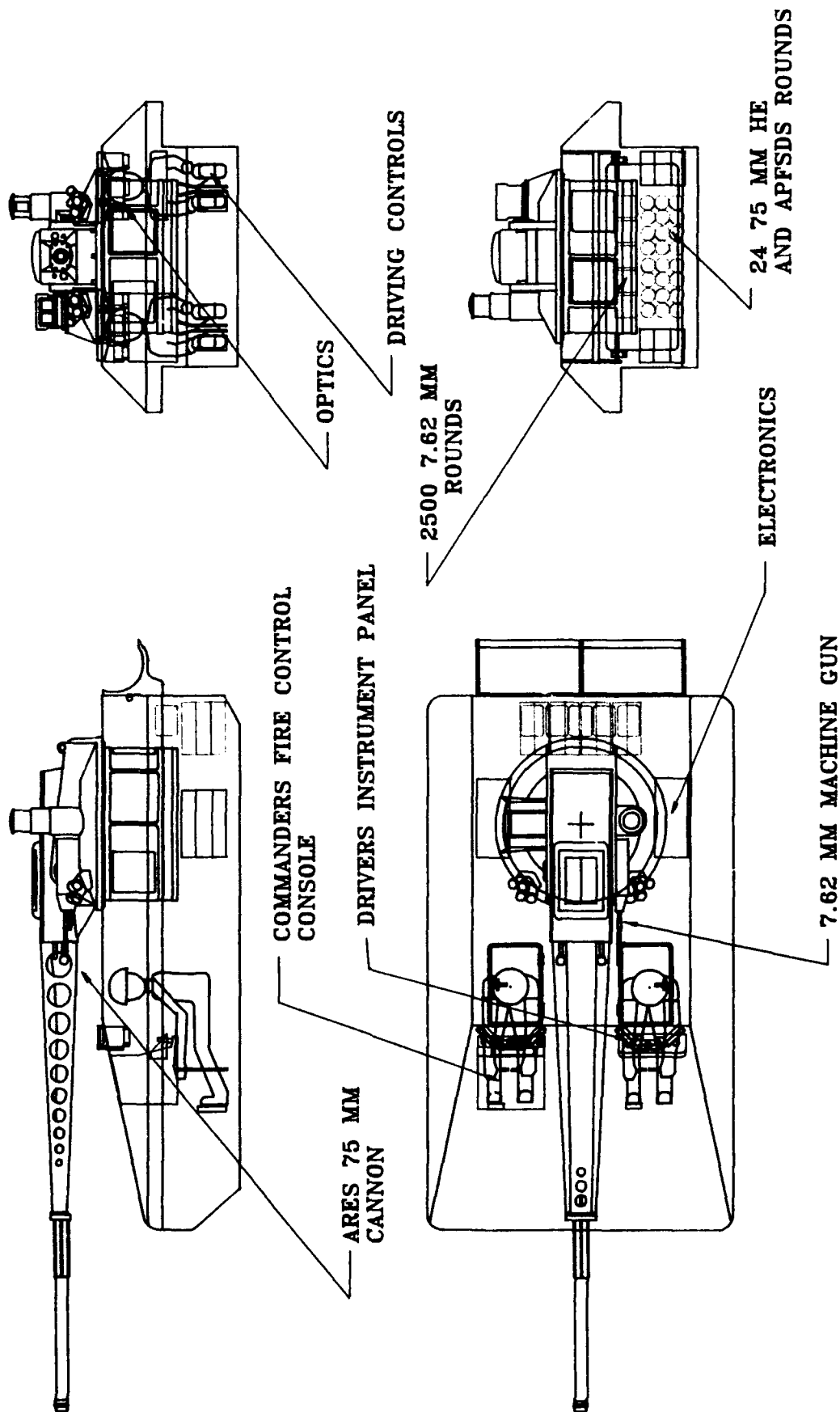
The front lower glacis armor has a line of sight thickness of 120mm. In order to reduce vehicle weight, armor protection levels, in general, on the lower hull sides and rear are at a level sufficient to provide protection against heavy machine gun projectiles at zero degrees obliquity.

The upper hull side of the AGS vehicle employs armor with a line of sight thickness of 50mm. The lower hull side and the rear of the vehicle have armor of 25mm thickness. If a sixty degree frontal arc of protection is selected, then the line of sight thickness of the upper (lower) hull side is at least 100mm (50mm) thick. Additional armor shields are placed below the locations of the vehicle commander and driver.

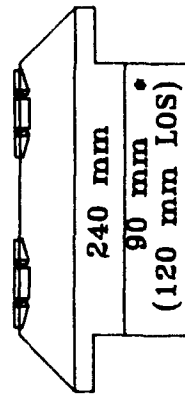
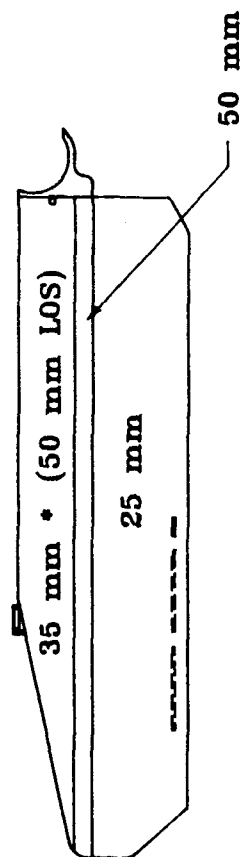
Figure 6 displays the main features of the structure of the AGS vehicle. The basic design is similar to the earlier Viking AFVs; however, we have provided additional and stronger structural members to support the added weight and to withstand the recoil momentum of the larger 75mm automatic cannon. As before, the crew compartment remains isolated, by design, from the engine and ammunition compartments by front and rear structural bulkheads. Spall liner materials are used within the crew, engine, and ammunition compartments to reduce damage given perforation by attacking projectiles. In addition, ammunition is stored in individual protected compartments located at the rear of the vehicle. The rear door of the vehicle is held in place with "explosive" blow-out pins which fail when a sudden pressure build up occurs within any of the ammunition compartments.

WEAPONS AND CONTROLS

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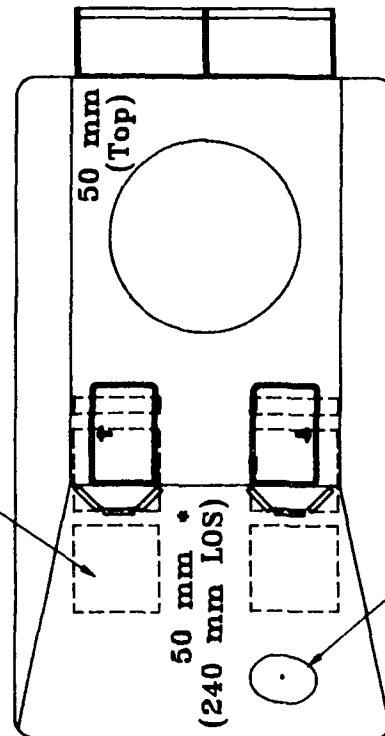


ARMOR



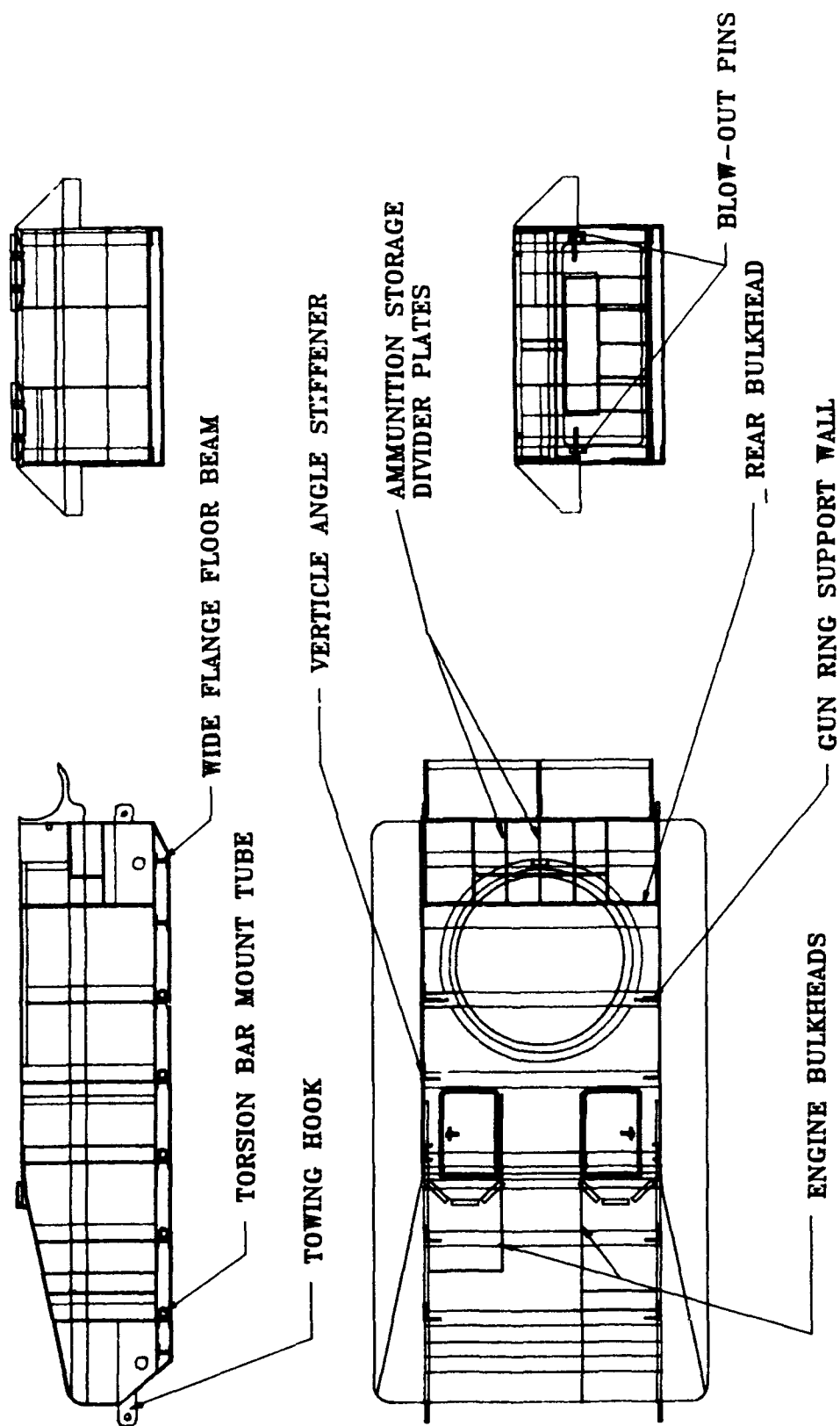
25 mm Aluminum
Deck Shield

* LOS = Line of Sight



Upper Glacis, Side, and Upper Sponson Studded to Accept
Reactive (Non-Explosive Reactive) Armor Applique

STRUCTURE



As shown in Figure 7, we have selected the John Deere 4026R Rotary Engine as the prime mover for the Viking AGS vehicle. This engine is a member of the SCORE (Stratified Charge Omnivorous Rotary Engine) 70 Series family of engines. The four rotor engine is estimated to produce 320 basic horsepower at an engine weight of 645 pounds. Based upon the power output of the engine and the combat weight of the AGS vehicle, the vehicle power-to-weight ratio is 17 HP/ton. It is anticipated by John Deere, Inc. that the 4026R engine will be available in 1994. Single, double, and triple rotor engines of this family are currently under development.

The engine is coupled to a T320 automatic transmission manufactured by the SCG Corporation. The transmission is a fully automatic cross-drive transmission which incorporates vehicle steering capability as well. It has a total of six speed gear ranges, any of which may be utilized in either the forward or reverse direction.

The enlarged radiator is located at the frontal portion of the upper hull deck. The radiator has intakes on both sides so that cooling air is ducted down from the sides and blown upward and through the radiator core. Two main fuel tanks are located on either side of and above the tracks of the vehicle. They provide additional armor protection and are self-sealing to perforation by small projectiles. The two main tanks have a combined capacity of 140 gallons. In addition, there are two auxiliary (and expendable) 55 gallon fuel drums affixed to the rear of the vehicle. Total fuel capacity is 250 gallons. Driver automotive controls are similar to those cited in Reference 1.

Table 1 enumerates the weight allocation of the vehicles by critical sub-systems and components. The left column exhibits the system/component weights for the Viking Assault Vehicle (Reference 1). In deriving the basic AGS design with diesel engine (center column), we removed the 35 mm cannon and gun basket, 0.50 caliber machine gun, and FOG-M "six pack" from the assault vehicle (Reference 1) and substituted the ARES 75 mm cannon/turret system. We also modified the hull and suspension to accept the heavier cannon/turret system. Vehicle armor weight decreased because of the removal of the assault vehicle canopy and 35 mm gun protection kit, modification of the rear vehicle armor, and reduction in width and length of the AGS hull.

As shown in the right column of Table 1, replacement of the Cummins 6CTA8.3 diesel engine with the Deere 4026R rotary engine, decreases the total weight of the AGS vehicle. The estimated total "dry" weight of the AGS vehicle is 33,345 pounds. The addition of crew, fuel, and ammunition brings the total combat weight of the AGS vehicle to 37,405 pounds.

Vehicle Weights (lbs.)

Component	Viking assault vehicle	AGS (diesel engine)	AGS (rotary engine)
Hull	3870	3620	3620
Engine	1335	1335	645
Transmission	1265	1265	1265
Final Drive (est.)	900	900	900
Supsension components - 20%	6300	6850	6710
Gun Basket	550		
Auxilliary power unit	200	200	200
Batteries	180	180	180
Talon 35 mm cannon	625		
Ares 75 mm turret system		6575	6575
Browning M2 .50 calibre	90		
FOG-M launch system	500		
Armor	13715	11585	11585
Miscellaneous - 5%	1500	1700	1665
SUBTOTAL (Dry)	31030	34210	33345
Fuel (250 gal.)	1870	1870	1870
Ammunition	2350 *	1750 **	1750 **
Crew	440	440	440
TOTAL	35690	38270	37405

* 175 rounds 35 mm + 3000 rounds
.50 calibre + 30 FOG-Ms

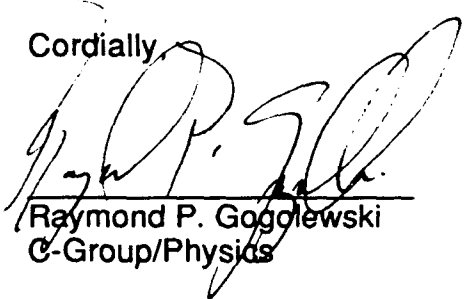
** 22 ready + 24 reserve
75 mm (1/2 KE + 1/2 HE)
+ 2500 rounds 7.62 mm

Table 2 displays the allocation of AGS vehicle weight in the "drop/drive out mode" -- in other words, the weight of the vehicle without crew, with 100 gallons of fuel, 22 carousel-loaded and ready cannon rounds, and 1,250 machine gun rounds. The AGS weight in this configuration is 34,920 pounds.

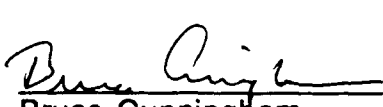
We anticipate that the Viking AGS vehicle can be strategically airlifted by all aircraft of the Military Airlift Command (MAC) currently capable of transporting the M551 Sheridan Light Tank.

We hope that this design effort has met your goals and objectives. We look forward to your comments. Please provide a distribution list for recipients of this technical letter report.

Cordially,



Raymond P. Gogolewski
C-Group/Physics



Bruce Cunningham
C-Group/Physics

- 1) "An Annotated Briefing: Preliminary Thoughts on Lightweight Armored Fighting Vehicles", by Bruce J. Cunningham and Raymond P. Gogolewski, Lawrence Livermore National Laboratory, UCID-21626, December 23, 1988.

Vehicle Weights (lbs.)

AGS - Drop Mode

Component	Rotary Engine
Hull	3620
Engine	645
Transmission	1265
Final drive (est.)	900
Suspension components - 20%	6710
Auxilliary power unit	200
Batteries	180
Ares 75 mm turret system	6575
Armor	11585
Miscellaneous - 5%	1665
SUBTOTAL (dry)	33345
Fuel (100 gal.)	700
Ammunition *	875
TOTAL	34920

* 11 HE, 11 AP rounds 75 mm
+ 1250 rounds 7.62 mm