

# Beating the Asymmetric Threat

New design strategies eyed to better protect vehicles and their crews against landmines and IEDs.



**By Marty Kauchak**  
**V&AR Correspondent**

Many models of wheeled ground vehicles deployed during Operations Iraqi Freedom and Enduring Freedom were not designed to adequately protect their crews and embarked troops against emplaced improvised explosive devices (IEDs) and landmines throughout the theaters. Indeed, since the OIF coalition transitioned to post-combat operations in May 2003, its forces have incurred more casualties than during the combat phase. Those personnel casualties were primarily due to IED attacks and ambushes by insurgents against military vehicles.

Coalition casualties in Afghanistan due vehicle strikes against IEDs and mines have also increased.

“These vehicles weren’t designed to be that blast resistant,” pointed out Brad Curran, senior industry analyst, Frost and Sullivan. “They were designed for fast, mobile, open-ground warfare, where you would first have a mine-clearing unit go through. The vehicles also weren’t designed for inside-the-city, counterinsurgency-type warfare where the enemy is using sophisticated, shaped charges, such as 152 mm artillery shells planted underneath them,” added Curran.

In response to the success and lethality of these asymmetric weapons, industry is bolstering the levels of survivability and crew protection in their newly fielded and planned vehicles.

### **Battlefield Survivor**

Krauss-Maffei Wegmann’s (KMW) Dingo 2 all-protected vehicle has shielded crews against mines, IEDs and other threats through its state-of-the art protection strategies. The model is an upgrade to the Dingo 1 which has been in service with the German Bundeswehr since 2000.

The Dingo 2’s “double hull offers highly effective fragment protection: together with additional components such as a belly pan inside the vehicle it minimizes pressure waves

and deformations caused by exploding anti-tank and anti-personnel mines. In addition, the crew is even protected against IEDs,” asserts the company. The vehicle conforms with STANAG 4569 levels 3b and 4c for mine protection. The IED rating is at a “high, confidential level, but equal to the high mine protection level,” said Christoph Muller, senior vice president for strategy and corporate communications. Dingo 1 is conformant to STANAG 4569 level 2b.

Dingo 2’s modular design allows it to be used as a patrol and security vehicle. With the addition of a large volume capsule, the model can be configured as an ambulance, a battle damage repair vehicle, a ground surveillance radar vehicle, and for other tasks. The vehicle has proven its combat survivability in a number of global hotspots, including the International Security Assistance Force mission. Dingo crews remained uninjured in two incidents with anti-tank mines (greater than six kilograms (kg) (13.2 pounds) of explosives), and in one incident with an IED car bomb.

Subcontractor DaimlerChrysler furnishes the Unimog commercial truck chassis which is designed for high mobility on a variety of terrain. The 12.5-ton vehicle is deployable by C-130s and other mid-size aircraft.

Dingo 1 and -2 models are in service with the armed forces of Germany, Austria and Belgium. About 500 Dingo 2s of different variants are on back order, reported Muller.

### **From Down Under**

Thales Australia-Land System has delivered to the Australian Army in excess of 200 Bushmaster vehicles from an initial 300-unit order. The majority of contracted



***Krauss-Maffei Wegmann’s Dingo 2 all-protected vehicle has shielded crews against mines, IEDs and other threats.***

vehicles will be the infantry mobility troop variant. Other Bushmaster models scheduled for delivery are the command, assault pioneer, direct fire weapons, mortar and ambulance.

In December 2006, the Australian government announced its intent to buy in excess of 100 additional Bushmasters. “All variants for the Australian Army offer the same levels of protection through a common monocoque and mechanical driveline components,” pointed out Geoff Miller, manager, business development.

The V-shaped hull in this and other vehicles helps defeat the energy of a mine blast, by disbursing the explosive energy. This contrasts to a flat hull, which is forced to absorb the bulk of an explosive shockwave. The Bushmaster hull encloses “virtually the complete driveline from and including the engine bay to the very rear of the vehicle,” noted Miller. This construction strategy “not only provides excellent mine protection, but also in its day-to-day running, minimizes underbody component damage from off-road wear-and-tear type exposure to service line and other exposed components,” he added.

Two representative sub-components in



***Several militaries, including the Australian Army, have deployed the Bushmaster operationally.***



*Force Protection designs have made a dramatic impact in the U.S. market and have delivered protection concepts, proven during harsh southern African conflicts, to forces slow to recognize their value and necessity.*

the system are mine energy-absorbing seating and stowage space for mission equipment and personnel weapons.

Another survivability strategy adds external modular, shear-off lockers to absorb energy, and remove additional fuel sources away from the vehicle in the event of an attack. Similar to many competing vehicles, Bushmasters have a protected fuel tank in the engine bay.

Commercial off-the-shelf components have been selected whenever possible to ensure that long-term serviceability and commonality are maintained.

The Thales Australia's team designed Bushmaster to be supported by a modular maintenance approach. This, in part, ensures the vehicle can be rapidly returned to service, following damage from a mine or an IED strike, or another material casualty. The engine, transmission, and cooling system package is removable from the vehicle as a single-part module. "This allows field repair or service, and replacement



*The Armored Security Vehicle has proven invaluable during convoy and other security and force protection details.*

back into the vehicle in a complete turnaround time and drive out in under three hours," said Miller.

The Australian Army has deployed Bushmaster to Afghanistan and Iraq. The Royal Netherlands Army has received 25 Bushmasters which have been deployed to Afghanistan.

The company has signed a manufacturing license agreement with Oshkosh Truck Corporation for the marketing and manufacture of Bushmaster in North America.

#### **Combat-tested Buffalo and Cougar**

Ladson, South Carolina-based Force Protection Industries has supplied more than 300 Cougars and Buffalos to the U.S. services.



*The Force Protection Buffalo melds modern engineering and EOD technologies on a rugged frame.*



*IMI's Wildcat*

Most of these vehicles are deployed in Iraq and Afghanistan. The 23-ton Buffalo primarily serves in a mine clearance role. The vehicle's 30-foot robotic arm has a large iron claw that can be used to detect and remove landmines and IEDs.

The Cougar Joint Explosive Ordnance Disposal Rapid Response Vehicle (JERRV) has found favor with explosive ordnance teams and other special-mission units in Iraq and Afghanistan. The JERRV is fielded in two models, the 15-ton, 4x4, and the 19-ton, 6x6. The Cougar first earned its stripes in Iraq with the 1st Marine Expeditionary Force in the battle of Falujah.

Buffalo and Cougar vehicles "have been hit by thousands of mine detonations and IED attacks," stated Michael Aldrich, vice president. According to the company not a single casualty has occurred in a Force Protection vehicle.

"Force Protection builds its vehicles tough from the ground up, incorporating a V-shaped steel hull that acts as an armored cocoon which shields passengers from the force of an explosive blast," pointed out Aldrich. "This combined with the weight of the Buffalo and Cougar respectively, makes them the strongest vehicles in the world," he opined.

In November 2006, Aerospace & Defense Group of Armor Holdings, Inc. joined the Cougar production team. The company will be a subcontractor operating from its facility in Sealy, TX, where it will help with automotive integration and assembly.

The Buffalo and Cougar support, in part, a U.S. Marine Corps' joint and urgent theater requirement to be met through the new family of mine resistant ambush protected (MRAP) vehicles.

## MRAP

The vehicles are designed to augment the current level of protection in Afghanistan and Iraq with the M1114s, HMMWVs, M1151s and M1152s, observed Captain Jeff Landis, spokesperson, Marine Corps Systems Command, Quantico, VA.

Three categories of MRAP vehicles support the following mission profiles: Category I is the mine resistant utility vehicle for urban combat operations; Category II is the JERRV for multi-mission operations beyond EOD, to include convoy lead, troop transport, ambulatory,

*Survivability as a design factor has always been important but has new importance in the world of the IED. Lives are saved by the application of techniques such as those applied to the BAE Systems' RG-31. Substantial damage to the vehicle, but the occupants all survived.*



maneuver battalions and combat engineering; and Category III is the Buffalo for mine and IED clearance operations.

The Marine Corps currently has 69 MRAP vehicles, with 38 having been funded by the Joint IED Defeat Organization. "We are in the process of procuring an additional 805 [vehicles]. The 805 will be purchased using approved Fiscal Year 2007 supplemental funding," concluded Landis.

## Armored Security Vehicle

Textron Marine and Land's (TM&L), Armored Security Vehicle (ASV) is a 4x4 armored vehicle in service with the U.S. Army in Iraq and Afghanistan.

The ASV protects embarked crew members "through the employment of multiple layers of armor that provides defense" against a variety of threats including land mines, according to the company.

TM&L has delivered more than 600 ASVs to the Army, and is delivering to contract 48 additional vehicles a month, reported Dave Whitaker, the unit's manager for public relations and communications. They have also delivered 63 ASV variants to the Iraqi Civil Intervention Force.

A contract modification announced in October 2006, requires TM&L to manufacture 64 ASVs to the new M707 Armored Knight configuration. The variant is equipped with a sensor package that is used to locate and designate targets for indirect fire and laser-guided weapons.

## Golan

Protected Vehicles, Inc. (PVI) and Rafael Armament Development Authority introduced Golan, a four-wheel, 13-ton armored fighting vehicle.

"The protection capability of the Golan sets a new world standard because its baseline protection, the protection offered without applying up-armor, is higher than many vehicles are capable of when their up-armor options are maxed out," stated Drew Felty, PVI spokesperson. He was speaking with the knowledge that the Golan design vehicle was tested against 30 pounds TNT in an anti-tank landmine and other criteria. Blast testing of a prototype vehicle was expected to occur through January 2007.

The Golan core requirement to provide protection to its passengers,

power pack and cargo is based on different types of armored steel, bent and welded, to create a V-shaped, monocoque hull.

Golan is designed to counter the energy of a mine blast which is powerful and almost instantaneous—and transmits strong shockwaves through a vehicle and its content in milliseconds. “The design of a monocoque hull or capsule and its load bearing attributes has been found to weather the stresses of these shockwaves on a repeated basis,” said Felty.

As of December 2006, the Israeli Defense Force was putting the vehicle through its testing paces. “To date the feedback is exceptional, and we are confident we can continue to meet the high standard of performance in a combat environment the soldiers of Israel demand,” emphasized Felty.

The Golan can ideally carry up to eight soldiers, however, up to 10 warfighters can embark.

Battelle Memorial Institute, another industry partner, helped develop ShieldAll, a multi-hit capable composite armor which has potential for being added to the Golan in the future. A yet-to-be-announced, major government contractor, is PVI’s partner for automotive integration and field logistics support.

### RG33L

Also in October, 2006, BAE introduced



*GeFaS is being built as a modular systems for a variety of missions and will be designed for optimum protection against landmines and ballistic threats.*

the lead RG33L model from the embryonic RG33 family of vehicles.

The RG33L “leverages the long history of performance across BAE Systems in developing mine-hardened and mine-protected wheeled systems as well as high-survivability combat vehicle systems,” said Matt Riddle, director, survivability systems. It also incorporates the latest designs which protect against IEDs.

A partial list of the company’s legacy products includes the venerable and combat-proven RG 31 and the RG 32 Scout Vehicle.

The RG33 FOV incorporates a modified monocoque, V-shaped hull design, leveraging knowledge gained in recent and ongoing conflicts, remarked Riddle. Three of many other enhancements provided to bolster soldier and vehicle survivability are run-flat tires; multi-positional, mine-protected seating; and dedicated space for equipment stowage.

The approximate 22-ton, six-wheeled vehicle is available with base protection against medium machine gun and small arms fire, and mine blast protection at a level equal to or exceeding any mine-protected vehicle—and the platform is designed with a power train equipped to handle upgrades and



*BAE Systems RG33L*

enhancements, observed Riddle.

The RG33L is also C-130 transportable.

### The Wild One

Israel Military Industries (IMI) has developed Wildcat, a 4x4 truck-based, armored personnel carrier. The first prototype vehicle is scheduled for delivery to the IDF for evaluation in early 2007.

The vehicle's crew compartment is designed to be protected against an anti-tank mine blast equivalent to an 8 kg explosive under any wheel, and a 6 kg explosive under any other part of the vehicle's belly. This capability conforms to STANAG 4569.

The Wildcat's level of protection is provided by an armor plate on the crew compartment floor and a V-shaped armor plate covering the belly—fitted to the vehicle width, explained Shmuel Agmon, marketing manager, armor protection systems. "The armor plate floor is welded to a steel construction beneath the floor. The walls and roof of the crew compartment are welded to this floor together with steel construction supporting the whole monocoque. The V-shape armor protection is attached to the floor by special elements capable of absorbing a portion of the anti-tank mine's explosive energy," added Agmon.

Wildcat industry partners include the Israeli company Special Tactical Vehicle and the Czech company Tatra, which provides the chassis.

### GeFaS

Rheinmetall Land Systems is developing a new generation of tactical vehicles which carries the moniker GeFaS—short for "protected vehicle system."

The vehicle will be built on modular systems for a variety of missions, and will be designed for optimum protection against landmines and ballistic threats. According to the company, "What makes this approach so groundbreaking is the building block principle: the basic vehicle consists of a small number of modules which can be mixed and matched for different missions."

Conceptually, the axle units, the power pack module and a main module can be configured in the field to create smaller and larger vehicles, from a two-axle command vehicle up to a five-axle weapons platform. Four envisioned GeFaS missions include a command vehicle or armored personnel carrier, a weapons platform, or mid-range

fighting vehicle. The vehicle's projected weight is 12.5 tons.

The embryonic vehicle's design and its capability to survive a landmine or IED strike are inextricably linked. In one case, the electric drive system removes axles and similar parts from underneath the crew compartment, so there are fewer vehicle fragments to injure the crew in the event of a detonation.

Other safety enhancements include higher ground clearance, positioning of the wheels at the furthest point from the crew, and the design of the crew compartment as

a safety cell hung in a supporting structure, noted Oliver Hoffmann, head of defense press.

The vehicle's pronounced rhomboid silhouette and sandwich-type design will additionally help dissipate blast waves from a mine or IED detonation. Rheinmetall expects to unveil its demonstrator vehicle in Spring 2008, forecasted Hoffmann.

GeFaS partners include the Irish firm Timoney Technology, for axles, and the German company MTU, for the diesel engine.

Turning vision  
into armor  
reality.

**PLASANSasa**  
Composite Materials  
www.plasansasa.com