



A CASE IN POINT

THE CV9035NL INFANTRY FIGHTING VEHICLE

At TNO, we are well aware of the difficulties connected with the acquisition of advanced military systems. By this we mean any system, like the next generation Infantry Fighting Vehicles. For one thing, this will require you to look ahead, sometimes for the next three or more decades. Which is, of course, a complicated matter. TNO has been acting as a strategic partner to the Netherlands MoD for many years now. This is one of the reasons why we are confident that we will be able to help you solve any problem in connection with protection, firepower, mobility, command and control, observation and system performance

As part of the Replacement Armoured Vehicles YPR and M557 programme the Netherlands DMO organisation placed an order with BAE Systems Hägglunds AB for a total of 184 multi-purpose CV9035 Infantry Fighting Vehicles (150 PRI Infantry and 34 PRCO Commander). Together with the Leopard 2A6 Main Battle Tank the CV9035 will form the core of the mechanised armoured brigades. During the CV9035 acquisition phase and afterwards, TNO supported the Netherlands MoD in more than one way:

- Protection: mine protection qualification test for accurate assessment of the load on the human body in case of a mine attack.
- Firepower: target definition, munitions lethality analysis, munitions development, and firing doctrine determination in connection with the gun system calibre.
- Mobility: operational analysis of mobility requirements to support tracked or wheeled solutions.
- Command & Control: 10 years of development and testing of the BMS for use on vehicles for quicker, easier and improved decision-making.
- Observation: selection of IR cameras for any conceivable operational conditions.
- System Performance: QFD sessions to define the operational requirements for the replacement of the YPR.

TNO.NL

TNO

TNO is an independent innovation organisation that connects people and knowledge in order to create the innovations that sustainably boost the competitiveness of industry and wellbeing of society.

TNO focuses its efforts on seven themes including Defence, Safety and Security: TNO works on a safe and secure society by creating innovations for people working in defence organisations, the police, emergency services and industry.

CONTACT

Rogier Kalkhoven MSc

E rogier.kalkhoven@tno.nl
P +31 888 66 1197

MILITARY VEHICLES

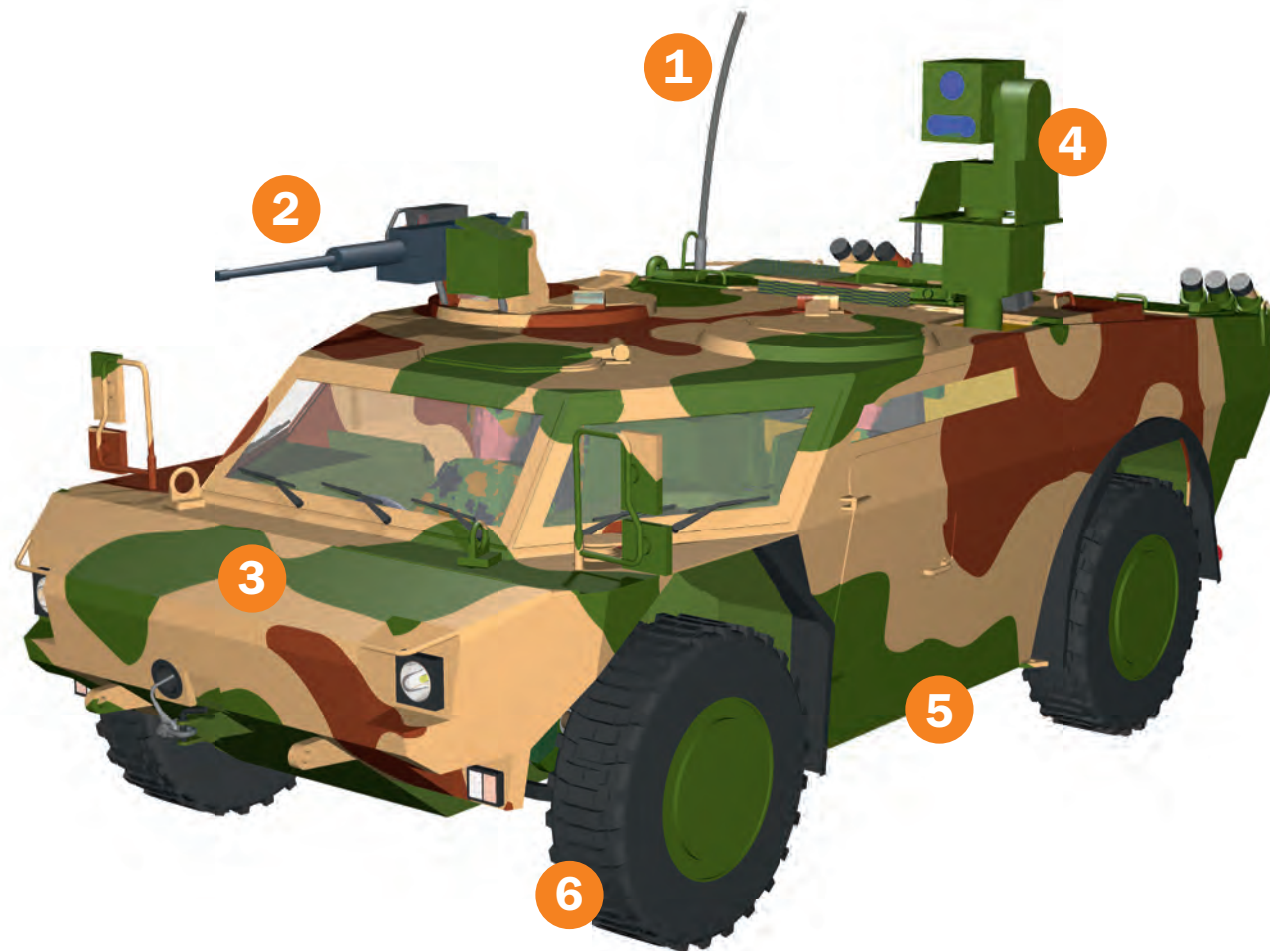
AN INTEGRAL APPROACH



TNO innovation
for life

At TNO Defence, Safety and Security more than 1,000 scientific researchers, engineers, IT and operations research specialists and countless other experts daily work on military research projects in e.g. system engineering and integration, human factors, logistics, weapon systems and effects, munition, mobility, protection, and C4I and observation systems. What makes TNO unique is the ability to combine this knowledge into a single and integral approach to military vehicles, including protection, firepower, mobility, command and control, observation and system performance.

A military vehicle is always a compromise. A few extra inches of armour will provide more safety. But it also means more weight and less mobility. The ideal military vehicle should always be custom-made for its anticipated mission. This calls for a design that includes an intelligent mix of various expertises. It also requires an integral approach to design and development. And this is where TNO comes in. We don't actually build military vehicles, but we will help you create the optimal design, so that these vehicles will do what they were made for. Carry out their mission.



1 COMMAND & CONTROL

IT has brought overall situational awareness within reach, at all levels. However, apart from the purely technical point of view - a C4I or Battlefield Management System has to be 100% reliable and robust - there is the human factor. Do we really need continual 1 on 1 contact between the vehicle crew and a UAV 10 miles down the road? TNO approaches this issue from all angles. We have worked with all C2, C4I and Battlefield Management Systems available today, on the ground, in the air and at sea. We can tell you what system will be best for your design and how to implement it (system integration), but we will also point out the dangers of an information overload. After all, Command & Control is all about the human factor.

For the past 10 years, TNO has been working on the development and optimisation of the Battlefield Management System for use in vehicles. This e.g. included a definition of the architecture and the operational requirements, as well as field tests at battalion level and the analysis of the use of the BMS during peacekeeping operations in Bosnia.

2 FIREPOWER

TNO will provide you with the perfect match between vehicle concept, the human factor and both man-operated and autonomous weapon systems. A match that will be reliable and cost-effective. Our solutions are on thorough military research - theoretical, simulated and through live experiments - on weapon and munition systems, fragmentation, penetration, lethality and firing doctrines. Our approach takes into account the entire vehicle concept, the tactical requirements and the latest military technology. This allows us to tell you if the firepower solutions you proposed will actually work.

The acquisition of the CV9035NL IFV included the choice of calibre for the gun system. TNO conducted an extensive programme - target definition, munitions lethality analysis, munitions development and firing doctrine - that led to the decision to select a 35 mm gun. Serious firepower.

3 SYSTEM PERFORMANCE

Buying a military system is one thing, keeping it in the field at an acceptable cost is quite another. TNO supports the acquisition, operation, maintenance and disposal of any type of military vehicle, giving you an estimate of the Life Cycle Cost as well as analysing the impact of all the so-called factors of influence. Military vehicles are designed to last for decades, meaning that both Operational Analysis and Midlife Upgrade Analysis form an integral part of what we call system performance.

TNO conducted an in-depth analysis of the possibilities for an overall midlife upgrade to extend the operational life of the Leopard 2A6 NL Main Battle Tank.

4 OBSERVATION

Observe and not be observed, while maintaining maximum situational awareness. Not exactly easy driving a large military vehicle in rough terrain and under threat. It's all about radar, IR and signature management, including camouflage, concealment, deception and obscurity (CCDO). Or about the latest in observation systems, including ATR, depending on your requirements. TNO has the knowledge and expertise to help reduce the vehicle signature and to maximise the chance of seeing the enemy before he sees you. TNO will subject your vehicle design to thorough radar and EO/IR simulations. Field tests will tell us whether the measures you propose - e.g. mobile camouflage, coatings and multi-spectral nets - actually improve your design.

TNO investigated the impact of the MCS (Mobile Camouflage System) on the detectability of the Fennek Reconnaissance Vehicle. This test included the effect of a desert climate on the crew compartment temperature as well as on the operating temperature of the sensor suite.

5 PROTECTION

Nowadays our work seems to revolve around the asymmetric threat, i.e. the protection against mines, IEDs and RPGs. But that's only part of it. In fact, our knowledge and expertise are based on decades of armour research, including CBRN protection. At the TNO facilities we perform live tests on all known (and unknown) armours by order of the defence

industry and the Netherlands MoD: metal/composite, hybrid including spall liners as well as (re)active armour and DAS. If your vehicle concept has any weak spot not complying with STANAG 4569, our Vulnerability/Lethality tool TARVAC will find it.

Together with five other user nations TNO developed the new mine protection kit as part of the Leopard 2A6 Main Battle Tank upgrade.

6 MOBILITY

Military mobility is hot. But will it be conventional, hybrid or all-electric? In any case, your military vehicle design will be needing a reliable powertrain. Not just for life-saving speed and manoeuvrability, but also to power the auxiliary systems. The simulation and rapid control prototyping tools developed in-house by TNO will help you make the right engineering decisions at the earliest possible design stage. If need be, we will then build you a prototype and test it under the most extreme conditions imaginable. To us, mobility also includes optimal vehicle ergonomics. Decades of research have taught us that soldiers feeling comfortable will perform better.

As part of an EDA project TNO investigated what may be gained by developing a European All Electric Vehicle. We then designed a demonstrator using state-of-the-art technology, including silent watch, skid steering, electric armour and pulse power weapons. Maybe one day we will even help build a prototype.

IN THE AREA OF MILITARY VEHICLES TNO HAS EXECUTED PROJECTS RANGING FROM APPLIED RESEARCH, PRODUCT DEVELOPMENT AND CONSULTANCY, TO TESTING AND EVALUATION FOR THE FOLLOWING CLIENTS:

Alcan, BAE Systems Land Systems Hagglunds, CMI Defence, CSIR, DEW, DSM, DuPont, EDA, General Dynamics European Land Systems, General Dynamics Land Systems Canada, Hatehof, IBD, IVECO, Kraus Maffei Wegman, LMT, M2I, Medical Collega of Winsconsin, Michigan Engineering Services, Ministry of Defence Netherlands, Ministry of Defence Belgium, Ministry of Defence Canada, Ministry of Defence Denmark, Ministry of Defence Germany, Ministry of Defence Norway, Ministry of Internal Affairs Netherlands, MKU, NATO, Plasan Sasa, Rafael, Rheinmetall Landsystems, Royal Netherlands Army, Roshield, RUAG Land Systems, Ruukki, RWMS, Scanfiber, SGL Carbon, TASS, Ten Cate, UROVESA, Van Halteren Metaal.