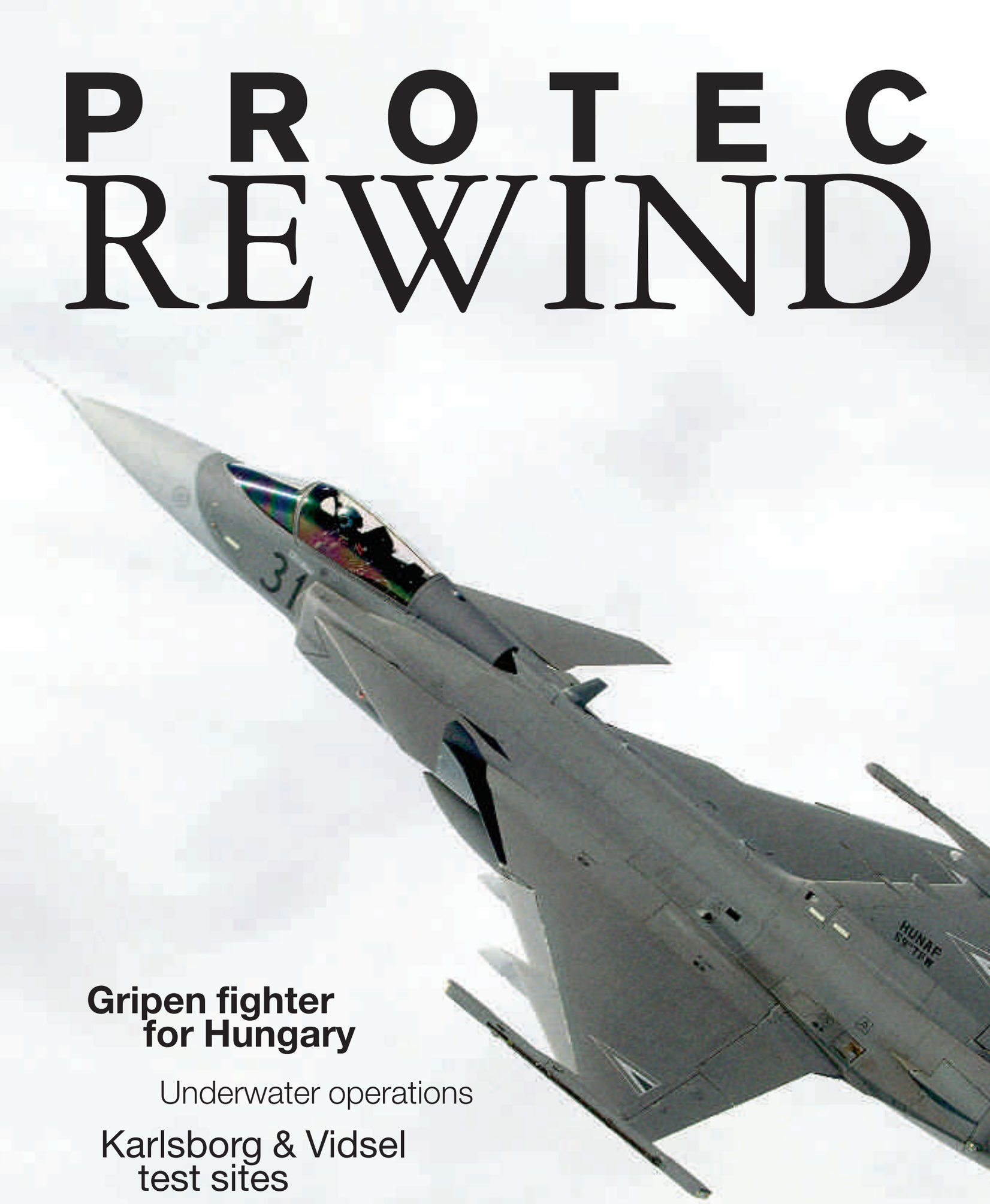
PROTEC REWIND



Gripen fighter for Hungary

Underwater operations

Karlsborg & Vidsel test sites

SELECTED ARTICLES FROM PROTEC MAGAZINE – ISSUE FOR **2007**

International cooperation – a central issue for FMV

FMV is an authority that develops and purchases materiel with high-technological content. From an historical perspective we have developed a lot of things "on our own," but our work will now, to a larger extent, involve creating knowledge about the materiel that is available on the market and purchasing and modifying that materiel. If the materiel is not available on the market we will investigate the possibility of developing the materiel with other countries. Only as a last resort will we develop materiel solely for the needs of Sweden. Nationally developed materiel shall, however, be possible to export. Special solutions adapted solely to Sweden are no longer of immediate importance. In this way we can achieve cost efficiency whilst allowing Swedish units to participate in international military efforts.

Our external magazine, Protec, has enabled Swedish readers to share in some of our 2006 assignments – large and small, national and international, with the common denominator that they all deal with technology for Sweden's security. In Protec Rewind we present a selection of articles from 2006.

Gunnar Holmgren
Director General

Contents

What is FMV?

FMV has a clear and inspirational assignment: to be responsible for the supply of materiel to the Swedish defence organisation.

The challenge FMV faces is to find, propose and introduce innovative and cost-effective solutions to safeguard the development of the defence organisation, in relation to both technology and new equipment.

Developments taking place in the total defence system presents a great many complex and exciting opportunities. Military defence has to be developed to operate in a network-based manner and in collaboration with international forces, while civilian defence has to cope with severe and unforeseen strains on society. As an independent, civilian authority, FMV contributes both knowledge and a high level of expertise in many different areas.

FMV has around 1,500 employees, mainly located in Stockholm, Linköping, Karlsborg, Vidsel and Arboga. Invoiced sales amount to around 20 billion Swedish kronor every year.

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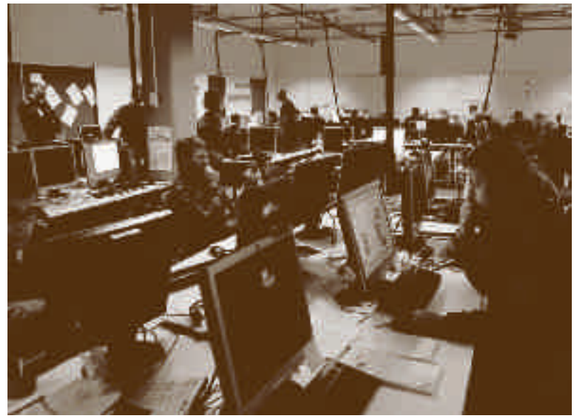
Cover picture
Jet fighter JAS 39 Gripen. Photo: Victor Veres

Information supremacy is the goal



Being able to receive and supply correct information, between different armed services and authorities and across national boundaries: that is what will decide success in future crisis situations. FMV lays the technical foundation for future command and control systems of the Swedish Armed Forces.

Foreign officers from nine countries, EU experts with experience from Kosovo, police officers, researchers and a number of other professional groups were represented at the Swedish Armed Forces development centre in Enköping during the four-week-long experimental exercise Demo 06 Autumn. The armed forces' new command and control system, the hub of network-based rapid-reaction defence, is being developed in a former fan factory in the town of Enköping. The recurring experiments are a way of testing technology that has not yet progressed beyond the development stage.

Civil and military

Network-Based Defence (NBD) is concerned not just with linking the army, navy and air force using technical systems, but also with preparing the way for more effective collaboration with civil authorities and the armed forces of other nations.

The results of this work are gradually to lead to a live system that will make it possible to gather information from a number of different sources. For example, military units at sea, in the air and on the ground, or from the police, emergency services and coastguard. It is anticipated that a first version of the system will be in service in 2010. Using technical "bridges", data from different systems can be "translated" and introduced into a common network. Secure solutions for this are now being developed by FMV. The Swedish Armed Forces, the Swedish Defence Research Agency and the National Defence College are also involved in activities aimed at laying the foundation for the future command and control system.

"Future defence will be service-based," says Lars Ahlm, project leader at FMV. "That means, for example, that a ship is no longer just a ship. With the aid of the network it can be used in a broader context. A cruise missile on board can be used by an infantry unit, and a radar station on land can be used to direct the ship's artillery."

The combat command and control centre, for example, can gather the information required from the network. The individual soldier can also gain a better picture of the situation with the assistance of information he or she gathers from different sources. As a result, the right decision can be taken more quickly.

Working in this way, it is possible to attain effective collaboration, not just during international operations, but during social emergencies on the home front too.

Large quantities of data have to be carried through the network. The data is taken from various places, collated to produce meaningful information and served in exactly the right portions to whoever wants the information at that time. The strings are pulled together by the command and control system, which has to merge data and create information superiority.

To ascertain how the new command and control system is to be designed and what roles the affected parties have to play, several trials were performed in conjunction with Demo 06 Autumn. Secret and open systems were linked together for the first time, for example. In addition, trials were conducted in which military and commercial radio systems were mixed.

Vision lab

In the 'vision lab' of the development centre, consisting of six laboratory rooms packed with computers, work is in progress on testing technology for the underlying functions of the future command and control system. This is something the normal user will not see, but it is essential for data distribution and catalogue services, for instance, to work. An important element is security. It must be possible to rely on the information the system supplies, for example on situational pictures and target scenarios.

Björn Zettergren at FMV, who is responsible for the vision lab, says that, at present, they are working on an experimental system that is intended to support the development of the design and the design rules that will govern the construction of the actual product in the next stage. In the third and last phase of the development work (starting in 2007), much of the work will be concerned with combining all the parts into a whole.

" The technology can be resolved. The difficult part is agreeing what we mean so that everyone involved speaks the same language," says Zettergren.

International

In one part of the vision lab an experiment is in progress on interoperability between systems and countries. Sweden, the UK, Germany and France are involved in this. Another part of the lab is the domain of Tigerlink, a cooperative project with Singapore.

The work will continue for many years, providing technical solutions for both existing and newly developed systems.

COPY: HANS IVANSSON
PHOTO: ENGSTRÖMS MFL

Gripen making its entrance at the Kecskemét air force base in Hungary on 21 March 2006.

"We've got what we wanted"

András Tóth is head of the Hungarian Gripen programme. He is pleased. Pleased that Hungary now has a new generation combat aircraft in its air force. At the turn of the millennium he took over responsibility for upgrading of the air force and was involved in the negotiations with the various bidders. He does not conceal the fact that, during these, he favoured the Gripen as the new combat aircraft. He also appreciated the speedy agreement with Sweden on the leasing and subsequent purchase of the fourteen aircraft.

"It's a completely different way of thinking than with our old MiGs. What I like most of all is that it is a smart system in which the pilot receives great support in decision-making. He can concentrate on his job. The aspiration on our side was to attain the most modern aircraft imaginable, which in addition is NATO-compatible. And we managed that. The Gripen is one of the best aircraft in the world. I am delighted the negotiations went the way they did and that we came up with a financial solution acceptable to both parties," says András.

With 34 years in Hungarian military aviation, including a period as chief engineer for the air force, he likes Gripen's simple and flexible maintenance systems. He also emphasises the support received from FMV in the construction of the new infrastructure at the Kecskemét air force base.

"We are very well placed to undertake effective maintenance work. The special maintenance team, with a mix of Hungarian and Swedish technicians, has been operating since February 2006.

András, who has learnt to appreciate Swedish pea soup and pancakes, does not see any problems with cultural differences either.

"The Swedes are receptive to our needs and easy to work with. Although there are occasional problems in such a large project, to date we have always managed to come up with joint solutions."

COPY & PHOTO: HANS IVANSSON

Delivery of an AIRFORCE

Mats Hansson has coordinated FMV's work on the Gripen deal with Hungary.

On the 21 of March 2006 the first five Gripen aircraft landed at the Kecskemét air force base. Mats Hansson was there when the contract with Hungary was signed three years previously. He and FMV have since been at the centre of the complicated process which in principle has involved exporting an entire air force. The Swedish and Hungarian governments, the Swedish armed forces and industry were parties to the negotiations.

Mats Hansson vividly remembers the effort that went into coming up with a solution that would appeal to all the parties involved. It was not easy. The financial aspect was the most difficult of all. All the costs that arise in connection with the deal are to be borne by the Hungarian state, and have to be met from the Hungarian state budget. These include training and development costs. In addition there are the political aspects that always have to be considered in deals of this kind, with competitors lurking and lobbying in the background, for example. Then there are the technical issues. But here Mats always feels comfortable: the JAS 39 Gripen is a world-class aircraft.

Meetings

During the three years since the contract was won, there have been many meetings with both Saab and the Hungarian project management. The meetings have concerned development of the aircraft, acquisition and the delivery and installation of various support systems, planning systems and tools.

Before the first five aircraft began their journeys to their new homeland, FMV carried out a series of test flights, which verified that the aircraft have the capabilities stipulated in the specification of requirements.

When the first aircraft came into land on Hungarian soil, Mats was relieved that the first stage of delivery was on its way to being accomplished.

"It felt a bit like what I imagine to be the feeling of winning gold in the Olympics. But it was not until all the aircraft had taxied in and the first phase of delivery was over that the sense of pride came," he says.

FMV's project group has held all the strings. There are many elements in a project that entails developing 14 combat aircraft with peripheral equipment. Some elements have gone to the manufacturer Saab, and some to a number of suppliers of the peripheral equipment. Others have gone to the Hungarian companies that have been responsible for the installations on the Kecskemét air force base. The training of Hungarian technicians, pilots and specialists are other areas that have been dealt with.

"We deliver more or less an entire air force, including buildings and equipment. Hungary is due to phase out its MiG-29 aircraft and replace them with the fully NATO-adapted Gripen of the latest C and D versions, the same type of aircraft Sweden is due to start using shortly.

The contract includes Swedish technicians and pilots being on the spot in Hungary. They are to support the Hungarians and provide continued training in the areas of servicing, regular maintenance and tactical employment of the aircraft. These requirements have posed a different kind of challenge for Mats and his project team. The 16 Swedish technicians, with their families, need somewhere to live and Swedish schooling for their children.

"If the Swedes' everyday lives don't work out well, we'll find it difficult to keep the planes airborne. So we've found homes and taken on teachers to provide schooling," says Mats.

Delivery

The aircraft deliveries are now reaching their conclusion. In December 2006 aircraft numbers six and seven were delivered, and in 2007 the remaining seven Gripens will be handed over to the Hungarian air force.

Cross-border cooperation has been of key significance in the project. If anything is important in such a huge project, it is smooth cooperation. And it has worked, according to Mats. In several cases the solutions have come about through close dialogue between Hungarians and Swedes.

"First there was the Czech deal and now Hungary: We are starting to get used to working directly with other countries. Nowadays I sometimes even think in English," says Mats.

COPY: HANS IVANSSON
PHOTO: HUNGARIAN AIR FORCE

JERRY LINDERGH

Technician friendly

MATS CARLSON

Major Dezsö Horváth (above) and warrant officer György Bodnàr back at the Kecskemét air force base in Hungary after a year's training in Sweden.

The hungarian technicians appreciate the ease with which the Swedish Gripen aircraft is maintained.

When Hungary was evaluating Gripen, F-16 and F-18, flight engineer Dezsö Horváth was part of the technical team that assessed the Swedish aircraft. He is not surprised that it was the Gripen that was chosen as the country's new fighter aircraft.

"Gripen is a new generation fighter plane, and it is very modern," he says.

Evaluation

When the three evaluation teams had put together their reports on the different aircraft, the Hungarian government decided that the country's future air defence should consist of Swedish-made aircraft.

"In comparison with the American aircraft, the Gripen was a financially better solution," says Dezsö. "The only factor not in favour of the aircraft was that it had never previously been purchased by a NATO member."

Dezsö has a solid military background. His officer career began in 1983, when he completed five years at military college in the former Soviet Union. He has since been a flight technician teacher, in charge of the Hungarian MiG-29 flight stimulator and an avionics engineer on the MiG-29. Today he is responsible for avionics technicians at the Kecskemét air force base. If extra assistance is needed, he also helps out as a mechanic.

"80 per cent of my job is concerned with checks," he says. "20 per cent is maintenance."

For aircraft technician György Bodnàr it is the other way around.

"Most of my working time is spent on aircraft maintenance," he says.

There are great technical differences between Gripen and the Russian MiGs.

"The MiGs have a conventional construction. The Gripen largely consists of computers," György says. "Each subsystem is controlled by a computer. The only thing built in a similar way is the engine."

György considers the Gripen to be a technician-friendly aircraft. It is generally easier to locate a fault on the Gripen than on the MiG. Nor does he need to kneel under the aircraft as much as he would with the American aircraft.

"Alongside the MiG-29 I have held extensive technical courses on the Mirage, F-16, F-18 and Tornado, and I appreciate the Gripen as a highly technician-friendly aircraft. I'm delighted to be able to work with the Gripen," he says.

All the technicians work together on the Gripen. In the case of the MiG, the technicians are divided into different groups, such as weapons, avionics, engine and so on. Like Dezsö, György also spends a lot of time working on the MiG aircraft. Thirteen of the original 28 MiGs are still in service. It is planned that the Russian aircraft will be phased out in 2009, that is to say two years after Hungary has received its 14th Gripen, the last under the present contract.

No comparison

A comparison between the MiG-29 and Gripen is almost meaningless. The MiG has two engines, weighs almost twice as much and has only half the range of the Gripen. The Gripen has a completely different construction and is substantially smaller than the large and powerful Russian plane.

"The Gripen is more slender," Dezsö comments. "Rather like a beautiful young woman."

COPY: JERRY LINDBERGH

VIKTOR VERES

The Carlsons moved to Hungary

During the ten years Hungary is leasing Swedish Gripen aircraft, Sweden is providing technical support. Sixteen technicians with their families have moved to Hungary and settled near the Kecskemét air force base. The Carlsons from the small Swedish village of Såtenäs are one such family.

Three years ago Mats Carlson, his wife Gunilla and their two sons took a drastic decision. At the beginning of 2006 they moved to Hungary. Mats had been given a job in the 16-strong team that was to support the Hungarians during the ten years they were leasing Gripen aircraft from the Swedish state.

When friends and neighbours heard what the Carlsons were planning, they were very surprised.

"Most people thought we were mad," says Gunilla. "Many people also thought it was unfair on the children. But who is to say that schools and so on are better back in Sweden?"

School

The two sons, 14-year-old Simon and 12-year-old Victor, now attend a newly established Swedish school run by the Swedish Armed Forces, together with the children of other families who have moved there. It is provided as a service to the members of the support team, and will continue to exist for as long as it is needed. For the practical subjects of sport, music, art and German, the Swedish children are integrated into Hungarian classes. These lessons take place entirely in Hungarian.

"But it works well," says Simon, before popping out to buy an ice-cream with some new Hungarian friends.

Today friends of the Carlson family take a different view of the decision to move to Hungary. They have come to realise that the family's stay is an adventure few people have the opportunity to enjoy. In addition, they have noticed that Gunilla and Mats now have a more relaxed everyday life.

"At home we both worked full-time," says Gunilla. "As I also had to commute almost two hours every day, there wasn't much time left for the family. The weekends were spent washing, cleaning and organising things we didn't have time for during the week."

Today Gunilla is free during the day. So she makes sure that washing and other everyday chores do not impinge on time when the family can do things together. Consequently the weekends can be spent socialising. They often visit one of Hungary's wonderful bath-houses.

Financially the family is coping well, despite the fact that Gunilla is not working. If they buy Hungarian products, food costs next to nothing.

"Our financial position is about the same here as it was back in Sweden," says Mats. "We're well off, but we're not rich, except in terms of the experiences we enjoy."

The house they are living in is rented from the Swedish Armed Forces, but it took time to find it.

"FMV suggested a number of different houses and apartments to us, but generally the rooms were too small," says Mats. "We felt it was important that the children's rooms were sufficiently large so that they could spend time in them, not just sleep."

Stucco

The Carlsons looked at several homes before they found the right one. When a fresh-looking house with rooms of normal size finally presented itself, that clinched it. They just had to accept that the style of building, stucco work and furnishings were a little on the gaudy side.

The support team of which Mats is a member has been put together to provide the broadest base of skills possible. It consists of nine air force technicians with different backgrounds in the Swedish Armed Forces, two pilots, a Volvo technician who knows the engine, and two technicians and two service engineers from Saab. Generally speaking, the group has to be able to assist the Hungarian air force wing in all areas.

Back in Sweden, Mats was a service platoon leader. In Hungary he has more or less the same duties.

"Except that at home I was also able to control, arrange and order. Here I can only control, arrange and advise," he laughs.

Mats describes the Hungarians as highly competent technicians. The reason why the Swedish support team is there is that the Gripen system differs substantially from the Hungarians' previous system. In addition, many of the instructions for the Gripen system are only available in Swedish. The same applies to the computer-controlled system Didas, which among other things keeps track of maintenance intervals and how many flying hours each part of an aircraft has had. As the aircraft are owned by Sweden during the lease period, it is important that they are maintained in the Swedish way, according to Swedish instructions.

"For the Hungarians it is, of course, impossible to work out that "by" stands for "byte" (replace) and that "rg" means "rengöring" (clean)," says Mats. It can also be difficult to know where information is to be found, or how it is to be interpreted.

"And sometimes I don't have the solution either and have to approach Saab, Volvo or the Swedish Armed Forces to obtain an answer to a question".

The days are filled with tasks such as interpreting instructions, assessing any damage and supporting the Hungarian technicians in carrying out repairs. An example of jobs carried out to date is replacement of the inertia-reel seat belt on one of the aircraft.

"This replacement required us to take out the whole pilot's seat, but there were only instructions in Swedish," says Mats. We got hold of English instructions through Saab, and that enabled the Hungarian technicians to carry out the replacement, with assistance from the support team.

Six of the 16 technicians in the support team will be needed for the full ten years of the lease period. The other positions will gradually be dropped. It is not yet clear how long the Carlson family will carry on living in Hungary. Mats is on a three year, renewable contract.

"Although we may stay for longer than three years, we might also stay for a shorter time," he comments. "It depends entirely on how happy the children are."

At present, however the family from Såtenäs find life in Hungary very much to their liking.

"The best thing is that everyone is so nice and helpful," says Gunilla. "Even though the population of Kecskemét is 150,000, everyone helps out as though it's a small village."

Before the Carlson family moved to Hungary, this country seemed to be at the "end of the world". But once they had settled in, a central European feeling became established. In their rented house in Kecskemét they feel very much at home, although it was built and furnished in what the family regard as a rather gaudy style.

COPY: JERRY LINDBERGH
PHOTO: JERRY LINDBERGH

Gripen jet fighter over Dubai, United Arab Emirates.

FMV has placed an order for the next major stage in the development of the Gripen system. The value of the order is over a billion Swedish kronor, and the order comes within the financial limit for the Gripen project laid down by the Swedish Parliament.

CONTINUED DEVELOPMENT OF GRIPEN

The requirements of Swedish rapid-reaction defence for international operations have dictated the specifications for the new capabilities of the Gripen system. It is principally in the areas of ground targets, darkness, interoperability, close combat and self-protection that these new capabilities are to be developed so that the requirements can be met.

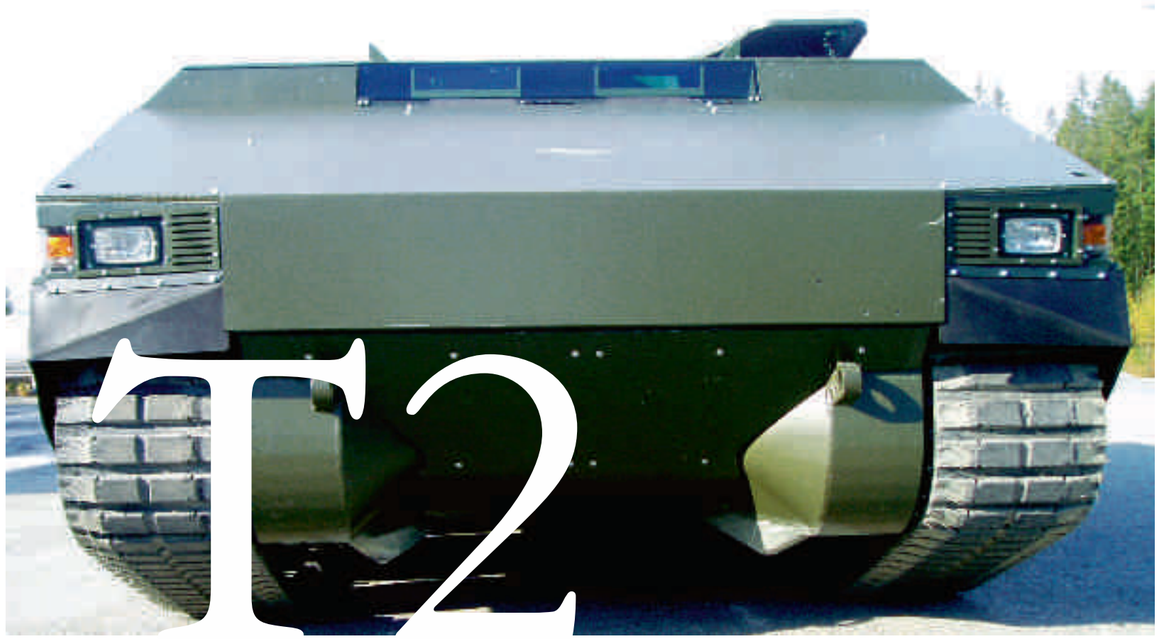
With this order, FMV's requirements have been specified at a higher system level than previously. The requirements to be met by the supplier IG JAS (Industrigruppen JAS AB) are now expressed in capabilities rather than in technical requirements for individual subsystems.

As a result, IG JAS will be given full system responsibility to develop these capabilities in the complete Gripen system, including aircraft, maintenance equipment, external load, pilot equipment and support systems. FMV consequently does not need to take responsibility for the challenges that arise at the interfaces between different subsystems, and can focus entirely on complete capabilities. With this order, the supplier IG JAS will also take increased responsibility for verification of the whole Gripen. This means that when the new capabilities are delivered FMV's testing will be made more efficient and will be focused on validation ahead of introduction into service. The lead time for delivery to the Swedish Armed Forces is consequently shortened.

Overall, the contract design and the supplier's expanded responsibility for system and verification signify improved efficiency and increased project safety for FMV's control and follow-up of development of the Gripen system.

The inherent flexibility and adaptability of the Gripen system to new requirements, as well as the developed relationship of responsibility between FMV and industry, will make it possible to deliver the new capabilities as soon as 2008-2009.

COPY: ULF LINDSTRÖM
PHOTO: KATSUHIKO TOKUNAGA



T2

T2 is the latest tracked demonstrator in the SEP project (modular armoured tactical system programme). Like its predecessor, it makes an important contribution to the continued risk-elimination studies ahead of the development of the Swedish military vehicles of the future.

The first tracked functional rig in the SEP project was delivered in 2000. It was called the T1, where T indicated that it was tracked. Today the focus is on its successor the T2, which differs in a number of crucial areas. The new tracked rig demonstrator has an electric transmission with permanent-magnet motors instead of asynchronous motors. In addition, it has a significantly more powerful diesel engine, different rubber band tracks, modified devibration, a new patented idler wheel that can be raised and lowered and an interchangeable roll-specific module that can also be installed on the wheeled rig developed under the SEP project. The T2 is also taller and narrower than its predecessor. The extra height allows for greater comfort in transporting people and provides better mine protection. The reduced width means that the vehicle can be carried on the Hercules C-130 transport aircraft.

The T2, which in comparison with its predecessor comes significantly closer to the envisaged solution for series production of the SEP, started an intensive period of trials in 2006. Tests were performed for instance on the demonstrator's manoeuvrability in various situations, both in deep snow and on very hilly terrain.

Future

The Swedish Government gave the go-ahead for the development of SEP at the end of 2005. The design for the next experimental vehicle version will be established in the spring of 2007, and it is intended that an order for series production will be placed with the supplier BAE Systems Hägglunds at the end of 2009. It is envisaged that delivery will take place at the end of 2010. A first unit of 112 vehicles in six different variants is due to be operational on 1 February 2014.

COPY: RICKARD O. LINDSTRÖM
PHOTO: RICKARD O. LINDSTRÖM

SEP T2 Demonstrator

Manufacturer: BAE Systems Hägglunds
Height/width/length: 190/283/627 cm
Engine: Two 6-cylinder Steyr diesels
Rating: 2x175 kW at 4,000 rpm
Max. speed: 85 km/h
Max. weight: 17.5 tonnes (of which 2.1 tonnes roll-specific module and 4.5 load capacity)

Devibrated baseplate for max. 85 dBA internally. Lowerable sprung idler wheel for increased manoeuvrability in snow and on soft ground. Interchangeable role-specific module. Electric transmission with mechanical override. The vehicle's dimensions mean that it can be transported on the Hercules C-130.

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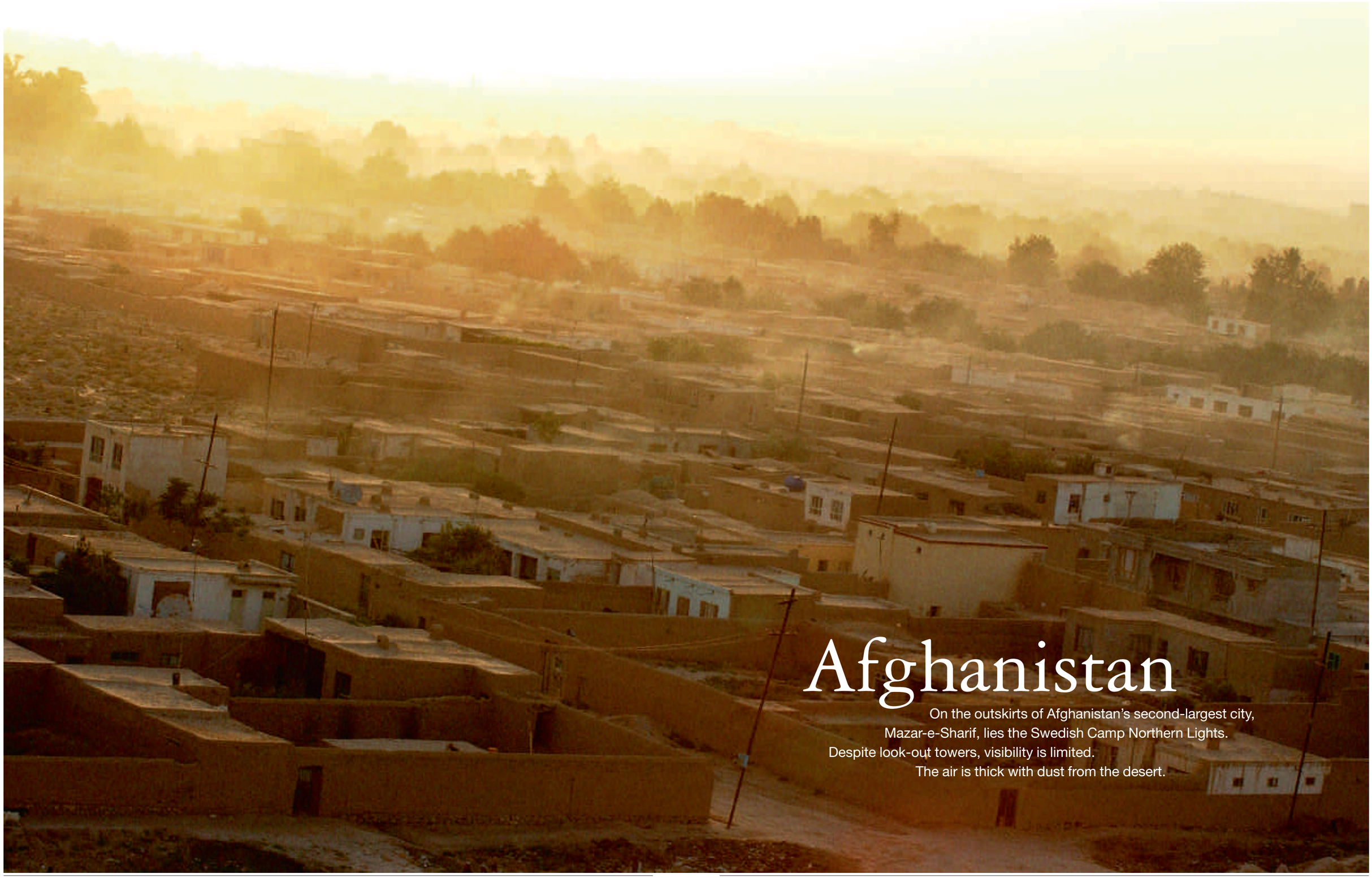

Afghanistan

On the outskirts of Afghanistan's second-largest city,
Mazar-e-Sharif, lies the Swedish Camp Northern Lights.
Despite look-out towers, visibility is limited.
The air is thick with dust from the desert.

Local building workers are used in order to create jobs and foster goodwill.

BUILDING A CAMP

In March 2006 Sweden took over responsibility for the regional unit for security and reconstruction of the city of Mazar-e-Sharif and environs. However, the take-over was not entirely free of problems. A large part of the camp had still not been built when servicemen were due to arrive.

Sweden has around 240 servicemen in Afghanistan. Most of them are stationed on the outskirts of the city of Mazar-e-Sharif, at the newly built Camp Northern Lights – a camp that also houses some of the Finnish, Danish and Romanian soldiers who are members of the same force.

When it was settled that Sweden was to take over the 70,000 square kilometre area of land from British troops, FMV was commissioned to draw up and hand over procurement documentation to the Swedish Armed Forces. This documentation was to form the basis for the Swedish Armed Forces' construction of Camp Northern Lights.

However, circumstances changed, so that as time went by FMV's tasks were greatly expanded. They eventually comprised acquisition, installation, commissioning, documentation and operational hand-over of infrastructure for command and control and electricity supply systems at the camp. The Swedish Armed Forces continued to be responsible for fortification measures, as well as for the procurement of container complexes of housing, offices, canteens and workshop areas.

"In some respects it has worked well, but in others distributing areas of responsibility in this way has created problems," says FMV's project manager Jan Sörberg. "In cases where the Swedish Armed Forces have been delayed in completing a building or a concrete foundation, we have been late too. This is because our installers are dependant on building work having been finished."

A fundamental reason for the delays has been the fact that the layout of the camp has been changed. Much of the construction work has therefore had to be dealt with through 'spur-of-the-moment solutions' where FMV has made quick judgements after each change to the original drawings of the camp.

"When we were allocated the installation of the command and control and electricity supply systems, there were no clear documents showing what the camp was supposed to look like," says Jan. "This has made the work difficult, but our experience of similar work has nevertheless enabled us to complete the task."

Jan Sörberg has directed the construction of Camp Northern Lights on behalf of FMV.

Surveillance

The surveillance system is one of the most important installations at Camp Northern Lights. A feeling of safety among the servicemen is fundamental to the whole operation. When they are out on patrol they have to be totally focused on what they are doing, so they need to be able to relax at the camp.

The surveillance system principally consists of camera units with special functions. These cameras principally monitor the areas around the camp. To further reduce the risk of anyone breaching the camp's security, there are sensors with microwave switches along the camp wall. When the microwave beams are broken, the system sets off an alarm and sends the information

White “peace doves” feel very much at home at the Swedish camp. However, they are not particularly appreciated when they set off the camp’s surveillance alarm.

to the surveillance centre.

At first there were some technical difficulties in making the complex system function as desired. Interference from radio equipment and the camp’s own power system was one type of problem. The countless white doves around the camp were another.

“The doves very much feel at home on the walls,” says Jan. “And when they entered the camp they sometimes set off the alarm.”

Without going into technical details, he says that the problems with interference and birds have now been solved.

Small price

The surveillance installations have cost almost five million Swedish kronor, but that is a small price to pay for the safety of personnel.

“We are very satisfied with the system. It’s ‘top of the line’,” says the camp’s deputy chief of staff, Per Sandgren.

There is a communication system so that the camp can keep in contact with units out on patrol. This is part of the command and control system and includes various types of radio equipment.

A 30-metre tower has been erected in the middle of the camp. This serves as an antenna carrier for radio equipment in the VHF band, that is to say equipment that covers local communication. The VHF equipment has a range of around 30-50 km. Beyond that distance short-wave radio, which works best at a range of 50-100 km, is used. After that satellite communication is used.

“Ranges depend on the weather and prevailing interference,” says Jan. “The dryness of the ground can also affect range.”

There are also four ’delta masts’ inside the camp. These are twelve metres tall and are used for short-wave communication. They are omnidirectional, but have a principal direction, and one of the masts has therefore been rotated and located a short distance away from the others.

It took a while before the camp’s temporary hand-painted welcome sign was replaced by a factory-made version.

Construction of the camp started when there was thick snow on the ground. Temperatures in Afghanistan range from around -20 to +50 degrees.

Camp Northern Lights is the home of Swedish, Danish, Finnish and Romanian troops. But also other nations, like the USA, also use the base.

Efficiently functioning communication is crucially important to the troops.

“With the prevailing camp layout, this was the best solution,” says Jan. An important requirement has been to position all the masts as close to the operational command and control centre as possible. This is to minimise loss in cables.

Telecoms

A significant element of camp life is being able to “connect”, both within the camp and with the outside world.

There is therefore a wide area network that connects all the units at the camp.

“We have put great emphasis on sustainability,” says Jan. “The servicemen must feel that they have a stable network to phone home and connect with the Internet.”

At the outset FMV’s commitment was limited to acquiring, installing and commissioning the wide area network, but it has since also been given the task of installing local area networks in a large proportion of the buildings. The local area networks are the ones that link different rooms in the same building. Jan’s responsibilities include the command and control centre, the welfare buildings and some of the residential complexes. In the command and control centre the network consists of both a traditional computer network and optical fibres that cannot be listened into.

Command and control

All the camp’s systems are linked to the operational command and control centre. The whole of the military operation is directed from here. Information from the external patrols is combined, and it is always possible to keep a check on where all Swedish patrol vehicles are.

Part of the command and control centre consists of a communications centre, known as the signal centre. Communication with units on the move takes place from here. This is also the site of the surveillance centre, which receives alarms if the cameras or sensors around the camp pick something up.

Cable television

There is also display equipment at the camp, consisting of several televisions, projectors, DVD and video players connected to a cable television system. This makes it possible to distribute ten cable channels and two internal information channels.

“The idea behind the system is that everyone should be able to obtain information quickly, almost regardless of where they are in the camp,” says Jan.

The canteen and all the briefing rooms have access to the system.

Planning, installation and documentation of technical systems have been carried out by FMV in cooperation with Saab Communications.

The Swedish Armed Forces make use of local workers for the construction of roads and other smaller technical jobs. With primitive tools and machinery, the work does not always progress quickly, but it creates both jobs and fosters goodwill in the Afghan population.

Morale

Despite all the problems and delays, good morale has been maintained among the servicemen during the completion of the camp.

“There has been a lot of talk about the camp being dreary, but we have what we need: cooked food, a gym, medical care, water and showers. Things could have been better for us, but they could also have been far worse,” said squad commander Johan in April 2006. His surname is not mentioned, because the safety of patrolling soldiers can be compromised if their names become known in Afghanistan.

In November 2006 FMV carried out a final inspection of the infrastructure installations for the command and control and power supply systems at the camp.

A country torn asunder

Afghanistan has been affected by war for decades: first a war of liberation against the Soviet-backed regime in 1978-1982, then a civil war that ended with the Taliban, an Islamic extremist group standing for a conservative interpretation of Islam, ruling most of the country in the early 1990s. The Taliban become known among other things for their strict administration of justice and conservative attitude to women.

Afghanistan’s conflict with the western world was exacerbated when the Taliban refused to hand over Usama bin Ladin, who was suspected of the terrorist attack on the World Trade Center. The Taliban regime was overthrown by US troops in 2001.

After a transitional period, a democratically elected government has taken over in the capital Kabul, but Afghanistan is still a long way from peace and stability. The central regime is weak, and there is widespread corruption.

Half of the world’s opium and 87 per cent of the world’s heroin come from Afghanistan and are thought to account for more than half the country’s GDP. The warring factions live off narcotics trade.

Despite the presence of American forces and multinational NATO-led forces, local warlords and opium barons continue to contest power and territory.

Afghanistan is one of the world’s poorest countries. 335 out of every 1,000 children die before reaching the age of five years, and average life expectancy is only 43 years. A large proportion of the population are illiterate. Only half of all children in the 7-12 age group attend school. It is estimated that up to half a million people are homeless or living in hovels.

Lotta Sellberg, Lottanytt

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PHOTO: JERRY LINDBERGH

Hanna Hellemaa

During the early summer of 2003 student Hanna Hellemaa decided, on the spur of the moment, to visit FMV.

After the holiday period she was taken on as an employee of Sweden's most project-intensive government agency.

Working in the state sector has both advantages and drawbacks and there are commonly held preconceptions about what that means.

"Looking at it from the outside, you might get the impression that work in the state sector is slow and laborious," says Hanna. "But that has not been my experience here at FMV, particularly in the areas I've been involved with."

When Hanna started at FMV in the autumn of 2003 she climbed straight into an area of operations the modern security-based society focuses on: CBRN, chemical, biological, radiological and nuclear analysis and protection.

"There is high pressure of work with anything concerning CBRN at present," she says. "There is a great awareness of the terrorist threat to society, and this area is taken very seriously."

Specific equipment is required to be able to counter these modern threats. Hanna has assisted in the acquisition of detection vehicles and decontamination and sampling equipment. She was recently also involved in the development of a mobile field analysis laboratory that is due for delivery during the summer. In some projects her focus has been on the acquisition phase, and sometimes she has assisted in the design review. On other occasions her work has been concerned with maintenance concepts, maintenance preparation and preparation of spare parts.

"Maintenance agreements in particular have been very important," she says. "With regard to CBRN equipment we buy small numbers of units, which have to have high availability. It has therefore sometimes been important to sign maintenance contracts that keep the supplier close to the product.

Lund

Hanna came to FMV straight from her studies. For five years she read industrial economics, focusing on production economics and logistics. She had a choice between the courses in Uppsala and Lund. She eventually opted for Lund, the quintessential student town.

An energetic lifestyle has always been important to Hanna. The duties at FMV therefore suited her well. She has been on many trips in the projects she has been involved in. One day she has been needed in Germany, the next in Karlskoga and so on.

"Sometimes I've sat in on large project meetings with lots of parties involved. On other occasions I've sat down with suppliers on my own to discuss maintenance agreements," she says. "Being given trust and responsibility early on has been enjoyable."

Some time ago Hanna was given a product manager role at FMV. This role, to some extent, is still under development, but it broadly means that she has to control and coordinate the maintenance in a number of equipment systems.

"It relates to general training equipment, CBRN protection equipment and food supplies," she says. "It's really exciting."

Riding

When energetic Hanna is not working, you might think she would allow herself to relax. She does no such thing.

As well as extensive renovation work on the apartment she shares with her partner, and quite a few fitness activities, she spends a lot of her time with the apple of her eye Tara – an eleven-year old mare who has energy to spare and finds it difficult to concentrate.

"She's absolutely wonderful, but clearly a horse with a bit of an hyper active problem," she says. "If I'm stressed, or if there is a lot of noise, she becomes really difficult to ride.

Hanna and Tara meet three times a week. Otherwise it is Tara's owner who cares for and feeds the horse.

Until 2003 Hanna was an active show-jumper. She competed over fences up to 120 centimetres high. Today she rides mostly for relaxation and mixes jumping with dressage. Combining her strong interest in horses with her work career has never been a problem.

"We even have a riding section here at FMV," says Hanna. "For a while I was head of the section, but I've given that up. Unfortunately there isn't time for everything..."

COPY: JERRY LINDBERGH
PHOTO: JERRY LINDBERGH

PORTRAIT

Hanna Hellemaa, aged 27.
Lives with partner Paul.
Idolised her brother when she was small, but blamed him as soon as anything happened.
In her childhood she was called "The Screamer" by her neighbours.
Her favourite time of the year is autumn.
For a time she wanted to become a vet.
Dreams about travelling to Zanzibar.

The FMV proving ground in Karlsborg is an independent body for the verification and validation of defence-industry products. The proving ground has held environmental certification since 1996, which means that great consideration is given both to the environment and to the people living nearby. Firing and blasting tests can be carried out on 200 days a year.

KARLSBORG TEST SITE

– more than just a firing range

FMV's various test facilities are, in many respects, amongst the best in the world. For firing tests, blast tests and climate tests, the facility in Karlsborg is the one to use.

FMV carries out extensive testing. There are high-quality facilities in Vidsel, Linköping and Karlsborg/Skövde. Together they provide the resources needed to meet most of the test requirements of various kinds of defence systems.

Testing has been done in Karlsborg for many years. The first measurements were performed on artillery guns back in 1927. Since then the proving ground has developed into something that is far more than just a firing range.

"With a number of restructuring operations, we have gone from being a firing range to a validation and verification centre with the resources to test most aspects of ground combat systems," says proving ground manager Bengt Gustavsson.

Another step in development was taken in 2006. All testing activity in FMV was combined in a unit run as a separate profit centre and with a joint manager for all test sites. This person directs operations, reports directly to FMV's director-general, and is a member of the agency's management team. The aim is to provide clearer management that can keep a collective grip on all verification and validation activities.

"I believe in this development," says Bengt. "It makes international cooperation easier, for example, as FMV test resources are often considered to be of great interest."

Major involvement

A large number of different types of blasts and firings have been performed over the years at the Karlsborg Proving Ground. Today there are not as many blasts. Instead of carrying out individual testing assignments, there is now a greater degree of involvement in the actual process of developing new systems.

"In the modern-day defence industry work has to be integrated," says Bengt. "Our aim is to take greater responsibility for the whole verification and validation part. This does not necessarily mean that we have to carry out the verification but it means that we have to assist in the specification of requirements and have overall responsibility for verification and validation in the development of new defence systems. If a good product is to be developed, the weapon and the vehicle that carries it cannot be developed separately, for example."

A strategic verification and validation plan is always established for each new project. This stipulates the tactical and technical objectives of the project. It also forms part of the contract with industry, and clarifies the distribution of verification and validation responsibility. The plan additionally provides the basis for detailed verification and validation programmes in which FMV has responsibility.

Protection

The testing of ballistic protection is one of the core activities for FMV in Karlsborg. Protection tests are carried out to show, for example, how a vehicle is affected by different types of threats, such as exploding mines. Deformations and the acceleration in the vehicle structure are filmed and measured during the explosion sequence. The risk of injury to the crew is calculated on this basis. The crash dummies of the car industry are used in some tests, with a number of load parameters being recorded and then compared with criteria for injuries to humans.

"The protection tested must obviously be adapted to the threats the equipment will encounter. The threat is unlikely to come from Swedish ammunition, so we try to acquire the threat ammunition the Swedish Armed Forces may encounter on foreign missions in various parts of the world," says Börje Kindbom, who is a test manager in the area of protection and direct fire. "If the ammunition proves difficult to acquire, we build ammunition that resembles the foreign original as closely as possible. As a result, we can carry out realistic tests."

Measuring equipment

Measuring activities at the Karlsborg Proving Ground have made great progress since firing began in 1927. At that time a weapon was loaded with a certain quantity of propellant and the range it achieved was measured. Today it is simply not sufficient to know how far it is possible to fire.

"Examples of information of interest in firing tests may be initial and impact velocities and interior ballistics, that is to say what the sequence of events in the barrel looks like," says measurement engineer Jonny Gustavsson. "The latter may entail measurement of pressure in the barrel, flight time in the barrel, flame dispersal and acceleration."

Measuring accelerations of up to 100,000 G and time sequences down to 100 nanoseconds requires advanced measuring systems. And everything that is needed is available at the Karlsborg Proving Ground.

The meteorological influencing factors are ascertained with weather systems, that is to say air temperature, humidity, wind and other factors that effect the results of firing. Before the test it is obviously also important to establish exactly where the muzzle of the weapon is located, what its direction is, where the target, testing and measuring equipment are located and so on. Geodetic systems ensure that the measurements are based on correct geographical reference points.

JERRY LINDBERGH

Torben Gustavsson and Lars-Ove Karlsson use computer-controlled high-speed cameras with digital image storage. The cameras can take up to 120,000 images a second. Using reference points on vehicles that are subjected to blasts, digital 3D models of the vehicle and the sequence of events are produced. The explosion and its effects can then be studied from all imaginable angles.

JERRY LINDBERGH

The climate hall offers temperatures between -52° and +63° and controlled humidity.

The measurements during firing may take many different forms. They may relate to anything from documenting impacts, rotation, precision and dispersal with a high-speed camera to various velocity measurements using radar.

They may also entail receiving data from airborne objects and transmitting data for example from a projectile to recording equipment on the ground by telemetry. Recording the performance of the projectile immediately after passing the muzzle provides a great opportunity to explain deviations in the remainder of the projectile's trajectory. The measurements, which may relate to rotational velocity, angle of oscillation or velocity, may be over in a fraction of a second and be performed on objects moving at up to 900 metres a second.

"These are short processes, where the enormous acceleration puts a great strain on the electronics," says Jonny. "It can sometimes be difficult to get things to hold."

Acoustics

Sound pressure is also of very great interest in the development of modern defence equipment.

"Today there are rules that say that you must not risk being injured in handling and using military systems," says Jonny. "Sound pressure measurements are therefore important in our activities. Both hearing and internal organs can be damaged by excessively loud sounds or pressures."

A striking example of the new approach in defence is the new artillery vehicle Archer. It replaces the old howitzer, which has exposed personnel to high sound and pressure levels. The same type of artillery gun is used in the Archer, but the crew is protected in a cab instead of standing next to the gun when it is fired.

It is important to follow standardised measuring methods in all measuring activities. The purpose of this is to allow different measurements to be compared. To make sure of always being at the leading edge in measuring standards, a number of test site employees act as observers in various groups for the development and standardisation of measuring methods. A new measurement standard has been developed and written at the Karlsborg Proving Ground. It has been adopted by several countries and relates to a method of measurement using mirrors to view the sequence inside the barrel.

"Dummy targets" are created for the tests carried out at the proving ground. These may consist of anything from a simple tent with an LPG burner to a tank shell with controlled temperature variation across the surfaces. The aim is to a create a signature equivalent to that of an actual target.

Ammunition

Ammunition and other explosive items are a core activity in testing. The ammunition is subjected to various tests at the proving ground's environmental centre. These relate for instance to accelerated ageing and impact and vibration tests. The ammunition is also subjected to various types of environmental effects. Cold, heat, moisture and salt spray are examples of these.

There are accurate programmes for checking the condition of the Swedish Armed Forces' regulation ammunition. Propellant is handled openly in such checking work. The work therefore requires specially built spaces. Static electricity is a complete no-no. Specific clothing is therefore worn in all work with ammunition and explosives. There is also an air humidity system that provides a stable indoor climate in the proving ground's ammunition workshop. The system regulates the climate by dosing the room with a shower of water vapour at regular intervals.

Overall the test site has extensive resources for the modification and measurement of ammunition prior to tests. This is required for full control of ammunition parameters during the test.

Effectiveness

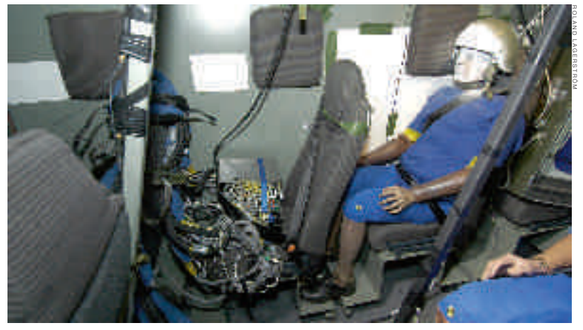
The Karlsborg proving ground has long endeavoured to improve the cost-effectiveness of its operations. This has in part meant reducing personnel numbers. In the 1970s there were 200 employees. Today there are 60.

"The climate has changed," says Bengt Gustavsson. "The Swedish Armed Forces' activities are being cut back every year, and it's noticeable to us too." The proving ground is principally intended to meet the needs of the Swedish Armed Forces and FMV, but during periods when these authorities are not using the resource we have been carrying out increasing levels of activity for external customers."

External efforts have yielded results. There are periods when foreign customers account for a large proportion of the Karlsborg Proving Ground's customers. One of the most faithful customers is the German company IBD. They specialise in protection work and often make use of Karlsborg as it is able to offer the discretion and level of security required for IBD's confidential activities. The independent expertise they are looking for is available within the bounds of FMV.

"Tests on protection technologies are becoming increasingly complex," says IBD owner and chief executive Ulf Diesenroth. High-performance diagnostics is required to be able to understand and optimise the effect of passive high-tech protection and the new, advanced active defence systems. The Karlsborg Test Site has personnel with the right expertise and experience, as well as access to the diagnostic tools necessary to be able to work together with IBD in this very challenging area. Working conditions at the Karlsborg Proving Ground also provide a very high level of safety.

ROLAND LAGERSTRÖM



ROLAND LAGERSTRÖM

Top: Patrik Persson and Gustav Pettersson, from the media technology master's programme in the Institute of Technology at Linköping University, are carrying out degree projects at the FMV proving ground in Karlsborg. The degree project is aimed at devising new methods and developing a specially adapted programming tool for measurements in image data. The picture shows a check measurement for the system's velocity calculations with a Doppler radar as reference system.

Right: Crash dummy before blasting the new personnel transport container of the Swedish international force. Right below: Ammunition superintendent Perry Lundquist shows a live 120 millimetre mortar shell sawn in two in front of the bunker in the ammunition workshop where these high-risk operations are performed.

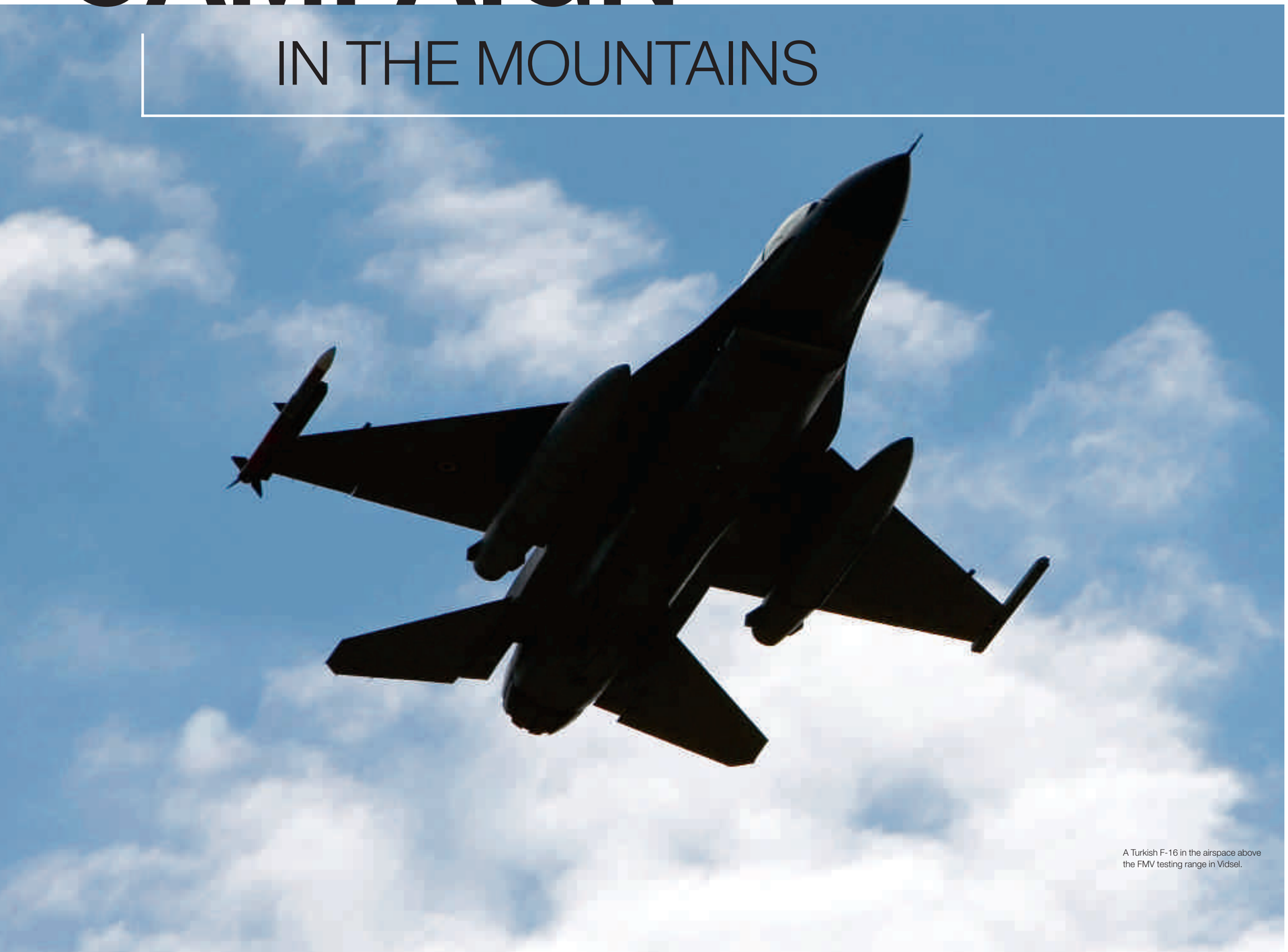
JERRY LINDBERGH

COPY: JERRY LINDBERGH

PROTEC

CAMPAIGN

IN THE MOUNTAINS



A Turkish F-16 in the airspace above the FMV testing range in Vidsel.

The largest test range over land in Western Europe is located in the Swedish mountains. Here the Saami people, reindeer and virgin nature co-exist with high-technology military equipment, technicians and aircraft.

After a one-hour car journey from Luleå in northern Sweden it comes into view: FMV's testing range in Vidsel. A hundred or so people are attached to the base, which initially was one of Sweden's wartime airfields. Amongs other things, there are specialists here in radar, telemetry, ammunition, aircraft and targets. Most aspects of Swedish-developed missile systems have been tested here since the sixties. That was also the time when an agreement was reached between the testing range and the three Saami communities that tend their reindeer on land included within the range.

"This cooperation works extremely well," says Mats Hedman, the test sites contact with the Saami. "Where our views have differed we have managed to come up with a solution that satisfies both parties."

International

In front of the fire at the local hotel you can often hear non Swedish voices. Although the speakers may be international tourists enjoying the mountains, the fact is that in recent years the testing range has had many foreign customers. Finland, Austria and Switzerland have been represented here for many years, but since Sweden joined the EU more nations have discovered what the testing range has to offer. As many as eight nations were represented in Vidsel at the time of the Amraam air-to-air missile tests in August 2006. Those present included Raytheon, a company based in Arizona in the United States.

"The conditions up here are the best possible. Equipment, personnel and the testing range are top class, and everyone works as a team. That means that even the most complex test firing is easy to carry out," says Brad Clifton from Raytheon.

These factors mean that he is happy to return to Vidsel. And it looks as though Raytheon will be returning for further tests in the near future.

"We have a fantastic testing range, where it is possible to fire over land. That makes it possible to locate and salvage the material, both for analysis and to ensure spent rounds and duds are not left lying around," says testing range manager, Nils Widén.

Income

The high level of interest from international customers is something that pleases Nils Widén. He views it as confirmation that efforts to attract interested foreign parties to Vidsel for tests have started to pay off.

"The campaign in August was intensive, with a large proportion of the test site's personnel involved. This means that we have a high income, but that is something we have to have when the Swedish defence organisation is cutting down on its own deve-

lopment of military equipment."

A sum of 40 million Swedish kronor has to be recouped with tests on behalf of foreign customers if the level of test activity is to be kept up.

Alongside Sweden, Denmark, Finland, the United Kingdom and Turkey took part in the test firing of the Amraam air-to-air missile with their own aircraft, personnel and equipment. In addition, Spain sent a whole army unit to attend the air-defence version of Amraam, known as Nasams. The United States and Greece took part with representatives from manufacturing firms.

Focus

A close-knit group of staff undertake testing activities in Vidsel. During the weeks of testing all the focus is on carrying out the test in such a way that the customer obtains the data necessary for further development of the product.

"It's great fun to see all the planning work lead to practical results in the actual campaign. It's like a kind of final in which everyone is incredibly focused," says Annika Lind, who is a project manager at the FMV test site in Vidsel.

Campaign

The term campaign is well established in Vidsel. It refers to a limited period of intensive work in which a lot of things have to work well with technology and logistics, both on the ground and in the air. Nordic Archer, which was the name of the campaign, has been preceded by careful planning over the last two years. Communication usually takes place by e-mail, but people from the testing range occasionally meet the customer and the parties involved to run through various aspects of the future testing. Individual contacts are also made, for example between the flight test leader and the pilot, when flight routes are discussed.

"Despite the fact that we are thousands of kilometres apart and sometimes on different continents, the coordination of these projects works incredibly well. I think this is due to everyone involved being clear about the goal of the activity," says Annika.

From mid-June until mid-July the Saami mark their reindeer calves. At that time the test site does not put any 'risk zones' on the testing range. Nor is this done during September, when the slaughter of reindeer bulls takes place. This is all part of the give and take characteristic of life in the mountains.

Top pictures: Spanish troops fired Amraam missiles from land-based air-defence missile systems.
Lower picture: The Turkish air force came to Vidsel with F-16 aircraft armed with Amraam.

COPY: HANS IVANSSON
PHOTO: ANDERS ÅBERG

BRIEF INFORMATION ON AMRAAM

The Robot 99 or Amraam missile is now integrated into the JAS 39 Gripen. The Amraam system works independently of light, can track several targets simultaneously and has advanced protection against various forms of interference. During the first part of its trajectory the missile receives target data from the aircraft, and in the final phase the missile's own homing device takes over. But it is also possible for the missile to become completely autonomous after firing. About twenty air forces around the world use the Amraam.

Weight: 158 kg
Length: 3.65 metres
Range: more than 50 km
Max. speed: more than 1000 m/s

HELIKOPTER 15 HAS ARRIVED

Helikopter 15 is here. Together with the, likewise new, Helikopter 14 and the proven Helikopter 10, it will form the future backbone of Sweden's military fleet of helicopters.

FMV has been working on renewing the helicopters of the Swedish defence forces for a number of years. The aim has been to obtain modern and more appropriate helicopters that meet both new and existing requirements of the Swedish Armed Forces.

Together with the manufacturer Agusta, FMV has been working on specific requirements for, and the development of, this new military helicopter, which internationally has been given the name A109 LUH (Light Utility Helicopter), since 2001. In Sweden it has been designated Helikopter 15.

Helikopter 15 is the first helicopter to be delivered under the current renewal plan. A total of 20 helicopters have been ordered, twelve of the 15A model and eight of the 15B model. The helicopters will be delivered between 2006 and 2009. The total cost of the whole system with helicopters, training, equipment etc. is around 1.4 billion Swedish kronor.

The Helikopter 15 will provide a platform for general crew training, with the emphasis on tactical training in land and sea operations. The helicopter will therefore exist in two versions, a ground operations version (15A) and a sea operations version (15B). The latter is also intended to be capable of being ship-based and collaborating with the Navy's Visby class corvettes.

Mission adaptation

The actual base helicopter has space for two pilots and six passengers. There are various examples of mission equipment. For the transportation of troops, weaponry and lowering ropes are fitted. A thermal camera and data link are fitted when the helicopter collaborates with a Visby class corvette for underwater reconnaissance. A winch, search light and stretcher are fitted for sonar buoys or for rescue missions. The mission equipment can also be combined in other ways.

In 2006 FMV handed the first six helicopters over to the Swedish Armed Forces. The remaining 14 helicopters will be delivered at regular intervals up to the spring of 2009.

The first verification of the sea operations version (15B) is scheduled for 2007.

COPY: ULF LINDSTRÖM
PHOTO: AGUSTA WESTLAND

HELIKOPTER 15

Manufacturer: Agusta Westland
Engine:
2 x Turbomeca Arrius (2 x 797 hp)
Crew: 1-2 plus 6 passengers
Length: 11.5 m
Rotor diameter: 11 m
Height: 3.5 m
Empty weight: 2.1 tonnes
Max. take-off weight: 3.2 tonnes
Max. speed: 310 km/h

SAPPHIRES

Second Generation AUV

Autonomous underwater vessels fall under the classification Autonomous Underwater Vehicle (AUV). With Sapphires, FMV is on its second generation of AUVs that can be launched from a submarine's torpedo tube.

Around the world more and more focus and resources are being placed on developing military AUVs, that is, vessels that can autonomously conduct missions that would otherwise put personnel at risk.

On assignment from the Swedish Armed Forces, FMV is also developing a new type of AUV. To assist them they have the Swedish Defence Research Agency (FOI) and the contractor Saab Underwater Systems AB.

The new AUV is a demonstrator designated Sapphires. The purpose of the project includes enabling the development of the Swedish Armed Forces capability to gain the intelligence advantage under water – primarily by effective high-definition sea floor mapping of large surfaces. Sapphires is also intended to prove that it is realistic to create an AUV system that has the capability to conduct intelligence activities and mine detection with a low risk of casualties.

Second Generation

AUVs have a broad range of applications. They can be used for everything from intelligence gathering to mine hunting. Even today, there remain large numbers of mines, for example in the Baltic, from the First and Second World Wars.

Sapphires gives FMV its second generation of 21-inch AUVs. The first one was designated AUV 62F and was based on Torpedo 2000.

Sapphires is similar, for the most part, with its predecessor. Externally, the most obvious changes are the new, sapphire colour and the considerably larger telescopic aerial. But it is under the hull that the biggest improvements are found. Above all, the new sonar technology is a major advance in technology. Sapphires is designed to demonstrate how mine hunting could be conducted; over large areas, under concealment and at low risk to personnel.

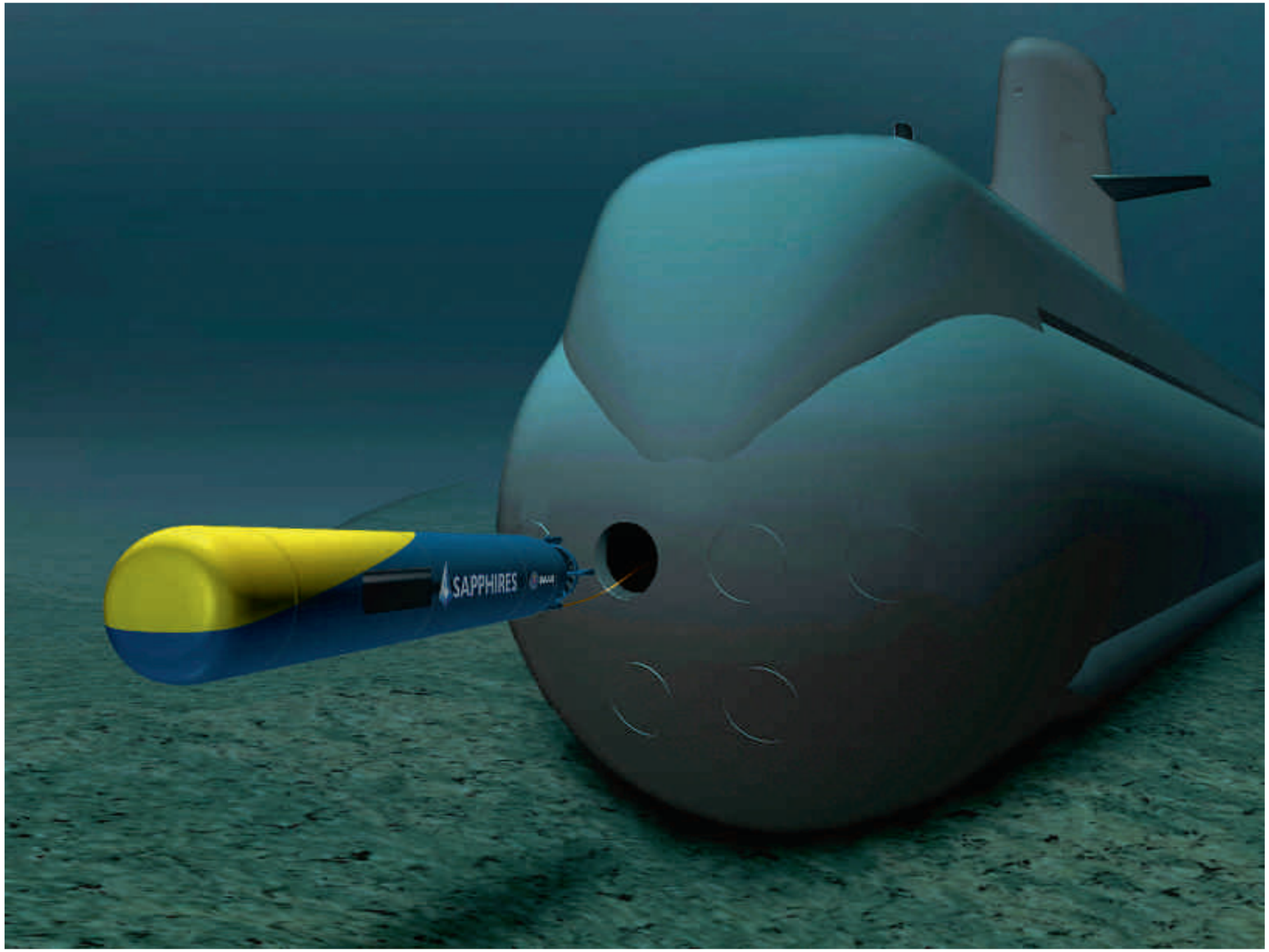
"The sonar uses a processing technology called Synthetic Aperture Sonar (SAS), which permits a combination of long range and high resolution. These are two characteristics that are incompatible in traditional sonar processing", says FMV's project leader Carl-Johan Andersson.

Carl-Johan is responsible for FMV's share of the project that goes under the designation FoT9. The abbreviation stands for "research and technology development" and the number 9 indicates that the project involves underwater technology. Both FMV and FOI are involved in FoT9. FOI is responsible for research while FMV is responsible for technology development. Underwater technology includes studies on sensor systems and areas of technology such as signatures, communication, and weaponry. Part of all this is Sapphires, which got its name from the abbreviation of "synthetic aperture processing, high resolution sonar".

Using the experience gained from AUV 62F and the Daim project*, FMV began to draft Sapphires during 2000. The focus of the project has always been on sensors. The task is to produce enough data to obtain a clear picture of the situation in the area being probed.

"In our waters, acoustics definitely provide the best pictures", says Carl-Johan. But there are areas in the Baltic where mine hunting is more or less impossible due to sea floor conditions. It is particularly troublesome when the sea floor has many stones of the same size and shape as mines. Or terrain where the sea floor vegetation has air bubbles on its leaves that the acoustic signal cannot penetrate. It is hoped that the high resolution provided to a certain extent by Sapphires will remedy this problem.

The preliminary studies were followed by a definition phase that extended to spring 2005.



The Sapphires AUV can be launched from a submarine's torpedo tube.

*The Daim project (Digital Acoustic Imaging) was conducted in 1996-99. The collaboration between FOI, Linköping University, Chalmers, and Saab Underwater Systems resulted in a broadband, high frequency sonar as well as algorithms for advanced signal processing with high-resolution methods. The results from the project were so promising that FMV and FOI continued the project.

During the definition phase, design documentation and specifications for the vessel and its sensor system were produced. Above all, the high-resolution signal processing algorithms for the sensor system were developed. The interfaces between the algorithms, sensor system, and vessel were also specified. The system's basic components were developed after the definition phase. During the second half of 2006, the focus was on tests, analyses and adjustments to make the component parts perform perfectly.

"We are in a rewarding period, with a lot of sea trials", says Carl-Johan. "We have now received the first indications that the system can perform sea floor mapping at the levels of quality we expected."

Large

At 6.5 metres in length, Sapphires is a relatively large AUV. In combination with its modular construction, this makes it very well suited to carry different types of payloads.

"Vessel operations for navigation can be supported by GPS. Two trim tanks that can be filled and emptied make sure that the vessel always has neutral buoyancy. The steering is thereby given optimal conditions for keeping the vessel on a steady course. A steady course is very important in achieving the resolution objective: an exactness of five centimetres over the entire mapped out surface.


MOTALA FOTOGRAFISKA

Sapphires has undergone testing in various types of water environments. Here it is in Lake Vättern.


SAAB

Sapphires can be launched from a submarine's torpedo tube. After a completed mission, a remote-controlled vessel grabs the AUV and guides it back into the torpedo tube.

tion, manoeuvring, and propulsion have been placed in the Sapphires aft", relates Carl-Johan. "We have thus created space for addon equipment or payload in the AUV's fore."

Depending on the mission, the fore can be used for various applications. Perhaps there is a need to transport a payload that must be placed in a particular location at sea. Or perhaps one would like to take along some type of transmitter that emits sound, and thus deceive a potential enemy.

"It can also be used to equip the vessel with more sensors, sampling equipment, or extra communication equipment", explains Carl-Johan.

Manoeuvring

To be able to conduct accurate mapping, Sapphires requires a well-developed manoeuvring and navigation system. The navigation system consists of a ring laser gyro, accelerometer, depth sensor unit, and a Doppler speed log that measures speed in relation to the sea floor. When surfaced, navigation can be supported by GPS. Two trim tanks that can be filled and emptied make sure that the vessel always has neutral buoyancy. The steering is thereby given optimal conditions for keeping the vessel on a steady course. A steady course is very important in achieving the resolution objective: an exactness of five centimetres over the entire mapped out surface.

Torpedo tube

During testing, launching has primarily been made from ships or docks, but because Sapphires has the same interface as a heavy torpedo, it is also possible to launch the vessel from the torpedo tube on a submarine.

This type of launching has not caused any problems, but returning to the torpedo tube has not been as easy. Even if the AUV manages to navigate autonomously in open seas, the margins are too small to be able to navigate into a torpedo tube after a completed mission.

"We have tested a few different solutions to the problem", says Carl-Johan. "Finally we settled for a method where a remote-controlled vessel grips the AUV and guides it into the torpedo tube.

Preliminary study

The Sapphires demonstrator project can be seen as a preliminary study or risk reduction for the larger TMS project (Torpedo Mine Sensor), where capabilities of torpedoes, area surveillance, and mobile sensors are integrated in a common system. The TMS system is intended to be modular and will be made up of a number of different components, where function is custom-made to meet the present need.

During the fall of 2007, the Sapphires project will be completed. The AUV will then be ready for use in different demonstration exercises.

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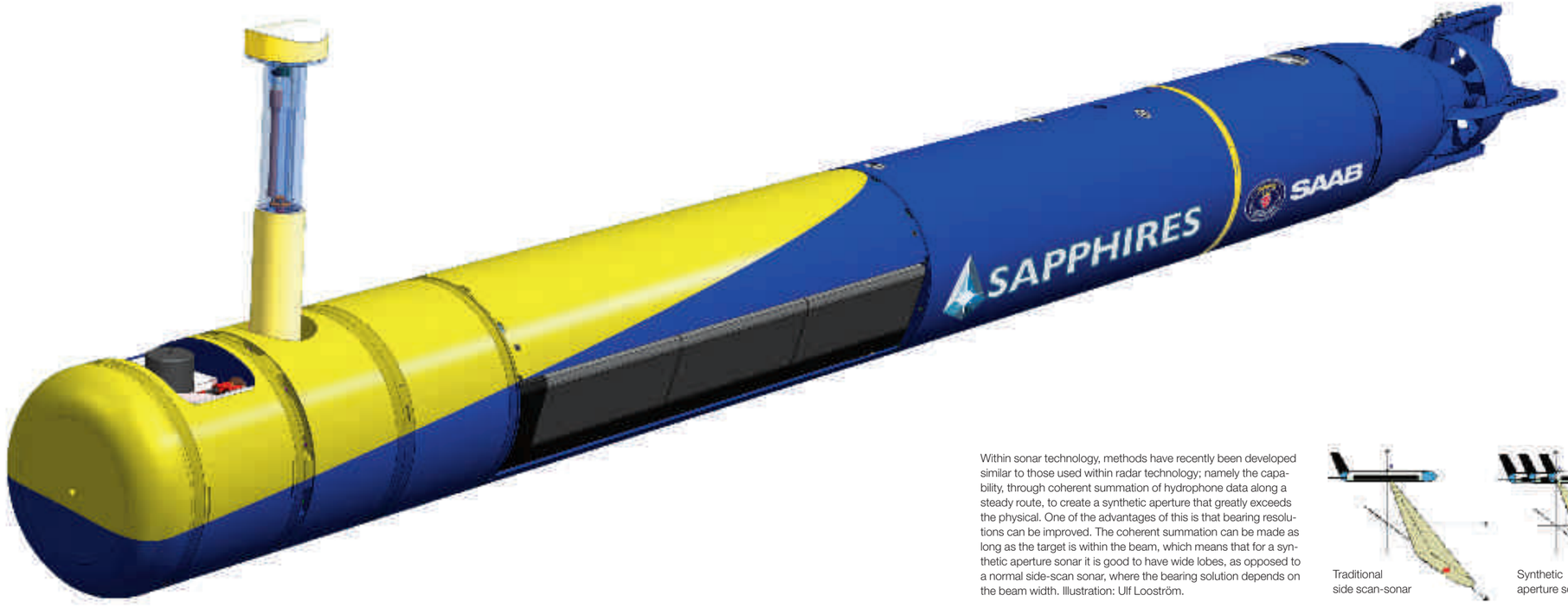
ILL: MOTALA FOTOGRAFISKA



Within sonar technology, methods have recently been developed similar to those used within radar technology; namely the capability, through coherent summation of hydrophone data along a steady route, to create a synthetic aperture that greatly exceeds the physical. One of the advantages of this is that bearing resolutions can be improved. The coherent summation can be made as long as the target is within the beam, which means that for a synthetic aperture sonar it is good to have wide lobes, as opposed to a normal side-scan sonar, where the bearing solution depends on the beam width. Illustration: Ulf Looström.

AUV operations around the world

The AUV technology is practiced in many places around the world. The American vessel Remus, for example, was used frequently for mine hunting during the Iraq war. Remus is however not as advanced as the Swedish Sapphires regarding navigation and sonar equipment. Part of the explanation for this is that the Remus is just over 80 centimetres long while Sapphires measures 6.5 metres. Sapphires greater size enables another degree of flexibility regarding payload.

Even the majority of the major European countries have AUV projects in progress. For example, our neighbours the Norwegians are developing an offshore solution named Hugin. It is being developed for Norway's special sea floor topography and has a working depth of nearly 4,000 metres.

Michael Siwertzon

SAPPHIRES

Length: 6.5 metres
Diameter: 21 inches (53 cm)
Weight: 1.100 kg
Weight in water: 0 kg (Adjustable ± 20 kg)
Maximum speed: 10 knots
Surface communication: WLAN, 54 Mbit/s
Submerged communication: acoustic modem, 320 bit/s
Internal communication within vessel: Gigabit Ethernet

Sapphires sonar
Centre frequency: 100 kHz
Bandwidth (-3 dB): ± 15 kHz
Coverage capacity: 2km2/h

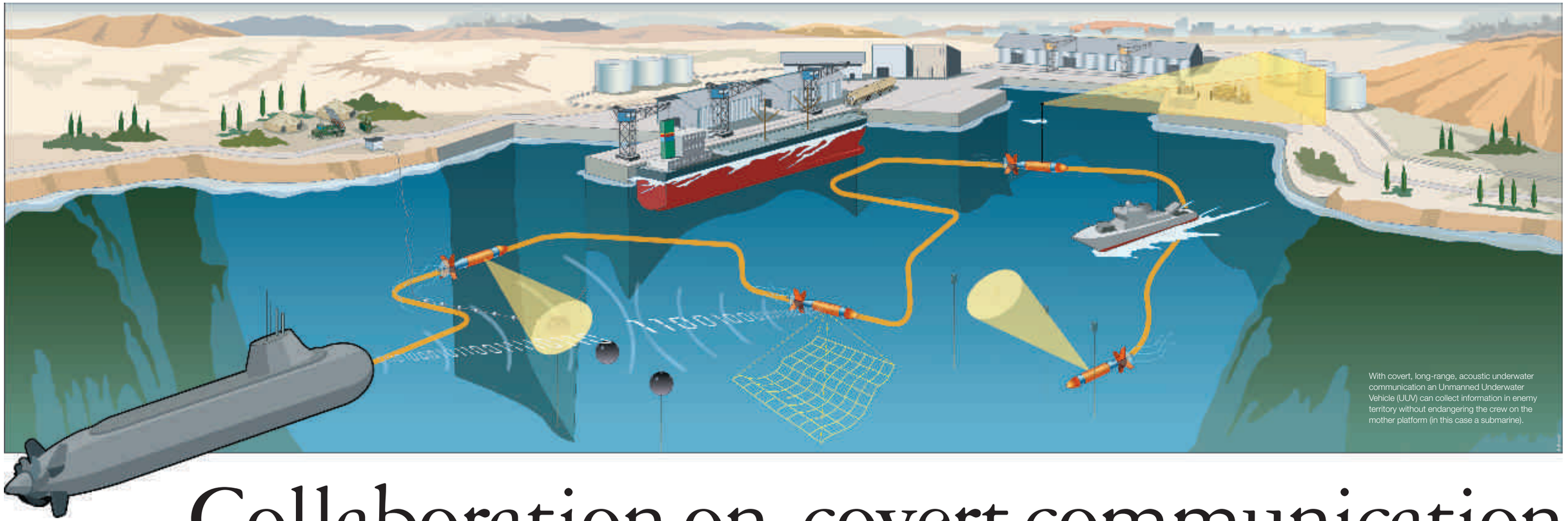
Receiver array
Length: 158 cm
Number of elements: 2×48
Horizontal beam width: 31°
Vertical beam width (upper array): 22°
Vertical beam width (lower array): 55°

Transmitter array
Height: 11 cm
Number of elements: 14 (3+11)
Horizontal beam width: 25°
Vertical beam width (3 elements): 27°
Vertical beam width (11 elements): 9.5°
Emission rate (3 elem.): 205 dB (rel 1µPa)
Emission rate (11 elem.): 215 dB (rel 1µPa)

Processing unit (July 2006)
PC from ACT
Operating System: Windows XP
Processors: 2 (ea.) AMD Dual Core
Internal memory: 8 Gbyte
Hard disc capacity: 300 GByte (SCSI)
Output data from sonar: 130 MBit/s

Applications that are run on the processing unit are chained to be able to use several processors. The development of computers advances so quickly that during the project, two to three hardware changes are scheduled to be able to fully take advantage of processing capacity in the latest technology.

PROTEC



With covert, long-range, acoustic underwater communication an Unmanned Underwater Vehicle (UUV) can collect information in enemy territory without endangering the crew on the mother platform (in this case a submarine).

Collaboration on covert communication

Together with Denmark, Finland, Holland, Italy, Norway, and Germany, Sweden is developing a covert, long-range, underwater communication system.

Communication between the different platforms is an important part of underwater operations. Often it is desirable that these remain "silent" to keep the risk of detection as small as possible.

"The driving forces behind our project include the joint military requirements that exist to be able to collect intelligence and detect mines using UUVs", says Anders Svensson, project leader at FMV. "This requires secure, long-range, and often covert communication between the vessel and the mother platform".

Development of methods for underwater communication with a low risk of detection is the project's central aim. Because it is not always possible to establish radio communications between platforms under water, acoustic signals are used. Until recently, acoustic communication was only possible with great limitations; but the research of the past few years has now made it possible to attain long communication distances and more "invisible" transmissions.

Despite the project's high demands on low detectability, the objective is that the system attains a range of fully 50 kilometres under good conditions. This is a major increase compared with Sweden's current system.

"At the same time we are also focusing on making the communications link robust", says Anders. It is important that the link can easily be established and that the correct information is delivered.

Sea trials

To explore and determine the characteristics of underwater communication, as well as to validate methods, the project conducts measurements during various sea trials. The trials are conducted in different waters with different levels of salinity, depths, and temperatures. All of these factors influence communication distances and the like.

Analysis of the obtained trial data is then the basis for compilation of different algorithms for underwater communication. One will even develop the simulation capability to support testing and validation of the algorithms that will be integrated in the communications modem that is also being developed within the project.

The Swedish Defence Research Agency (FOI), together with Dutch TNO Defence, is responsible for development of the signal processing algorithms, including coding, modulation, and compensation for multi-path dispersion in the audio channel.

Contractual responsibility

The project originally started within the European cooperation organization, the Western European Armaments Group (WEAG). But when WEAG was dissolved in favour of the new European Defence Agency (EDA), a new solution was required. Neither Norway nor Denmark is affiliated with EDA.

"During the summer of 2005, the project was transferred to FMV, which thereby was allowed to represent all of the countries as commercial counterparty", says Anders.

He is pleased that FMV was given the controls. This shows that the participating countries have great confidence in Sweden and FMV. Sweden is even "lead nation", which means that FMV holds chairmanship of the steering group in which the participating nations take part.

It is also FMV's role to lead and control the deliveries that are included in the contract with the industry.

All seven countries share the costs of development and the like. The project costs a total of approximately 60 million kronor during a three-year period. Sweden contributes 6.2 million kronor, of which half goes to research and half goes to the principal contractor, Saab, for project management. Besides the shared costs, there are other advantages of the collaboration between the countries.

"It is a big step towards interoperable underwater communication", says Anders. "During future missions, it is very important that we be able to communicate with other countries' systems."

The project is scheduled for completion in December 2008. Then the communications equipment will be implemented and tested in the North Sea with the Norwegian underwater vehicle Hugin.

Seven countries are involved in the development of the new, covert hydroacoustic underwater communication system designated "UUV Covert Acoustic Communication". FMV is responsible for the contract with the following companies and organisations.

Sweden
Saab Underwater Systems AB
(principal contractor/project management)
Swedish Defence Research Agency (FOI)
(methods development).

Germany
Forschungsanstalt der Bundeswehr für Wasserschall und Geophysik
(sea trials, planning, and implementation).

Norway
Kongsberg Maritime AS
(integration of hard/software and demo.)
Norwegian Defence Research Establishment
(modelling of audio channel).

Holland
TNO Defence
(methods development in collab. with FOI).

Denmark
Reson A/S
(developm. of low-freq. acoustic transmitter).

Finland
Patria Advanced Solutions OY
(modem development/integration).

Italy
Fincantieri
(scenarios and systems requirements).

COPY: JERRY LINDBERGH
ILL: LEIF ÅBJÖRNSSON

Coordination of remote operated vehicles for the Swedish Armed Forces and Swedish Police

The remote operated vehicle (bomb robot) – an invaluable resource when a suspect explosive charge is to be destroyed. FMV has procured the latest version of the robot for both the Swedish police and the armed forces.

When a suspect explosive device is to be examined, moved or destroyed, it is a remote operated vehicle or robot that is given the job. An unknown device can explode at any time, and it is essential that no one is in the vicinity if this happens.

There are activities aimed at dealing with suspect objects in both the armed forces and the police. The Swedish Armed Forces have been using the Amröjrobot 1 and 1B for many years, but something new was now needed. FMV was therefore asked to sound out the market and procure the most suitable system in competition, from both the functional and cost points of view.

"When we received the request from the Armed Forces, we also approached the police. We knew that they had a number of ageing remote operated vehicles and might be interested in this procurement," says Mattias Skeppstedt, who alongside Jan Lindgren, has been the man responsible for striking the deal for FMV.

It is sometimes possible to find common needs between the police and the armed forces. That was the case here. Effective coordination made good economic sense.

"We are very pleased with the way prices have developed," says

Forensic scientist Jesper Wohlert and Captain Dan Johanson discuss use of the Amröjrobot 2.

Mattias. The fact is we got the price down by 20 per cent per ROV after we involved the police in the deal. That represents a good saving for the Swedish treasury.

Following an evaluation of quotations received, the order went to the British firm of Allen-Vanguard. They had just developed a new ROV, which suited the Swedish Armed Forces and police well. That made it simpler for FMV to get a number of modifications made in time for delivery, in particular a number of safety-related functions. Among other things, they did not want the ROV to be able to fire more than one weapon at a time. This was to ensure that a check could be kept on what happens to the device after each round.

The Amröjrobot 1B will be gradually phased out and replaced by the new Amröjrobot 2.

"We also wanted the emergency stop button to shut off all power to the robot. Previously the robot stopped but still had power for communication. This meant that there was some risk of it moving if a lever was deflected. In addition, an explosive device can be ignited by radio waves," says Jan Lindgren.

Allen Vanguard's product manager Dave Norton confirms that hundreds of e-mails have been exchanged between him and FMV. These have led, in several cases, to the company modifying the ROV design.

"This has resulted in useful discussions, and we are very pleased with the order," says Dave Norton. "Sweden is our first European customer, so it has been good for us to enter a new market. We hope to be able to build good relations with FMV and the end-users."

Advantages

The new ROV offers a number of advantages over the Amröjrobot 1B. The most visible advantage, perhaps, is that it has six wheels instead of four. It does not have the tracks the Amröj robot 1B also had, but as all six wheels are drive wheels and each axle moves independently of the others manoeuvrability is just as good as with its predecessor. Tracks are not entirely desirable either, as they result in shaky movement, which shortens the life of the robot.

Other advantages of the new robot are that it can carry more tools, such as X-ray equipment and weapons. An example is the shotgun, which is used to penetrate laminated windows. Another example is what is known as the disrupter. This exists in several calibres and acts as a canon that fires concentrated liquid, usually water.

"The pressure in the jet can become so high that the device can be shot apart before it explodes," says Jan. "There are also other types of ammunition, such as clay projectiles in case there is a need for a different effect in the target."

Real-time X-ray can also be fitted in the tool attachments. Being able to see through a suspect object can provide information of great significance.

Remote control

The Amröjrobot 2 is remotely operated from a compact control unit that is easy to carry. Remote control usually takes place through fibre optics, which means that the robot has a cable several hundred metres in length behind it. The control unit's monitor is also supplied with images and sound recordings from the various cameras and sensors through this cable. The robot can also be radio-controlled, but the range is then shorter.

"This gives us a real lift," says Jesper Wohlert, who is a forensic scientist at the police authority in Västa Götaland. "Some of our old robots only have 90 metres of copper cable. That was both short and awkward. And if you have to go down into a multi-storey car park or other buildings that block the radio signal, for example, good remote control via cable is required.

Scenario

When a suspect terrorist explosive device is discovered, the operator manoeuvres the ROV forward to the object while he or she stays at a safe distance. The ROV's real-time cameras give the operator a good overview over manoeuvring and the situation in the area. The operator can also talk or listen through the ROV – necessary, for example, if it is a suicide bomber or hostage thats is being approached.

If the suspect device is to be rendered harmless, there are some different approaches to follow. Either a plastic explosive charge is placed over the object, or one of the robot's available weapons is used, for example the disrupter, which shoots the object apart with its concentrated jet of water.

Training

For end-users in the armed forces and the police to get as much as possible from their new equipment, training on the system has also been purchased by FMV.

"It's a natural part of the delivery," says Jan. "We have developed a programme with the supplier. Allen-Vanguard have also carried out the training courses. They obviously know the system best."

The instruction has been entirely focused on the equipment: how it works and how to handle it. Training on how the robot will be used in purely tactical terms will come at a later stage and be provided by the Swedish EOD and Demining Centre (Swedec).

The first training course was "technical training" for technicians. The construction of the robot and its various functions were examined.

After the technician course a five-day training course was also held for principal instructors, that is to say people who in turn are going to train ROV operators. The training was divided into theory, operation and utilisation of weaponry, the last stage of which was divided into different sections for different weapons and X-ray equipment, for example. At the end of the course all the participants were assessed by the course leaders, and were issued a licence on condition that all individual elements were passed. All the courses were held in English, which is beneficial as international missions often require operators to master English in their own specialist field.

On the police side there is great satisfaction with both the training and the procurement in general.

"When we previously bought equipment we received a box of equipment and a manual, often only in English. We have now received training in the equipment and user manuals in Swedish through FMV," says forensic scientist Jesper Wohlert.

The Amröjrobot 2, or Defender as it is known in the police force, is carried in handy boxes.

The control unit gives the operator a complete overview of the robot and its surroundings.

Amröjrobot 2

Supplier: Allen-Vanguard
Weight: approx. 2.50 kg
Width: 0.7 m
Length: 1.5 m
Max. speed: 3.2 km/h
Horizontal range: 1.65 m
Turning circle within its own diagonal length.
Known as Amröjrobot 2 in the armed forces and Defender to the police.

COPY: JERRY LINDBERGH
PHOTO: JERRY LINDBERGH

Mobile laboratories for CBRN analysis

Three laboratories together form a mobile CBRN field analysis laboratory with separate units for chemical (C), biological (B) and radiological/nuclear (RN) analysis.

Take a 20-foot standard container and give it fragment protection, ventilation and air conditioning. Then add advanced laboratory equipment, computer systems and a power supply. You then have a laboratory that can be transported by a Hercules aircraft, boat or truck to a place where there is a need for rapid analyses. This is the basic concept for the system of three mobile field laboratories FMV has delivered to the Swedish Armed Forces during 2006. The three laboratories together form a mobile CBRN field analysis laboratory with separate units for chemical (C), biological (B) and radiological/nuclear (RN) analysis.

The laboratories have been developed for Swedish Armed Forces missions, both domestically and internationally. They are to be used to support society in the event of major accidents and disasters and in humanitarian operations. They are intended to be placed near the accident area, where they can receive samples for rapid analysis. Soil, air, water, vegetation and smear samples can be analysed.

"We have acquired mobile labs that contain the very latest technology and have the capability to analyse what NATO envisages mobile laboratory being able to do," says Åsa Tjärnhage, head of section at the Swedish Armed Forces protection centre in Umeå.

When people from the protection centre and the Swedish Defence Research Agency (FOI) drew up the guidelines for the mobile laboratories in 2001, the focus was on analyses of classic NBC substances (nuclear, biological, chemical). Today the focus has been broadened so that it is possible to analyse a broader range of substances, in both the military and civilian sectors.

For example, the radiological/nuclear laboratory took part in a civil exercise arranged by the Swedish Radiation Protection Institute (SSI) in October. Radioactivity was dispersed over a limited area and then sampling and decontamination exercises took place. In the N laboratory samples were analysed and checks were made to ensure that radioactivity was not dispersed outside the area.

"This is a very valuable type of cooperation, and I also hope to find international partners for cooperation," says Åsa.

Chemical laboratory

The chemical laboratory is equipped with instruments that make it possible to measure directly from the sample. However, this depends on the sample largely consisting of one substance. This is useful in establishing quickly whether a sample is dangerous or not. It is also possible to measure liquids without opening the container the sample is stored in, which is useful when dangerous samples are involved. If there are very small quantities in a composite sample, chemical processing which is labour-intensive and time-consuming is almost always required. Equipment for this is also available in the laboratory. As well as analyses of chemical warfare agents, it is possible to perform environmental chemistry analyses, for example in support of Swedish units abroad.

Ten square metres is sufficient to carry out the job, as here in the C laboratory.

Biological laboratory

Two techniques are used in the biological laboratory to determine bacteria, viruses and toxins. One of these in brief entails isolating DNA from bacteria in the sample and duplicating a piece of DNA a number of times from the bacterium that is being looked for. The second technique, which is an immunological technique, entails using antibody-based reactions that can detect the substance being searched for.

The samples to be analysed are passed through a hatch in the container wall. There is an airlock between the hatch and the laboratory for increased safety.

She feels that the capability for the analysis of radioactive substances is an example of how the laboratories can be used, irrespective of whether the reason for dispersal is war, terrorist activity, accident or negligence.

Tight schedule

At FMV the project manager Lars Nilsson is greatly relieved. The schedule for the development of the laboratories was tight.

"We coped with the tough timetable by using existing technology in the basic framework and integrating all the skills at FMV in our work. And last but not least we chose a supplier who could cope with the requirements and delivery time."

What is it like for two to three people to work in a laboratory that fits into a 20-foot container? According to Åsa Tjärnhage it does not cause any problems.

"They're compact laboratories, but surprisingly spacious. I think FMV has been very successful with this. Everything is within easy reach. What can prove a problem in the long term is that the required ventilation and cooling systems can be noisy."

After analysis, data from the sample is interpreted. When interpretation has been completed, the result is saved on the laboratory computers and sent to a staff unit as a basis for decision-making. The laboratories can be connected to several different computer networks for analytical support and management of results.

"To stand up to judicial examination, a sample has to be analysed by several different methods. In these cases we forward the sample to FOI's laboratory, for example," says Åsa.

It was intended at the start that personnel in the mobile field laboratories would be conscripts. However, an evaluation after two courses of training showed that a longer period of training is required to carry out the job in the laboratories. The solution instead was to take on staff from FOI on temporary contracts.

"Staff skills are extremely important in these contexts. They are what dictate which analyses can be done and how dependable the test results are," says ÅsaTjärnhage.

Radiological/nuclear

The radiological/nuclear laboratory is used for the identification and analysis of radioactive substances. With spectrometric equipment it is possible to determine which gamma-radiating substances are in a sample, as well as the quantity of each individual substance. There is also equipment to determine the quantity and type of alpha- and beta-emitting substances and neutron radiation.

The mobile laboratories are housed in 20-foot containers and can easily be transported to the emergency scene by truck, boat or aircraft.

COPY: HANS IVANSSON
PHOTO: TOTALFÖRSV. SKYDDSC.

Technology for Sweden's security

FMV

FOTO: LASE ALLWIN, PETER NILSSON/FBB, HÅKAN BRANDT/FBB, JERRY LINDBERGH