

# Defence **24**

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Raport

Security Promoters –  
Flagship Export Products of the Polish Defence Industry

Partners



Warsaw, 2019



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## Introduction



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The Polish military is currently initiating a broad and expansive modernization programme that is going to involve **185 billion zlotys of funding**, thanks to the gradual increase of defence expenditure level beyond the amount exceeding 2% of GDP. Most of the funds above would be received by the domestic defence industry. The above may become an excellent opportunity to expand the R&D potential available locally. This would make it possible for the Polish businesses to deliver solutions that would provide the Polish military with proper combat capabilities, at the same time, remaining competitive on the global defence market.



Polish defence industry's offer is rich even today. In many cases the domestic companies offer unique solutions that surpass the offerings of the global industry leaders. Know-how and expertise at hand, pertaining to artillery, unmanned, radar systems and individual equipment of the troops have been, since many years, utilized for the purpose of modernizing the Polish military. In many cases, the systems listed above are also offered abroad.

Today the Polish defence industry is beginning **a series of grand investments** that may be used to further reinforce its potential in the future. Specialization and focusing the investment on the domains where the Polish industry's know-how is potent may result in multiplication of the potential owned, which could be further amplified by the scale-effect.

Development of the Polish defence industry is also one of the priorities adopted by the government in the Strategy for Responsible Development. Defence and aerospace industries can be placed among the most important industrial domains in Poland. This means that activities undertaken by the defence industry, this includes foreign activities, shall be

supported by the state in a comprehensive manner. Not only does the export of armament and military equipment render direct economic benefits, as it also reinforces the national security. Furthermore, funds received by the defence industry thanks to the export sales may also be used for the purpose of undertaking R&D efforts. Thanks to those efforts, new generation of defence products can be developed, both for the Polish military, as well as for the foreign partners.

The Polish industry is driven and motivated to open itself towards the international customer. The equipment that is being developed and perfected to meet the requirements of the Polish military, the strongest military on the NATO's Eastern Flank, can and should be an interesting offering for the armed forces all around the world. Presenting the key and leading, potent products to the foreign and international partners bears a high relevance.



Defence24 Group is organizing the "Security Promoters – Flagship Export Products of the Polish Defence Industry" conference. The event is going to receive support from the Polish MoD and during the MSPO 2019 event in Kielce, the largest Central-European defence industry exhibition, it is going to have a purpose of presenting the Polish defence industry potential to the foreign partners and public opinion. The report you are holding in your hands provides you with a synthetic outline of the capacities offered by the Polish defence industry. It also contains a selection of ten leading products that remain especially attractive, especially for the international customer.

# Modernization of the Polish Armed Forces: An Opportunity for the Polish Defence Industry



## Chapter 1

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Poland, as a key Central-European NATO member state, is carrying out an expansive armed forces modernization programme. The efforts undertaken can be interpreted as a decisive response to the dynamically changing and evolving security environment. Modernizing the equipment used by the Polish military and replacement of the Post-soviet hardware is one of the priorities defined by the Polish Ministry of Defence, the government and by the President of Poland. Warsaw is planning or carrying out a number of military modernization programmes. The effort is taking place both through procurement made at own, domestically based companies, as well as with involvement of international partners. Thus, **the process is a natural base for reinforcement of the domestic industrial potential.**

The funds allocated to modernize the military should be used in a way that would expand the know-how of domestic industry, for instance through investments in the manufacturing capacity or implementation of R&D projects. This also creates an opportunity to develop and implement competitive and attractive products that could be exported. Furthermore, introduction of new, domestically developed equipment into the inventory of the Polish military also increases the credibility that the export offer entails. Equipment proven in own armed forces is usually much more attractive for any of the foreign partners. Planning and executing procurement with involvement of the domestic manufacturers amplify the sales probability on the export market.

Act on Reconstruction, Technical Modernization and Financing of the Armed Forces constitutes a legal basis for carrying out the modernization process in the Polish military. According to the provisions of that Act, **starting from 2018 the defence expenditure shall not be lower than 2% of GDP for the given FY** (financial year). According to the data published by NATO Poland would spend more than 45 billion zlotys on defence in 2019 (12 billion USD), which is an equivalent of 2.01% of GDP. The assumptions made within the Act stipulate that the share of defence expenditure is to be increased, **with 2.1% level to be reached in 2020 and 2.5% in 2030.** All of the above makes it possible to spend more on modernization. The Technical Modernization Plan concerning the period between 2017 and

2026 assumes that 185 billion zlotys (more than USD 47 billion) would be allocated for that purpose. Plans have been defined for a longer timeline of 15 years (2021-2035). This should make it even easier to manage complex and convoluted procurement.

The Polish Ministry of Defence is working on modernization programs, the main goal of which is to reinforce the defence capabilities of the individual branches of the Polish military. At the moment most of the effort is focused on **modernization and expansion of the Integrated Air Defence Systems.** In case of the Wisła air defence program, IBCS/Patriot medium range air defence batteries are acquired. The 4.6 billion dollar FMS agreement pertaining to delivery of the first two batteries was signed in March 2018. It was accompanied by offset memorandums. During the stage II of the Wisła programme, IBCS/Patriot system is going to be integrated with the Polish early warning sensors – P-18PL VHF radars and PCL-PET SPL solution (Passive Location System). Acquisition of VSHORAD assets is also taking place. Here, the domestic industry is acting as the main supplier. The Polish military is receiving Piorun MANPADS (420 launchers and 1300 missiles are to be delivered by 2022) and Poprad 4x4 SAM systems. Poprad may use Piorun or Grom missiles as the main effector, with the latter being far more common. Contract is being implemented, concerning delivery of six autonomous Pilica 23 mm SAM/AAA system. Actions have also been undertaken to get ready to implement the Narew short range air defence system. Polish industry is to play the leading role within that scope. It is expected that Narew would use Polish sensors and license-manufactured missiles.

**Polish Air Force** also undergoes a modernization process. The Polish Ministry of Defence defines the **Harpia** new generation Multi-Role Fighter Aircraft acquisition program as a priority. Its goal is to replace the Post-Soviet Su-22 and MiG-29 fighters. Back in 2018 8 M-346 Master AJTs were ordered. They are a part of a larger AJT training system. Drop medium airlifter acquisition program is in the phase of preparation.

Expansion of capabilities of the artillery and rocket component of the Polish military is another key area of technical modernization. Two domestically-developed

artillery systems are being currently delivered to the Polish military by the domestic industry. The first one is the Regina module – featuring the 155 mm Krab self-propelled howitzers with 52-calibres-long barrels. The Polish military received the first Krab sph squadron (24 platforms) in 2017. In December 2016 an agreement was signed concerning series delivery of another four squadron, 96 platforms in total. The first howitzers contracted in 2016 have already been delivered. Completion of the 2016 agreement will make it possible to introduce new equipment at the division level and within some of the armoured brigades. The Polish military is also receiving **Rak self-propelled mortars** using the Rosomak APC as the base platform. By the end of 2019 the Polish military should have all of the 64 ordered mortars placed in its inventory. Most of the mortars have been already delivered. It is also expected that more Rak mortars based on the Rosomak APC platform and, in a longer run, on a tracked vehicle, would be ordered. Rak and Regina systems have been designed by HSW S.A. HOMAR rocket artillery programme is another element of modernization efforts undertaken with regards to the rocket and artillery component of the Polish military. According to the agreement concluded in the early 2019, the Polish military would receive 20 HIMARS systems along with the rockets by 2023. Acquisition of anti-tank assets is also somewhat related to modernization of the rocket and artillery component. At the moment Spike-LR missiles are being delivered. The production is taking place on the basis of a technology transfer at the Mesko company based in Skarżysko-Kamienna. The plans also include development of Pustelnik light ATGM and Ottokar-Brzoza tank destroyer based on a tracked platform and equipped with heavy ATGM launchers. The ATGMs will be also integrated on the modernized helicopters, Rosomak APCs and Borsuk IFVs.

Modernization of the equipment used by the **armoured, motorized and mechanized units of the Army** is another of the priorities set by the Polish Ministry of Defence and the military as a whole. Modernization of the Leopard 2A4 main battle tanks and upgrade to the 2PL standard, procurement of Rosomak APCs and overhauls and modification of 300 T-72 main battle tanks can also be listed among the programmes

considered to be highly relevant. All of the projects listed above see the Polish industry acting as the main contractor. However, Leopard 2PL programme is taking place with involvement of a foreign partner while the Rosomak APCs are license manufactured, locally.

The industry is also working on development of Borsuk new generation amphibious IFV and ZSSW-30 unmanned turret module. The turret in question is expected to be integrated on Rosomak and Borsuk platforms. Introduction of ZSSW-30-fitted Rosomak and Borsuk vehicles will make it possible to gradually replace the BWP-1 IFVs. In a longer run Wilk new generation MBT program would be implemented. Wilk is going to become a replacement of the T-72 and PT-91 platforms operated at the moment.

The **Polish Navy** is another subject of modernization. **“Kormoran II” class MCMV** deliveries are most advanced, with a rescue vessel and tugs to follow – the contracts concerning the latter projects were signed back in 2017. All of the vessels listed above are being build at Polish shipyards. The Technical Modernization Plan also envisages acquisition of Miecznik-class coastal defence surface combatants (corvettes or frigates) and Orka-class new generation submarines. However, these programmes are only a subject to analysis as for now. The Navy is also planning to acquire support vessels. At the same time, work has been undertaken to extend the lifecycles of the existing vessels, including the Oliver Hazard Perry class frigates.

One of the **helicopter acquisition programmes** is also tied to the Polish Navy. It was in April 2019 when an agreement was signed, concerning acquisition of four AW101 Anti-Submarine Warfare helicopters with optional capability to carry out CSAR duties. PZL-Świdnik, Polish subsidiary company of Leonardo Helicopters, is acting as the contractor within the scope of this contract. The agreement assumes that offset agreements would be signed, to the benefit of the Polish industry. Before the AW101 contract was signed, an agreement had been concluded envisaging acquisition of four S-70i Black Hawk helicopters for the Polish special operations component. The aircraft in question would be manufactured at PZL Mielec, the Polish branch of the Sikorsky company subordinated



to Lockheed Martin. Polish Ministry of Defence is also looking forward to further helicopter acquisitions. The MoD declares that it remains its priority to acquire a new generation Kruk attack helicopter. Perkoz programme comes next. It is aimed at acquiring a multi-role Mi-2 replacement. The existing helicopter fleet, Mi-24 and W-3 platforms in particular, would also undergo upgrades. Polish companies will play a key role in this effort.

The MoD is also working on acquisition of a number of **Unmanned Aerial Vehicles**. Land Forces, Special Operations Forces and Territorial Defence Component all utilize the WB Group's FlyEye UAV tailored to act in a role of artillery directing asset. The Territorial Defence Component is also operating the WB Group's Warmate loitering munitions system. Furthermore, the Polish military has also concluded an agreement, within the framework of the Orlik programme, aimed at acquiring domestically developed PGZ-19R tactical UAVs. The MoD is already making plans with regards to future UAV programmes. Mini-UAVs and tactical platforms wait for their turn to be procured.

C3ISR systems are another relevant domain in which the modernization process is taking place. Over the last several months the MoD ordered WTI ICT nodes and Mobile Digital Communications Nodes. For the purpose of involvement in the NATO operational activities, JASMINE C4ISR support system elements were acquired, along with command variant of the Rosomak vehicle. Plans are also being made to procure ROSOMAK BMS integrated battle management system for the land component, along with "Wierzba" Integrated Automated Command System. Acquisition in the domain of C2 suites is frequently taking place within the framework of larger modernization initiatives. For instance, new Rak and Krab/Regina artillery systems have been, since the very beginning, equipped with the WB Group's TOPAZ Automated Fire Control System. ZZKO TOPAZ system had also been integrated on older artillery platforms in the past. New digital communication assets are an element of modification implemented in case of the T-72 main battle tanks and other post-soviet equipment.

Simulator and training systems are also being acquired in parallel to modernization programmes. Polish Ministry of Defence has been making major investments in

the area related to development of **cyber capabilities**. The above domain is one of the priorities adopted by the MoD. In early 2019 a decision was made to form a military Cyberspace Defence branch.

Another important point of the modernization process is the acquisition of **individual soldier equipment**. Starting from 2017, deliveries of the GROT MSBS modular firearms solution have begun. The gun is going to be used by the Territorial Defence Component, among other units. Support weaponry (sniper rifles, mortars), communications assets, protective systems and NVG/FLIR systems are also being procured. It is also planned that new anti-tank grenade launchers would become a subject to future acquisition. The Polish military is also planning to introduce several types of 4x4 vehicles into its inventory – Mustang heavy-duty/passenger vehicles and heavier PEGAZ armoured platform for the special operations component. Żmija (Viper) vehicles have been ordered for the reconnaissance units (2017) and another platform has been acquired for the air-mobile units (in 2018). However, the major tenders in this area still remain unresolved. Meanwhile, when it comes to heavy duty vehicles, the inventory undergoes a gradual modernization, through acquisition of the Jelcz vehicles.

Polish Ministry of Defence and the Armed Forces are implementing or planning acquisition of equipment aimed at crossing the generational gap, so that the Polish military remains completely ready to face the contemporary challenges associated with the evolving security environment. The modernization effort undertaken by the Polish military is very broad in its nature, as it covers different branches of the Armed Forces. Meanwhile, Polish domestic entities act as the direct contractors or participants, in case of most of the modernization programs. Being a part of modernization effort concerning the Polish military, which is the leading force on the NATO Eastern Flank, makes it possible for the Polish industry to create an attractive offer for the international customers. The offer should be focused around the key areas of specialty within which the Polish industry can use its ability to offer comprehensive integrated systems for the foreign partners.

## Polish Defence Industry: Key Areas of Expertise



Chapter 2.

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Polish defence industry is working on most of the modernization programmes undertaken by the Polish military. The industry has in-depth and broad know-how at hand, pertaining to development, manufacturing, maintenance and modernization of a variety of military equipment. In some areas the Polish entities remain capable of integrating and delivering holistic, integrated solutions that are received by the Polish military and can be viewed as an interesting offering by the potential export users. Meanwhile, in other domains the expertise is being broadened, also through collaboration with international partners.

### Polish Defence Industry: Structural Composition

**PGZ Group (Polska Grupa Zbrojeniowa)** currently remains the largest entity of the Polish defence industry, gathering over 50 companies including manufacturing and maintenance facilities as well as research and development entities. It was established back in 2013 due to the start of the consolidation of the Polish Defence Industry. Today, PGZ employs over 18,000 staff and it has a yearly sales revenue of PLN 5,5 billion. PGZ is the manufacturer of systems and solutions used by the Polish Armed Forces as well as the allied formations, it is also the main partner of the Polish Armed Forces modernization projects. The domestic defence industry also involves numerous R&D institutes, such as the PIAP Industrial Research Institute for Automation and Measurements, Military Institute of Armament Technology (WITU) or Air Force Institute of Technology (ITWL).

**Private defence entities** are also growing strong. WB Group is the largest of the privately owned defence companies in Poland. It works on BMS solutions, UAVs, communications or, for instance, systems used to monitor the car traffic. Meanwhile, Lubawa Group, another privately owned entity, is present on the Warsaw Stock Exchange. This company develops and manufactures protective systems, individual equipment for the soldiers or camouflage systems. Remontowa Shipbuilding company is one of the most important, privately owned entities in the shipbuilding sector, building specialist vessels for military and civil applications. In the private sector one may also find a number of smaller companies, often working on C4ISR systems.

These companies include entities such as Teldat, KenBIT or TransBit. They deliver their own, original solutions or participate in integration of larger systems.

Subsidiary companies of foreign entities are another group of businesses working in the defence and security domain, within the framework of global supply chains. These entities also deliver products of their own. The best known businesses of that group include the **aviation companies** based in eastern Poland, founded as a result of privatization of former state companies manufacturing helicopters and fixed-wing aircraft. PZL Mielec is one of those companies. Now owned by Lockheed Martin, PZL Mielec currently offers license-manufactured Black Hawk helicopters and light fixed-wing aircraft. PZL Świdnik, on the other hand, is a helicopter manufacturing facility belonging to the Italian Leonardo Helicopters company. Apart from the businesses listed above, a number of aerospace and defence companies is also tied to the foreign partners.



### Export Structure

According to the data published by the Polish Ministry of Foreign Affairs, the export value pertaining to the Polish-made armament and military hardware was defined as EUR 472.2 million, for the year 2017. This constitutes a growth of 23%, when compared to 2016. When it comes to structure, most of the sold goods belonged to the ML10 category, including aircraft and their components. The above also concerns the UAV systems. The export value for this category has been defined as EUR 213 million. Most of this amount pertains to the equipment exported by the companies subordinated to the global aerospace players (such as the PZL Mielec and PZL Świdnik facilities mentioned above).



ML 6 (land vehicles and components thereof) comes second – EUR 96.6 million; the next categories include: ML 14 (simulator systems for military applications) – EUR 41.5 million; ML 13 (armoured and protective equipment, structures and components) – EUR 40.8 million; and ML 2 category (medium calibre weaponry and associated equipment) – EUR 28.1 million. The first five categories listed above constituted 88% of the Polish defence export sales in 2017.



When it comes to specific companies, PGZ has recorded export revenue of PLN 730 million in 2018 – about 13% of total sales. The WB Group recorded export revenue value of PLN 60 million which means that foreign sales share was at the level of 19%. As more modernization programmes are being implemented by the Polish military, Polish defence companies are willing to increase the export share, thanks to the expertise and know-how developed over the course of the undertaken modernization programmes.

### Domains of Specialization

The expertise owned by the industry in the specific domains makes it possible to offer modern, potentially attractive solutions. These domains of specialization create relevant opportunities for product development, also through international cooperation.

Polish defence industry remains capable of **developing and manufacturing a broad range of heavy combat vehicles**. HSW S.A. company belonging to the PGZ Group is manufacturing 155 mm Krab self-propelled howitzers and 120 mm Rak self-propelled mortars, along with support, command and

logistical platforms. HSW also acts as the leader in the Borsuk new generation amphibious IFV and ZSSW-30 remote controlled turret programmes. The latter product – the ZSSW-30 turret – has been fitted with a 30 mm gun and Spike-LR ATGMs. The turret is going to be integrated both on the Rosomak APC, as well as on the future IFVs. Both in case of the artillery projects, as well as in case of the turret project, HSW is working quite closely with the WB Group that delivers communication and fire control systems.

PGZ Group's Silesian facilities also have some relevant know-how available at hand, in the heavy armour department. ZM Bumar-Łabędy facility had been manufacturing T-72 and PT-91 main battle tanks in the past. Currently a task was assigned to this company to upgrade the Leopard 2A4 main battle tanks to the 2PL standard. The programme is carried out in collaboration with PGZ, its companies, and the German partner.

The ZM Bumar-Łabędy facility also acts as the leading entity in the area of overhauls and modifications of the T-72 main battle tanks. These platforms will receive WB Group's communications suite and Polish night-vision and thermal imaging systems. ZM Bumar-Łabędy and OBRUM companies also offer specialist vehicles, such as ARVs or self-propelled bridge solutions. Last year OBRUM was awarded with an order concerning MS-20 Daglezja bridges from a Vietnamese partner. Earlier on, these bridges had also been delivered to the Polish military. OBRUM is also working on numerous R&D initiatives, such as the Gepard close support vehicle for instance.

Rosomak S.A. company is another entity that belongs to the Silesian group of companies specialized in working on armoured systems. Rosomak S.A. manufactures APCs and specialist platforms. WZM S.A. facility in Poznań is another entity that works on combat vehicles. The company in question is a part of PGZ as well. The Poznań-based facility specializes itself in rendering support, maintenance, modification and upgrade services for a variety of combat vehicles, including Leopard 2A5 main battle tanks, and BWP and BWR platforms. Centre of Powerpacks has been established in Poznań as well. It is responsible for manufacturing and supporting the maintenance of powerpacks used in case of the Polish military vehicles.

**Radars and air defence** constitute another key domain of expertise in the Polish defence industry. Expertise in the area of radars and airborne threat detection/tracking have been developed by the Polish defence industry since several years now. Thanks to the above most of the Polish radars have been delivered by the Polish industry, primarily the PIT-RADWAR company that belongs to the PGZ Group. PIT-RADWAR's offer includes both long range early warning radars, as well as short and medium range systems that can be coupled with air defence assets. PIT-RADWAR also manufactures the LIWIEC firefinder radars. PIT-RADWAR also offers the Bystra Deployable Radar, the first of the Polish radar designs that uses the AESA design. The company has also developed P-18PL and PCL-PET early warning radars that could be used to detect stealth aircraft, with a lowered RCS.



PIT-RADWAR is also acting as an integrator of VSHORAD air defence systems, such as the Kobra or Poprad systems or naval solutions using the 35 mm cannons. The Polish industry also has a capability of manufacturing IR-guided MANPADS systems. These missiles have been developed by Mesko and

Telesystem-Mesko as early as in the 1990s. Grom MANPADS that is quite common in the Polish military has also been exported to Indonesia, Georgia, the United States of America, Japan or Lithuania. Starting from 2018 the Polish military has been receiving the next generation Piorun systems that belong to the next generation and offer much greater capabilities. Grom and Piorun experiences also helped the Polish industry in development of laser guided PGMs for Krab howitzers and Rak mortars, and new Pirat ATGM. All of the projects listed above are in stages of advanced development.



The air defence domain is also related to another stage of specialization of the Polish industry: **command and control, fire control and battle management systems**. PIT-RADWAR also developed a number of air defence command systems, along with air defence systems and radars. These include the SAMOC solution operated by the Air Force or the Łowcza/Rega system used by the Land Forces. These capabilities are a subject to further development. Command, fire control and battle management systems are also an area of specialty for privately owned entities. The WB Group has developed the automated Topaz fire control system, 500 examples of which are used by the Polish artillery/rocket artillery units. TOPAZ is also a subject to continuous modernization – currently it can be viewed as a multifunctional battle management system. The WB Group also offers the FONET vehicle intercom system that is utilized quite broadly in the Polish military. The solution has also been a subject to export – the US Armed Forces are one of the users. WB Group has also developed a family of programmable radios. Gdansk-based Radmor company belonging to the WB Group is the manufacturer of those radios. The entity is also a participant of the European ESSOR initiative.

Other Polish privately owned entities are working in the C4ISR/BMS domain as well. These include the TELDAT company (that created the JASMINE C4ISR system, recently ordered by the NATO Multinational Division North-East), Transbit, delivering programmable radios for instance, or the KenBIT company. The latter entity has developed the Integrated Communications Suite for the Kormoran II minehunter. OBR CTM S.A. company belonging to PGZ, on the other hand, was responsible for creating an integrated combat system for that vessel, also preparing some of the mine countermeasures, including remote control assets. The company also offers other solutions that raise situational awareness in maritime and underwater environments that could be potentially utilized for the purpose of protecting the critical infrastructure. OBR CTM S.A. is involved in the European Defence Agency OCEAN 2020 programme.



**Shipbuilding sector** is another of the important areas of speciality of the Polish defence industry. Polish shipyards are able to build selected types of surface combatants. They also remain capable of integrating warship combat systems or specialist equipment. Polish shipbuilding facilities are currently working on special purpose vessels that are to be delivered to the Polish Navy in the future. The privately-owned Remontowa Shipbuilding company based in Gdansk is working on another two Kormoran-class MCMVs, in collaboration with OBR CTM S.A. and PGZ SW. The shipyards gathered within the PGZ Group, working together with OBR CTM, are currently involved in a project, the goal of which is to build a rescue vessel. They are also overhauling the Polish Navy's assets that remain in operation now.

Polish defence industry also has some particular know-how at its disposal, in the area of **unmanned systems**. WB Group has developed a family of mini and tactical UAVs. FlyEye platform is the best known of the WB Group's offering. FlyEye is hand-launched and it is capable of being operated together with artillery fire control systems and BMS solutions or Warmate loitering munitions. Both FlyEye, as well as Warmate have been proven in real combat and they are being constantly refined and modified to meet the ever-changing security environment. PIAP Industrial Research Institute for Automation and Measurements delivers specialist reconnaissance, intervention and bomb disposal robots onto the global markets. Land and aerial unmanned systems are also being developed by other state-owned companies and PGZ Group's entities.



Polish companies also specialize in delivering **modern individual soldiers equipment, observation systems and protection and camouflage solutions**. Maskpol company belonging to PGZ Group and privately owned Lubawa Group offer modern equipment for soldiers, including headgear and bulletproof vests. Maskpol also delivers CRBN protection measures and uniforms. Lubawa, meanwhile, delivers equipment for rescue services and multispectral camouflage solutions. The latter group of products protects the camouflaged assets from being detected by optical, radar and thermal imaging systems. Polish defence industry also remains in possession of know-how required to deliver a broad range of NVG and thermal imaging systems. Starting from systems developed for individual soldiers, aviation NVG systems, through combat vehicles equipment, and air defence systems to finish with. The equipment in that domain is offered primarily by the PCO S.A. company belonging to the PGZ Group



and by Sulejów-based Etronika. Polish companies also offer a broad range of firearms. FB "Łucznik" Radom is the main manufacturer of firearms in Poland. The company is also a part of the PGZ Group. The Radom facility is the manufacturer of MSBS modular firearms system that since some time now has been replacing the Beryl rifles in the Polish military. Beryl's concept has been based on the Kalashnikov design. Radom offers pistols and machine pistols as well. ZM Tarnów company, meanwhile, offers machine guns, sniper rifles, and AAA/AAA-SAM anti aircraft systems utilizing 23 mm cannons and light mortars.



Other Polish defence companies also offer their products abroad, with many successes involved. For instance, the Bydgoszcz-based Nitro-Chem company delivers explosives for military and civil customers from six continents. The explosives made in Poland are sold to US-customer, also to meet the demand of the DoD. Starting from July 2019 the company has also become a certified manufacturer of the Mk 82 bomb units. Capabilities within that scope were being established as a result of the offset agreements signed after the Polish Air Force acquired the F-16 jets. Stomil Poznań company is also one of the exporters – the company offers special purpose rubber products on the foreign market. Autocomp-Management plays an important role in the export domain as well. The Szczecin-based company offers a variety of simulator systems, including some solutions developed in collaboration with Krauss-Maffei Wegmann. Product offer of Autocomp-Management includes varied types of Leopard 2 main battle tank simulators. These are sold in Norway, Qatar, Germany, Greece or Switzerland. The simulators offered by Autocomp include **high fidelity** cabin solutions and TTT Table-Top Trainers.

A lot of export potential can be found in the domain of maintenance services dedicated for post-soviet systems: combat vehicles and aircraft. Back in 2017, for instance, PCO S.A. signed an agreement covering the modernization of optoelectronic systems in the Ukrainian combat vehicles. WZL No. 1 facility that belongs to the PGZ Group also finalized a modernization programme concerning the Senegalese Mi-24 helicopters that year.



Currently, the Polish defence industry has a rich array of products available that could potentially become export offerings. However, complex solutions developed by the Polish companies with the use of potential established in key domains stand the greatest chance of becoming a product that could boost the presence of the Polish industry on the export marketplace. And these very products should be intensely marketed on the foreign markets.

Increasing the defence exports with the use of owned and developed know-how needs to become a primary objective for the state as a whole. Involvement of the industry may not be enough, as government's, MoD's and Polish military assistance could play a role that may be equally relevant. Broad use of those products by the Polish military, the key force on the NATO Eastern Flank, involved in international military cooperation initiatives, may also become a contributing factor, boosting the credibility and reputation of the Polish defence industry offerings. R&D should be focused on the key areas of speciality. This effort shall be aimed at further development of the industrial potential. Development of the Polish defence sector is conditioned by the process in which R&D, production and marketing efforts related to the specific domains would be defined and comprehensively supported. The above should refer to the areas that offer the greatest competitive potential on the global marketplace.



## Flagship Export Products of the Polish Defence Industry

### Chapter 3





### 3.1 RAK Self-Propelled Mortar

Rak is a 120 mm self-propelled mortar developed by HSW S.A. in collaboration with other Polish defence industry companies. Rak is utilizing an autonomous turret system fitted with a 120 mm mortar. The turret may be installed on any tracked/wheeled platform of proper parameters. It may also be used on naval vessels. At the moment the mortar is integrated on the Rosomak APC, LPG tracked platform, Opal tracked platform and Marder IFV.

The mortar uses a 3000 mm (25-calibres-long) barrel along with an automatic targeting system and autoloader, with a capacity of 20 rounds. Another 26 rounds are carried in the ammunition compartment. The mortar has been integrated with an advanced fire control system based on the Topaz solution and coupled with a fire-solutions computer, and Fonet intercom system. The two above systems, as well as certain electromechanical equipment components used in Rak, were created by the WB Group. MRSI (Multiple-Rounds Simultaneous-Impact)

capability is ensured in Rak mortar, which greatly enhances the effectiveness of engagements.

The mortar is highly accurate and can act against targets located 8 to 12 kilometres away, depending on the rounds used. Rak gets ready to fire in less than 30 seconds and can leave the position in less than 15 seconds. The turret can lay down fire in an unmanned setting.

Additional armament comes in a form of a 7.62 mm UKM-2000D machine gun, or any other machine gun selected by the customer. There is an option to integrate a remote-controlled weapon station on top of the turret. The mortar also features CM120 targeting system used to conduct direct fire engagements. The system uses ZIG-T-2 electro-optical sensor fitted with thermal imaging and daylight camera and laser rangefinder. Rak has also been fitted with its own GPS/INS system and an odometer. The level of protection is enhanced thanks to the Obra self-protection suite and a smoke grenades dispenser. SOD 360-degrees observation system enhances the situational awareness.

Rak can work with external data sources and it can process those in its fire control system in real time. The mortar can also be operated jointly with the FlyEye UAVs, recce vehicles and Joint Fire Support Controllers. The mortar platform described here is capable of employing unguided rounds and Precision Guided Munitions. The unguided assets include HE, illumination and smoke rounds. The Polish industry currently works on precision-guided rounds for the Rak systems. The rounds will utilize laser guidance and will make it possible to neutralize armoured vehicles both in top-attack mode and in direct attack mode, if necessary.

Rak self-propelled mortar is a component of a self-propelled mortars fire module destined to be a part of a support company embedded within mechanized or motorized battalions. Other elements of the fire module include an AWD artillery command vehicle (for all levels), based on Rosomak APC, AWA ammunition supply vehicle, AWRU artillery armament repair vehicle, that are utilizing a Jelcz platform, and a recovery vehicle. The system also features an Artillery Reconnaissance vehicle that is based on the Rosomak APC - R&D effort is in progress now.

**All Rak modules may be based on other tracked or wheeled platforms indicated by the user, as long as they have appropriate parameters.** The module includes eight mortars, four command vehicles and a relevant number of support vehicles. It is assumed that a single support company, depending on configuration selected by the user, may include up to 16 mortars.

The first contract concerning the Rak system destined for the Polish military was signed in April 2016, it covered 64 mortars and 32 command vehicles, most of which have been delivered. It was back in December 2017 when a contract was signed to deliver AWRU platforms. In August 2019 AWA vehicles contract was signed. Rak mortars are currently operated by four brigades of the Polish military using or expected

to use Rosomak APCs. In a longer run, a tracked variant of the mortar is expected to be introduced. It would be used in battalions operating tracked IFVs.

Rak self-propelled mortar may provide fire support for mechanized and motorized units. It may also be placed on the very same platform as the one used by the given mechanized or motorized units, thus it can be a part of a single element. The applied design solutions allow for **rapid reaction times, high responsiveness and high mobility of the system**. Rak mortars greatly expand the capabilities of the mechanized and motorized units. They make it possible to attack targets with indirect fires, even before enemy contact is made. Rak system also exhibits a potential for further development, with unmanned combat platforms also taken into account.

#### **Main features of the Rak self-propelled mortar:**

- Automated weapons system, short reaction time, high accuracy;
- Digital fire control system capable of working with external data sources;
- Ability to act against targets at distances up to between 8 and 12 kilometres;
- Ability to lay down direct and indirect fires, within elevation range between -3 and 80 degrees;
- Option of integrating the system on wheeled, tracked and naval platforms;
- High level of autonomy, ability to lay down directed fire with the crew staying outside the vehicle;
- Option of ordering support vehicles: command, ammunition, logistics and reconnaissance ones.



### 3.2 FlyEye and Warmate Unmanned Aerial Vehicles

FlyEye UAVs and Warmate loitering munitions can be found among the products offered by the WB Group. They may, however, act as two complementary elements of a single weapons system. The systems in question can be used autonomously. However, it is the joint use that creates a synergy between them. Both platforms are operated by the Polish military. They have also been exported and they have already been operationally deployed.

**FlyEye** is a reconnaissance system based around a mini-UAV platform with a wingspan of 3.6 meters and length of 1.8 meters. The aircraft is fitted with an electric propulsion system. The platform in question has flight endurance of 150 minutes, with an ability to attain speeds of 50 to 120 kilometres per hour, at distances of up to 50 kilometres from the operator. The UAV can be carried by soldiers and prepared for take-off in less than 10 minutes. It takes off being thrown into the air. FlyEye features a twin optronic sensor (thermal/daylight cameras) and a positioning system. It is also possible to integrate acoustic sensors on FlyEye (allowing the user to detect the firing positions of the enemy forces), or miniaturized PGMs.

FlyEye have been used by the Polish military, including the Special Operations component, land forces and Territorial Defence Component as well as the Polish Border Guard. FlyEye have also been purchased by several countries around the world, including Ukraine, and they have been operationally deployed under the symmetric conflict conditions. The UAV may transfer information in real time, including position-related data, to BMS-class systems. The system may also be used to coordinate the artillery fire, in direct conjunction with the Topaz automated fire control solution. Polish Rocket and Artillery Forces utilize FlyEyes in that very role. NATO NSPA (NATO Support and Procurement Agency) can support acquisition and provide operational support with regards to FlyEye systems. FlyEye 3.0 is the third generation of the WB's product. It is currently being introduced into service. Meanwhile, the previously delivered platforms undergo regular upgrades.

**Warmate** is a loitering munitions system also referred to a short range Unmanned Combat Aerial Vehicle (UCAV). The aircraft that has a wingspan of 1.5 meters and is 1.1 meters long has flight endurance of 30 minutes. Over those 30 minutes it may search



and destroy targets at distances ranging from 10 to 12 kilometres from the control station. Take off is carried out with the use of a small launcher that can be carried by two soldiers along with the aircraft, warheads and the control system. It takes less than 10 minutes to get the first aircraft airborne. Once the launcher is deployed, further drones can be launched at intervals of 2 minutes. Warmate utilizes a broad range of interchangeable warheads: HE, Fuel-Air Explosive or shaped charge warheads are available. Other variants, including a training one, are available as well. The system is characterized by flexibility of use, and ability to act against a variety of threats. Modular design allows for easy integration of new components, warheads included.

Warmate systems have been introduced into use in the Polish military and in several other countries, including Ukraine and Turkey. It has been operationally deployed.



UAE-based Tawazun company was acting as a partner for the WB Group, in development of the larger Warmate 2 solution that offers greater range and is larger. The UAV in question has wingspan of 2.5 metres and offers a wide range of warheads weighing up to 5 kilograms. Warmate 2 can carry anti-tank warheads (penetration: 800 mm of RHA) and anti-infantry warheads. Being launched from a launcher that is used by the FT-5 Łoś UAVs as well, Warmate 2 has a range of 20 kilometres, exceeding the standard model's endurance even twice. The system can fly at speeds of up to 150 kilometres per hour for up to 2 hours.

Advantages of the FlyEye and Warmate systems are fused in the WB Group's SWARM system, including a recon-command vehicle (RCV) fitted with a control station and carrying both UAVs. Thanks to full integration of those two aerial platforms fused within a single SWARM C2 suite, the system makes it possible to closely observe and precisely select the targets thanks to the data provided by FlyEye, with rapid response ensured by the Warmate drones. Placing the control station on a vehicular platform also makes it possible to control a greater number of aircraft. The control system may also feature a deployable mast that extends the operational radius.

Sokół system tested in Ukraine is a derivative of this solution. It consists of a 4x4 Kozak-2M vehicle that hosts a control station, three Warmate platforms and a single FlyEye reconnaissance UAV. **SWARM** system can be based on other vehicles, trucks and APCs included.

#### Main features of the FlyEye systems:

- Short time required to deploy;
- High mobility;
- Integrated with modern BMS and artillery-fire-directing solutions;
- Ability to operate at night and during the day and in tough weather conditions;
- Developmental potential.

#### Main features of the Warmate systems:

- Short time required to deploy;
- High mobility;
- A wide range of warheads available, allowing for neutralization of a broad range of targets;
- Ability to work with a myriad of recce systems;
- High precision and hit accuracy.



### 3.3 GROM and PIORUN Man-Portable Air Defence Systems

Grom and Piorun MANPADS systems manufactured by Mesko and CRW Telesystem-Mesko can be ranked among the best solutions in their class. The Polish missile systems in question have been proven to be **highly effective**, with the Grom missile having seen real combat use. Several thousand examples of the Grom systems have been manufactured. Meanwhile, Piorun MANPADS is a new generation solution. Since 2018 it has been delivered to the Polish military.

Grom MANPADS has been developed back in the 1990s. The first variant, Grom-I, made use of the components used in the Soviet-made Igła missile system. However, this version was quickly replaced. Since the early 2000s, Grom systems are being made with the use of new Polish technologies, remaining completely under control yielded by the domestic entities.

Grom utilizes an IR guidance system and it remains capable of acting against threats at distances of up to 5.5 km and altitudes of up to 3.5 km. It was also integrated on the Kobra, Poprad, ZSU-23-4MP Biała, Jodek-G or Pilica anti-aircraft systems. The missile is series manufactured and it has been introduced into the inventory of the Polish military, replacing

the obsolete Striela-2M (SA-7) system. Grom missiles are also a subject to export sales. They have been sold to Indonesia, Georgia (where they saw **successful combat use**; the missiles hit nine Russian aircraft) and to Lithuania, the United States of America and, finally, to Japan. The missile is simple to use, highly reliable and effective. The effectiveness has been confirmed in the course of both numerous test launches, as well as in operational use.

Piorun MANPADS is an advanced derivative of the Grom missile. Similarly as Grom, the Piorun system includes elements as follows: single use tube launcher with a single stage anti-aircraft missile inside and a trigger mechanism that is transferred to the next launcher, for further use. In both cases the missile utilizes solid fuel.

Most of the upgrades have been implemented in the guidance system and in the rocket motor. The seeker of the Piorun missile uses a photodiode that is cooled in a redesigned manner. The photodiode in Piorun replaced a nitrogen-cooled photoresistor, such as the one used in case of the Grom system. This made it possible to increase sensitivity of the seeker, and the seeker also exhibits a higher level of resistance to jamming. Thanks to the above Piorun could be used to

act against a wide spectrum of threats. Not only can it be used against fixed- and rotary-wing aircraft, as the missile may also be effective against cruise missiles and small UAV, also when strong natural or artificial interference is present. The field tests did confirm high effectiveness of Piorun, also in foggy conditions and at night, and with **strong interference present as well.**

Piorun and Grom systems can act against low flying threats as well, starting from altitudes as low as 10 meters. The maximum range of the Piorun missile has been extended, when compared to Grom. Piorun may be used against threats flying 6.5 kilometres away at altitudes of up to 4 kilometres. The seeker of the Piorun missile can be programmed, so that the missile attains greater capabilities of acting against a specific type of threat.



**Piorun missile has been fitted with three types of fuses:**

- Proximity fuse, activated at close distance to the target, that heightens the probability of effective target neutralization.
- Impact fuse with a delay time, so that the missile could penetrate the first layer, and thus place the explosive inside the target.
- Eddy-current electromagnetic fuse – immediately activated fuse that is initiated when the seeker penetrates a layer of metal and enters the interior of an aircraft for instance.

The values and parameters for those fuses are automatically selected by the system, depending on the engagement mode (chase, head on engagement, engagement against a stationary target). Velocity and dynamics of the manoeuvrers depend on the selected engagement mode. The engagement mode is selected

by the operator with the use of a special switch on the trigger mechanism, shortly before the launch.

Piorun has been fitted with a launch mechanism featuring a daytime/night thermal imaging sight and a daytime optoelectronic sight. The launch mechanism also features a recorder allowing for execution of after-action review. Piorun also features an authorization system which prevents unauthorized use by third persons, should the launcher be lost, for instance – if it is stolen.



Piorun may be used both as a portable solution, as well as on anti-aircraft systems, such as the self-propelled Poprad, Kobra, Kusza and Biala system or the AAA/SAM Pilica solution, offered by the Polish industry. Work has also been undertaken, aimed at tailoring the Piorun missile for air-to-air use on helicopters.

#### **Main features of the Grom MANPADS:**

- High level of effectiveness, when used against airborne threats;
- Combat-proven system;
- Option of integration on anti-aircraft systems;
- Reliability;
- Good cost-effect ratio.

#### **Main features of the Piorun MANPADS:**

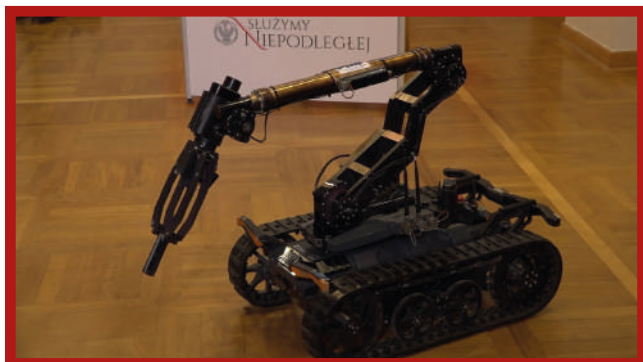
- Ability to neutralize the most challenging airborne threats, also when serious interference is present
- Programmable seeker and proximity fuse;
- Increased range and altitude at which targets can be neutralized;
- Day/night targeting system;
- Option of integration on anti-aircraft systems;
- Reliability;
- Good cost-effect ratio.





### 3.4 PIAP Mobile Robots

Industrial Research Institute for Automation and Measurements (PIAP) manufactures a wide range of robots for the uniformed services and for the military. These products have been, so far, successfully utilized both by the Polish, as well as by the foreign users. PIAP systems are quite useful in reconnaissance and bomb disposal activities. They may also be used outside the operational context usually associated with the uniformed services, e.g. when inspecting areas that remain difficult to access in case of industrial facilities.



Robotic platforms offered by the Institute are highly useful, thanks to their modular designs that make it possible to tailor the platforms to the user-defined requirements and operating conditions. The robots are complementary, capabilities-wise. PIAP systems are operated by the Polish military,

uniformed services and by numerous foreign users. Different kinds of robots developed and manufactured by the Polish Institute are used, inter alia, in South Korea, Nigeria, Saudi Arabia, Switzerland or Spain.

**Below you may find an outline of features of the selected robots offered by PIAP.**

- **IBIS®** is the heaviest of the robots offered by PIAP. It weighs more than 320 kilograms and moves around using 6 wheels. IBIS may attain speed of up to 10 kilometres per hour in virtually any terrain conditions. The platform has been equipped with four independent cameras and a heavy duty, three-meter-long arm with six degrees of freedom. The arm may be fitted with a range of jaws or other tools that make it possible for the robot to carry out a number of different tasks. Tools that may be used include measurement devices, manipulators or a shotgun with a red dot sight or a recoilless disrupter. **IBIS®** could also be fitted with a CBRN reconnaissance kit.
- **PIAP RMI® (Robot Mobilny Interwencyjny - Mobile Intervention Robot)** is a universal tracked robot weighing 95 kilograms with a payload capacity of 25 kilograms. It has been equipped with a manipulator arm that has a range of up to 2 meters. The

**RMI®** platform has been used to create the **RPP (Robot Patrolowo-Przenośny – Patrol Portable Robot)** system for the Polish military. Its weight does not exceed 75 kg. RPP is to be a platform that could be used by the engineering units, removing, picking-up or neutralizing mines, unexploded ordnance and IEDs.

- **PIAP GRYF®** is a bomb disposal robot weighing 38 kilograms, with a payload capacity of 15 kilograms. Wheeled-tracked drive solution provides this platform with a high degree of mobility. The wheels may be quickly dismantled which allows the tracked platform to reach narrow and hardly accessible spaces. Low weight facilitates transport of the robot, making it quite portable. Its 1.9 meter arm can use a wide range of interchangeable tools.

- **PIAP FENIX®** is a reconnaissance robot developed for the purpose of carrying out activities in combat conditions. It may be configured for a wide range of missions, including operations in confined spaces or outdoors. The platform has been designed for reconnaissance, transport and hazardous material handling purposes. Thanks to its tracked-wheeled design, the robot remains able to move around in difficult terrain conditions, indoors and on the staircases. Once the manipulator arm is attached, the user may utilize it within 1 meter radius.

- **TRM® (Taktyczny Robot Miotany – Tactical Thrown Robot)** is a small-size support system designed for operations in environments that are hardly accessible and dangerous. The robot has been constructed as a response to threats and dangers involved in reconnaissance carried out in the domain of operations undertaken by the tactical units, prior to execution of the operation proper. It is used by the entities responsible for public safety. The system, weighing 1.5 kilograms, may be thrown through a window for instance. It is able to withstand an impact when falling from height of up to 9 meters, on a hard surface. TRM® may also be armed with a flashbang or tear gas grenade.

The whole family of robots has one, distinctive feature – namely their modular design. This applies both to the manipulators, as well as to the platform design itself. Thanks to the above, the robots may be modified to meet the user requirements. The above robots feature

a hybrid (tracked/wheeled) chassis, where the wheels can be dismantled to reduce the size of the robot. Design as such makes it possible for the robot to move around varied terrain and overcome a myriad of obstacles, such as staircases for instance. The robots have also been fitted with positioning systems and wire- and wireless remote control solutions.

The manipulators can be fitted with a broad range of interchangeable jaws, sensors and other specialized equipment which allows the robots to carry out a broad range of missions. PIAP systems may replace humans in hazardous circumstances emerging in bomb disposal and reconnaissance contexts, also when CRBN threat is present. PIAP undertakes a constant R&D effort, concerning new types of robots. The range of applications in which its products may be used is being expanded in a continuous manner, in defence and security sector and beyond.



#### Main features of the PIAP robots:

- Functionality and reliability of the platforms;
- Good off-road capacity;
- Easily reconfigurable, depending on the mission;
- Ability to use a variety of wire- and wireless control systems;
- Broad range of military and uniformed services applications.





### 3.5 LUBAWA Multispectral and Mobile Camouflage Systems

Lubawa Group and Miranda, its subsidiary company, jointly manufacture a broad range of military camouflage systems. Their overall purpose is to make it more difficult to detect vehicles and objects in visible light and in infra-red or radar spectra. The systems in question may be integrated onto the armour plating that reinforces the levels of protection of the combat vehicles. Different types of Lubawa's protection systems and covers are used by the Polish military and by the foreign users.

Miranda camouflage covers are being developed on the basis of the data gathered in the region where they would see most use, as this plays a relevant role in defining the tone and shape of the camouflage. The colors correspond with the region-specific foliage. Thanks to the above, vehicles or objects using the camouflage blend in better and thus they are harder to recognize in field.

Meanwhile, the Lubawa's solution also works in NIR/TIR spectra, diminishing the thermal and night vision signatures – these just blend onto the background. Thanks to the above, the camouflage solutions in question make it possible to dissipate the thermal signature by 85%. At the same time, the camouflaged object is not distinguishable on the background.

Proper shaping of the covers and selection of materials makes it possible to diminish the RCS as well. This makes it more difficult to detect objects and equipment, if battlefield surveillance sensors are used.



Several variants of multispectral covers and protection systems are available. These include:

**BERBERYS Multispectral Cover** makes it difficult to detect and identify objects, infrastructure and vehicles when stopped. The camouflage comes in a form of spatial masking system that is covered with a camouflage tailored to weather conditions, region and season. The system is available in numerous variants, tailored to the needs of the specific customer. It is also possible to create a double-sided cover with two different camo patterns on them.



The camouflage layer provides the protected assets with low visual, thermal and radar signatures. It is also lightweight which makes it easier to transport, fold and unfold it. The material used to create the camouflage cover absorbs very little water. It is also tear/break resistant.

**Multispectral Mobile Camouflage** is a group of products destined for vehicular use. The system consists of modules covered with a material the properties of which are reminiscent of those applicable to the BERBERYS covers. These modules may be quickly installed and removed. If damaged, it is enough to replace a single module.

Mobile camouflage modules shape and layout are tailored individually for the specific type of vehicle. Thanks to the above, the camouflaging effect obtained may be optimal for being on the move, firing the weapons or other standard procedures, without a risk of shifting or damaging the camouflage which, in turn, would diminish its effectiveness.

**IMMA** (Integrated Multispectral Modular Armour) is a development of this system, fusing the multispectral camouflage with composite armour modules. The camouflaging elements can be replaced quickly, allowing for easy change of camouflage from winter to summer one, or to one matching a different background. Camouflage panels are installed on the modular composite armour elements. The camouflage provides the user with a level of protection, dependent on the user-defined requirement, ranging from level 1 to level 4 of the STANAG 4569 norm. Weight of the armour elements depends on the level of protection provided. Solution as such ensures a high level of flexibility, both within the scope of camouflage, as well as within the scope of ballistic protection.

Lubawa's multispectral camouflage covers are used by the Polish military, Multinational Division North-East based in Elbląg included, on command vehicles based on the Rosomak APC platform. Meanwhile, **Finland** has introduced Lubawa's mobile camouflage and armour solutions within the framework of the modernization programme concerning the BMP-2 IFVs.

Multispectral camouflage makes it possible to protect the assets from detection when commonly used optoelectronic systems are applied (they are more and more common on combat vehicles and manned/unmanned aerial vehicles). This, in turn, greatly contributes to survivability of those assets on the contemporary battlefield. Multispectral camouflage solutions offered by Lubawa may be used in a myriad of configurations, for the purpose of protecting combat and support vehicles or command infrastructure.



#### Main features of the multispectral camouflage and mobile camouflage systems offered by Lubawa:

- Tailored to camouflaging in specific terrain conditions, dedicated for a specific platform;
- Special camouflage pattern protects the assets from optical recce systems;
- Re-emission properties replicate the signature of natural environment and surroundings, protecting the camouflage assets from NVG systems;
- Reduced thermal signature;
- Reduced RCS;
- High resistance to wear and tear;
- Low weight;
- Fast set up and disassembly;
- Option of fusing the camouflage with extra armour.



### 3.6 P-18PL and SPL Early Warning Radars

PIT-RADWAR company, belonging to the PGZ Group, has developed two modern early warning radars: P-18PL and SPL. The systems in question offer early warning capabilities, also allowing the user to detect "stealth" objects, the RCS of which is low and with signatures difficult to detect for conventional designs. Hence, P-18PL and SPL may become a part of IADS in a role of an early warning asset. In the Polish military those radars would support the medium and short range air defence assets acquired within the framework of Wisła and Narew programmes.

The former one, the P-18PL design, is an active long-range VHF radar. Use of this bandwidth, that is quite a rarity in case of the western radar designs, provides the user with a number of relevant advantages. First, it **extends the range at which the targets may be detected and tracked**. Attenuation of electromagnetic radiation in VHF range in the atmosphere is lower than in case of the higher frequencies. Secondly, the bandwidth in question makes it more difficult to utilize anti-radiation missiles, since most of them work within a different frequency range. Thirdly, VHF range makes it **easier to detect low-RCS (stealth) aircraft**.

So called electrical resonance phenomenon is used here, occurring when the probing signal wavelength is comparable to the size of the aircraft being detected.



P-18PL radar name is derived from the Soviet P-18 design operated in the meter band frequency range. The radar has been made out of new elements in its entirety, and the bandwidth was broadened. An entirely new VHF AESA antenna array is the main distinguishing element of the system, with an electronically controlled and shaped beam and control of the antenna receiving array in azimuth (despite the

rotating antenna) and elevation planes. The aforesaid radar system utilizes transmitter-receiver units based on semi-conductors and integrated with the emitting elements, installed on a hydraulically deployed frame.

Contrary to the P-18 design, P-18PL is a 3D radar that detects distance, heading and altitude of the given threat. The whole antenna array can be hydraulically folded and extended. This accelerates the process in which the radar leaves its position. The system consists of two units – antenna vehicle towing a field power generator and C2 vehicle, accommodating the operator station, communication systems and datalink.



P-18PL also utilizes an entirely new signal processing solution. Thanks to the above, it was possible to achieve better resistance to potential jamming. The radar is also equipped with a Polish IDZ-50 IFF long range interrogator. It is a Mark XIIA system with a dedicated antenna array. Instrumental range of the P-18PL radar is defined as 450 kilometres. The radar may also be operated in a passive mode, with the use of other probing signals provided by P-18PL or legacy P-18 radars.

Notably, alongside the P-18PL system, PIT-RADWAR has also developed, working together with AM Technologies and Warsaw University of Technology, the **SPL** system (System Pasywnej Lokacji - Passive Location System). The SPL solution makes it possible to constantly monitor the airspace **without any emissions**. Thus, SPL is invisible for the enemy SIGINT assets.

The system designed by the consortium acts as a multistatic solution composed out of 4 RPL radars that are identical, hardware- and software-wise. All

of the RPL radars are identical, as sources of information. However, one of those stations has a master-role assigned. That radar is used to fuse the data from the remaining radars, to create an integrated air picture on the basis of the SIGINT gathered. The “master” radar connects to the C2 systems to which it is subordinated, transferring the data and receiving commands concerning the further actions. Each of the four RPL radars is fitted onto a 4-axle wheeled vehicle.

SPL is also known as **PET/PCL**. It fuses complementary passive systems within itself: PCL (Passive Coherent Location) and PET (Passive Emitter Tracking). Each of the RPL stations features seven independent subsystems (3 in PCL and 4 in PET portions of the solution). The PCL subsystem makes use of the signals emitted by occasional emitters, such as the FM radio, DVB-T or cellular GSM sources. These signals, reflected from the airborne objects and received by the individual stations, make it possible to detect and locate the individual objects mentioned above.

The PET subsystem, meanwhile, detects the signals generated by the onboard emitters of the airborne objects, including radars, datalinks, IFF systems and navigation systems. Connecting the PCL/PET systems together and using a **fusion module** results in increased detection probability and higher accuracy in locating the target, and thus allows the user to achieve a more stable target tracking and enhanced classification functionality with regards to airborne threats. This is achieved via a detailed signal analysis.

#### Main features of the P-18PL and SPL radars:

- Ability to act as an early warning asset, also with regards to low-RCS targets;
- Resistant towards the enemy ECM;
- Difficult detection with the use of SIGINT assets;
- Capable of integration with the Integrated Air Defence Systems.





### 3.7 Kormoran II Mine Counter Measures Vessel

Kormoran II Mine-Counter Measures-Vessel has been built by a consortium led by Remontowa Shipbuilding and involving OBR CTM and PGZ Stocznia Wojenna (formerly Stocznia Marynarki Wojennej) entities. The main mission of the vessel is to search for, classify, identify and act against naval mines and underwater IEDs. Kormoran is also used for the purpose of inspecting naval routes and guiding other vessels through waters where mine threat is present. The vessel may also lay mines itself and remotely control the mine countermeasure platforms. The first vessel of the series, the ORP "Kormoran" II, was handed off in 2017. Agreement concerning delivery of another two vessels was signed during the very same year as well. **The vessels in question would become a part of the NATO maritime groups.**

Limiting the vessel's signature was one of the design priorities adopted in case of Kormoran. Remontowa Shipbuilding created a MCMV with a hull made out of austenitic steel that diminishes the probability of triggering the magnetic mines. The hull is also silenced, so that risk of triggering acoustic mines is also limited.

The vessel is 58.5 meters long, 10.3 meters wide,

it has a draft of 2.7 meters, displacement of 830 tonnes and can reach speeds of up to 15 knots. ORP Kormoran has a range of 2500 NM and can remain autonomous for 10 days. The two latter performance figures may be even higher, as the vessel can do replenishments at sea - both with the use of RAS system, as well as with involvement of helicopters (VERTREP). Kormoran has a crew of 45, including 7 officers. A team of divers, with two pairs of divers and diving leader may also stay onboard.

Searching for and neutralizing naval mines is the primary mission of the vessel. To detect and identify this threat, Kormoran utilizes sonars. The vessel uses three types of sonar sensors in total.

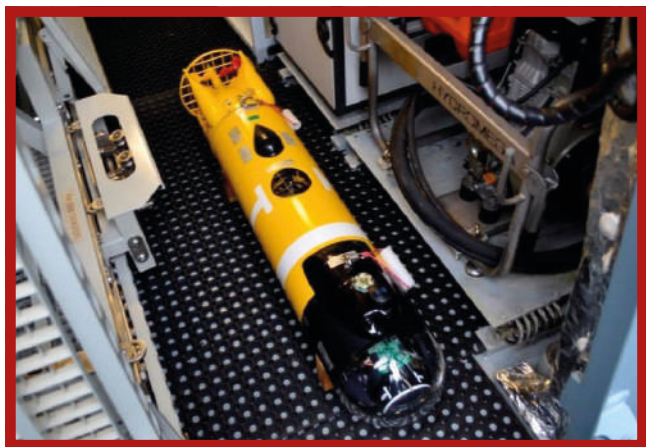
- SHL-101T/M under-keel mounted sonar developed by the Gdynia-based OBR CTM entity, allowing for scanning of the water under the vessel;
- SPVDS (Self Propelled Variable Depth Sonar) installed on the Saab Double Eagle Mark III UUV;
- Sonar system integrated on the Kongsberg Hugin 1000 AUV.

The mines, if detected, can be neutralized in three

manners, listed below:

- With the use of self-propelled, single-use Głuptak explosives developed by the Gdańsk University of Technology. These are controlled with involvement of fiber optics that are used to transmit commands and visual data provided by the cameras;
- With the use of cable-powered and controlled Morświn underwater robot, developed by the Gdańsk University of Technology. The robot may deliver OBR CTM TOCZEK remotely detonated explosives to the hazardous areas.
- The mines may also be destroyed by the embarked team of divers. A special hangar is present onboard, housing a decompression chamber, among other assets that remain useful for the divers.

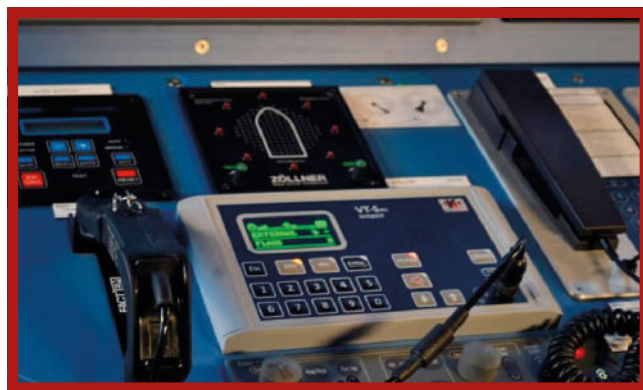
Optoelectronic sensors, two navigation radars made by Raytheon and Saab R5 military-grade AIS transponder belong to the surface observation system that Kormoran utilizes.



Data gathered by all of the sensors is transferred to the Combat Information Centre (CIC) where command process is taking place during the minehunting operations. CIC features **SCOT-M battle management suite consoles**. The system has been developed by OBR CTM S.A. It supports the crew in combat, helping them to effectively utilize all of the effectors and sensors installed onboard. The system can be used for the purpose of mission planning, search, classification, identification, mine countermeasures, decisionmaking support, task monitoring, reporting and training and simulation activities. The movement of the vessel is

controlled from the integrated bridge that is also equipped with visualization systems and hardware required to control the engine room and the vessel status.

ORP "Kormoran" also features the OZSŁ system (Integrated Vessel Communications Suite), manufactured, set up and integrated by the Polish KenBIT company (Gdynia branch). The system is divided into external and internal communications sections. In case of the vessel's external communications suite, the main emphasis was placed on securing of the secure and non-secure (NATO or national systems) radio communication, taking place simultaneously and involving land based stations, other vessels and aircraft. Meanwhile, the system for internal communications has been designed with a purpose of providing communication between the internal, individual elements of the vessel's organizational structure - primarily between the battlestations and between the crew-members. OZSŁ interconnects and synchronizes different elements of the comms suite, terminals or cryptography components included. Thanks to the above, communication is taking place in a secure and reliable manner that also remains ergonomic for the operators.



#### Kormoran II Minehunter - Primary Features:

- Innovative design with limited signatures;
- Ability to carry out minehunting activities with the use of remote control assets;
- Modern, integrated combat system fusing a variety of mine countermeasures;
- High level of situational awareness achieved thanks to advanced reconnaissance and communication solutions.



### 3.8 TOPAZ Battle Management System and FONET Onboard Internal Communications System

**TOPAZ** is a scalable, integrated BMS (Battle Management System) solution developed by the WB Group. The first variant of TOPAZ was introduced into the inventory of the Polish Rocket/Artillery component at the verge of the 20th and 21st Century. The system was known initially as ZZKO TOPAZ (Automated Fire Control System TOPAZ). Not only had it a purpose of fire control, it also acted as a command support solution at the tactical level. TOPAZ was first introduced in case of the upgraded post-Warsaw Pact artillery assets, such as the **Gvozdika** and **Dana** howitzers or **Langusta** rocket launchers. New versions of the ZZKO TOPAZ solution are also integrated on the new artillery platforms operated by the Polish military - including Krab self-propelled howitzers and Rak self-propelled mortars. TOPAZ systems are being integrated within the Polish artillery recce and support subsystem.

Ever since it has been introduced, TOPAZ has been undergoing continuous development. It may be used as a complex Integrated Battle Management System, also outside the domain of artillery. TOPAZ integrates a broad array of hardware and software within itself. Elements of the TOPAZ suite may form a battlefield management system that would be gathering,

processing and visualizing the tactical picture in real time. TOPAZ remains capable of gathering and processing data on own forces, their status and on the position of the enemy. The system is capable of working with a number of recce and surveillance assets, such as UAVs, fire-finder radars, acoustic or optoelectronic sensors (used by JTACs and forward observers). The recce data can be used to direct artillery assets and loitering munitions, joint operations included.

WB Group offers the TOPAZ system in five, primary variants. They may be used solely within the specific scope, working with other systems, but they can also constitute a complete, comprehensive solution in the domain of battlefield management.

- TOPAZ Tactics is the primary TOPAZ system module that supports planning, command and control and tactical picture visualization processes (digital maps). It also provides the user with the BFT (Blue Force Tracking) capability and may be integrated with the systems used by the allies. The remaining variants may be operated autonomously or within the framework of the Topaz solution.
- Among them, TOPAZ Fires fire control module may be found. Its purpose is to be used with a variety of weapons systems and with



other elements, such as the command vehicles for instance. The Polish military utilizes the aforesaid module in the Krab 155 mm sph batteries, Rak 120 mm self-propelled mortar batteries, and in other systems as well. The module makes it possible to carry out fire solutions computations in line with the NATO-compliant ballistic algorithms (NABK - NATO Armaments Ballistic Kernel). The system is also compatible with weapons systems and ammunition coming from the former Soviet Republics, including 152 mm and 122 mm howitzers. Thus, it is a great product that may be used to upgrade those assets.

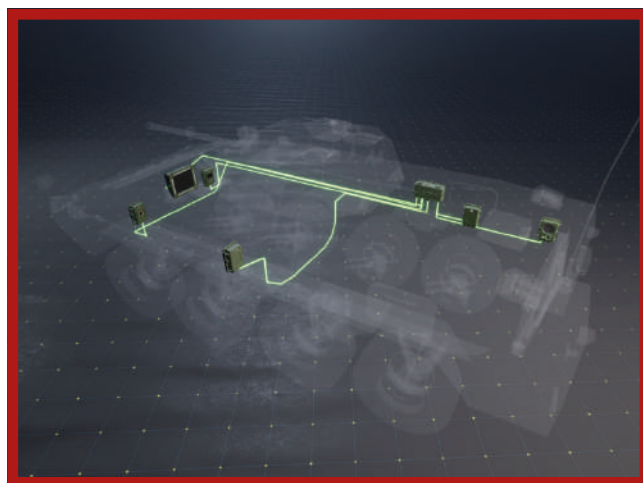
- TOPAZ Recon is a module that makes it possible to analyze reconnaissance data in real time (with regards to data gathered by fire-finder and battlefield surveillance radars, optoelectronic and acoustic sensors or UAVs, such as the FlyEye platform).
- TOPAZ Strike is a system that supports precise strikes carried out with the use of loitering munitions. It is a part of the WB Group Warmate loitering munitions system.
- TOPAZ Logistic is a module that supports the technical support/supply chain activities, including the ammunition supplies. It also makes it possible to support the engineering units, logisticians and elements working on recovery of the equipment, and so on.

TOPAZ is a scalable solution that can be tailored to the user requirements. It may also become a foundation block for advanced UAV control systems, fire control systems or a complex automated BMS-class solutions. The system includes software and hardware.

**FONET Digital Vehicular C2 System** on the other hand, is a separate but important element that is destined to be used on a number of combat vehicles: main battle tanks, IFVs, APCs, artillery assets, and multi-purpose and support vehicles. The basic task assigned to FONET is the provision of digital voice communications and means of data exchange. The system integrates vehicular electronics and controls radio and wired networks. The above makes it possible for the FONET-integrated vehicles to become embedded in automated command or fire control systems, such as the ZZKO TOPAZ solution. FONET has also been successfully integrated with a number of C2/

BMS solutions delivered by the external partners, including some of the leading NATO member states. Notably, the US-based Harris company manufactures a licensed variant of the FONET system that has been integrated on the Stryker and JLTV platforms, among other vehicles, used by the US military.

Modular design of the FONET solution makes it possible to select a configuration that would match the requirements defined for the given vehicle and its mission. FONET can be integrated with a broad range of radio communication assets (short-wave, VHF, UHF, SAT) and wire-based communications and broadband radio as well. Furthermore, the system can also be connected to field communication systems and public PBX phone networks.



#### Main features of the TOPAZ system:

- Modular BMS solution with a scalable structure;
- Ability to support fire control activities, carry out UAV coordination, manage the logistics or to execute battle management in a complex manner;
- Compatibility with MIP, NFFI, NVG and JCHAT protocols; compliance with Polish military and NATO standards, within the scope of digital mapping;
- Ability to utilize user-selected wireless/wire comms suites;
- TOPAZ and FONET systems may be integrated on both new and on existing platforms, including the Post-Soviet ones;
- Both TOPAZ, as well as FONET, have already seen operational use.



### 3.9 GROT Modular Firearms System (MSBS)

**GROT** is a Modular Firearms System manufactured by the "Łucznik" Radom Arms Factory (FB Radom). Grot is a modern solution that is based around a concept that makes it possible to easily reconfigure the rifle for a specific purpose. This is done through replacement of basic modules, such as the barrel, stock or extra accessories (such as a grenade launcher for instance). 5.56 mm rifle is the primary variant of this gun. It is currently placed in the inventory of the Polish military and of the Polish Border Guard service.

GROT C 16 FB-M1/M2 variant introduced into service is a conventional design with a folding stock and 16 inch (406 mm) barrel. The rifle shoots the 5.56×45 mm NATO round. With fully extended stock the gun is 900 mm long (843 when the stock is folded). Empty weight is 3.6 kilograms. Theoretical rate of fire is defined as up to 900 rounds per minute. The gun uses 30-rounds magazines. Other options are available as well. GROT may utilize any magazine that fits the M4/HK416 standard.

GROT features iron sights, however, it is assumed that Picatinny rail placed along the upper part of the gun would be used to integrate optics on the gun. The rail is

very long, it extends from the extreme ends of the barrel and receiver covers. MSBS may then make use of a **full range of optics**, that can also be configured in line with the requirements of the user. Meanwhile, the remaining Picatinny rails may be used to install further accessories on the gun. A **40 mm grenade launcher module** that is slung under the barrel has also been designed for GROT. The rifle is ambidextrous in its design.



The first order concerning the MSBS/GROT system for the Polish military was placed back in 2017. Between 2017 and 2020 the Polish military is to receive more than 53 thousand rifles in total. MSBS/GROT system is becoming one of the primary weapons in the newly formed Territorial Defence Component (WOT). High level of ergonomics, the fact that the weapon is well balanced and simple to use mean that the WOT soldiers using GROTs are able to obtain better results

than those using the legacy wz. 96 Beryl assault rifles. Beryl has been a primary rifle used by the Polish military, but it is being gradually replaced by the MSBS/GROT system. The gun is undergoing constant development and upgrades, implemented in line with the feedback provided from the military units. Since the year 2018 MSBS/GROT has also been introduced into the inventory of the Polish Border Guard.



GROT 5.56 mm gun is **available in several variants of varied barrel length and with a wide range of accessories:** sub-carbine, assault rifle, rifle/grenade-launcher, machine gun and sharpshooter's rifle. All of those variants are also available as a bull pup gun, without a proper stock. It is a variant with a much shorter length but with barrel length equal to the one of a standard rifle. This has been achieved thanks to the fact that the chamber and the magazine have been placed behind the pistol grip. Configuration as such makes it possible to use the gun in tight spaces – which is a major advantage for mechanized infantry units and in urban operations. When it comes to the operating principle and most of its components, the bull pup gun is identical to the conventional variant. This makes it easier to manufacture and maintain the gun.

MSBS/GROT system also features **two extra variants** shooting a different round. The first one comes in a form of GROT SKBW (Semi-Automatic Sniper Rifle). It shoots the 7.62×51 mm NATO ammunition. It is a proposal of replacement of the SWD semi-automatic sniper rifles for the Polish military and for other countries as well. The gun shoots a new, larger round. At the same time, most of its elements are homogeneous when compared to the base variant. This makes training and maintenance much easier.

Another variant is the GROT gun shooting the Soviet 7.62×39 mm round used in Kalashnikov system guns. It is a round that remains quite popular all around the world. Thanks to the design and due to the fact that ammunition remains similar to the .223 round, the weapon's elements are identical, in their majority, to the variant shooting the NATO round.



The MSBS/GROT firearms system is modular in its nature. Thus, it may be easily modified and developed, also when specific user requirements and local conditions are taken into account. MSBS/GROT rifles fire three different rounds today. New variants of the MSBS could also be developed in the future, ensuring further expansion of combat capacity and flexibility of use.

#### MSBS has main features as follows:

- Rate of fire: 700-900 rounds per minute
- Length of the gun (16 inch barrel): 900/843 mm (conventional design)/675 mm (bull pup)
- GROT C16 FB-M1 (conventional design) weight: 3.65 kg, GROT B16 FB-M1 (bull pup) weight: 3.75 kg, without the mag;
- Range: around 500 meters;
- The gun is available in three calibres at the moment: 5.56×45 mm NATO, 7.62×51 mm NATO, 7.62×39 mm;
- Modular design allows for upgrades and modernization. GROT is available in conventional and bull-pup layouts.
- GROT rifles are used by the Polish military and by the Polish Border Guard.





### 3.10 APR 120 and APR 155 Precision Guided Artillery Rounds

Polish defence industry is fairly advanced in its effort to develop 155 mm artillery **precision guided rounds** for the Krab howitzer platform and other artillery assets of its class. Meanwhile, PGMs are also developed for the Rak 120 mm self-propelled mortars as well. APR 155 and APR 120 systems mentioned here, and belonging to the family of Polish Precision Guided Munitions PGMs, utilize a laser guidance system. Both solutions mentioned above allow the artillery assets to precisely attack stationary and moving targets.

The aforesaid systems are being developed by the Skarżysko-Kamienna-based Mesko company, with the guidance system being provided by the CRW Telesystem-Mesko Sp. z o. o. company based in Lubiczów near Warsaw. The latter entity also created the LPC-1 laser target designator that may be used to indicate targets for both of the aforesaid PGM types. APR project also involves other Polish defence industry businesses – Gamrat or Nitro-Chem included.

**APR 155** system has been developed, partially, over the course of an international cooperation, in collaboration with the Ukrainian partner. The round makes use of the technologies used in

the 152 mm Kvitnyk round. APR 155 mm may be used, however, in case of NATO-compliant artillery systems, such as the Krab, M109 or PzH 2000 howitzers. APR 155 round, in its final, production variant, would also be fitted with a Polish programmable digital guidance system coupled with a domestically developed sensor. This would make it possible to use a NATO-standards-compliant encoded beam.



APR 155 weighs around 45 kilograms, its maximum range exceeds 20 kilometres. It remains able to attack targets with accuracy brought down to a couple of meters, this applies to targets that are both moving and stationary. The primary variant of the APR 155 round would feature a HE charge.

**APR 120** round is the second of the offerings. It is to be used with the Rak self-propelled mortar. Similarly as the APR 155 mm round, APR 120 also utilizes a

laser guidance system. Furthermore, the round has also been fitted with an INS solution coupled with the optoelectronic sensor. The INS provides guidance over the course of the initial phases of flight. This means that the mortar round may be effectively guided towards the reflected laser beam. APR 120 is 800 mm long and weighs 16.8 kilograms. The round has a maximum range of around 8 kilometres.

The basic APR 120 round features a single high-penetration shaped charge warhead. Thanks to the above, the system makes it possible to attack armoured targets, main included, and this also concerns platforms protected by modern ERA. This is possible because of the top-attack capability. The round hits the weak armour of the top portion of the vehicle. Thus, it may be said that Rak self-propelled mortar, once equipped with the APR 120 rounds, could become an important element of the anti-armour defence system. Considerations are also being made with regards to development of another variant of the APR 120 round, fitted with a HE warhead.



**LPC-1 laser target designator** has also been developed, within the framework of the effort undertaken with regards to the Polish Precision Guided Munitions Systems. The designator may be used with the Pirat light ATGM offered by the Polish defence industry as well. The system could be utilized for the purpose of designating targets for other laser-guided ordnance, such as the NATO military aviation's guided bomb units. LPC-1 makes use of Nd:YAG laser (wavelength of 1.064  $\mu\text{m}$ ). Its signal is encoded. Programming the impulse sequence is done remotely from the fire control facility or manually. In both cases, the procedure is compliant with the NATO STANAG 3733 norm. The embedded laser rangefinder also makes it possible

to measure distances of up to 20 kilometres. GPS solution integrated on LPC-1 makes it possible for the designator to define its own position. LPC-1 is also tailored for bidirectional data exchange with the C2 system to which it is assigned. This makes it possible to monitor the device status, target coordinates and to remotely control the system from the command centre.

Introduction of APR 155 and APR 120 precision guided rounds may greatly enhance the effectiveness of artillery elements. Both systems listed above make it possible to engage targets designated by laser with a high degree of precision and this applies both to stationary and moving threats.

#### **Use of the APR 155 and APR 120 PGM has an effect as follows:**

- Limited use of ammunition on the mission (as a single round may be used to attack the given target, instead of a salvo);
- Shortening the time required to execute the mission, limiting the exposure to potential counter-battery fire;
- High hit accuracy – possibility to act against moving or point targets;
- Diminished collateral damage.

#### **Main features of the APR 155 round:**

- Precision guidance system utilizing a reflected laser beam;
- Ability of being used with any NATO-compliant 155 mm artillery assets;
- Range exceeding 20 kilometres;
- HE warhead.

#### **Main features of the APR 120 round:**

- Precision guidance system utilizing a reflected laser beam;
- Ability of being utilized in case of the 120 mm self-propelled mortars;
- Maximum range of 8 kilometres;
- Shaped-charge warhead.





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